



ADOLESCENT STRESS AND MENTAL HEALTH

*Effectiveness of school-based
intervention programs and the impact
of the COVID-19 pandemic*

AMANDA VAN LOON

ADOLESCENT STRESS AND MENTAL HEALTH

Effectiveness of school-based intervention
programs and the impact of the COVID-19 pandemic

Amanda van Loon

ISBN: 978-94-6421-906-7

Cover & layout: Marilou Maes | persoonlijkproefschrift.nl

Printed by: Ipskamp Printing | proefschriften.net

Copyright © 2022 Amanda van Loon. All rights reserved. No part of this publication may be reproduced, stored, or transmitted in any way or by any means without the written permission of the author.

Adolescent stress and mental health

Effectiveness of school-based intervention programs and
the impact of the COVID-19 pandemic

Stress en mentale gezondheid bij adolescenten
Effectiviteit van schoolinterventies en de impact van de COVID-19
pandemie

(met een samenvatting in het Nederlands)

Proefschrift

ter verkrijging van de graad van doctor aan de
Universiteit Utrecht
op gezag van de
rector magnificus, prof.dr. H.R.B.M. Kummeling,
ingevolge het besluit van het college voor promoties
in het openbaar te verdedigen op

vrijdag 11 november 2022 des middags te 2.15 uur

door

Amanda Wilhelmina Geertruida van Loon

geboren op 25 november 1991
te Utrecht

Promotoren:

Prof. dr. J.J. Asscher

Prof. dr. P.M. Westenberg

Copromotor:

Dr. H.E. Creemers

Support for the research in this dissertation was provided by a grant from the Netherlands Organization for Scientific Research (NWO grant number 400.17.601, work package 3) to Prof. dr. P. M. Westenberg.

Beoordelingscommissie:

Prof. dr. S.J.T. Branje
Prof. dr. M. Deković
Dr. G.W.J.M. Stevens
Prof. dr. M.A. Adriaanse
Prof. dr. A.C. Huizink

CONTENTS

Chapter 1	General Introduction	9
Chapter 2	Can Schools Reduce Adolescent Psychological Stress?	21
Chapter 3	The Effects of School-Based Interventions on Physiological Stress in Adolescents	51
Chapter 4	The Effectiveness of School-Based Skills-Training Programs Promoting Mental Health in Adolescents: A Study Protocol for a Randomized Controlled Study	89
Chapter 5	Promoting Adolescent Mental Health: Recommendations for Successful Implementation and Evaluation of School-Based Intervention Programs	111
Chapter 6	The Effectiveness of School-Based Skills-Training Programs Promoting Adolescent Mental Health: A Randomized Controlled Study	127
Chapter 7	Prepandemic Risk Factors of COVID-19-Related Concerns in Adolescents During the COVID-19 Pandemic	153
Chapter 8	Negative Impact of the COVID-19 Pandemic on Adolescent Mental Health: Fact or Fiction?	183
Chapter 9	General Discussion	211
Addendum	Summary	230
	Nederlandse Samenvatting (Summary in Dutch)	236
	References	242
	Publication List	270
	About the Author	273
	Dankwoord (Acknowledgements)	274



CHAPTER 1

General Introduction

Adolescence and mental health

Adolescence is a transitional phase between childhood and adulthood, characterized as a period of rapid development in physical, social, and psychological domains (Christie & Viner, 2005). Adolescents, aged between 10 and 24 years old (Sawyer et al., 2018), experience various changes, including changes to the body (e.g., puberty), changes in the social environment (e.g., transition to secondary school, peer identification), and changes to the brain and mind (e.g., neurodevelopmental processes, increased cognitive ability; Blakemore, 2019). These changes reflect a unique and necessary stage of development for adolescents to become successful, healthy adults. For example, cognitive skills improve during adolescence, which provides adolescents with the tools to be reflective of themselves and others, necessary to become independent (Blakemore, 2019). Yet, these various changes can also be stressful or aversive. For instance, the transition from elementary to secondary school might be stressful for adolescents, because of the novel social environment and hierarchy of the new (and often larger) secondary school (Blakemore, 2019). Moreover, brain maturation (in particular brain regions sensitive to stress, such as the hippocampus and amygdala) and neurodevelopmental processes (e.g., increased transmission speed of neuronal signals, synaptic reorganization), make adolescents vulnerable to stressful or negative experiences, increasing the risk of developing mental health problems (Blakemore, 2019; Romeo, 2013).

Although most adolescents develop into healthy adults, some are confronted with emerging mental health problems. Mental health is an essential part of health, and includes one's emotional, psychological, and social well-being, affecting the ability to think, feel, and act (e.g., dealing with stress, making choices, interacting with others; WHO, 2001). Many mental health problems, such as mood, anxiety or substance use disorders, generally emerge before the age of 25 years (McGorry et al., 2011). Worldwide, mental health problems affect 10-20% of children and adolescents (Kieling et al., 2011). Yet, while effective interventions for mental health problems are available (Weisz et al., 2006), the majority of adolescents with mental health issues, in particular mood and anxiety disorders, do not receive treatment for these problems (Merikangas et al., 2011). Child and adolescent mental health problems cause individual and familial suffering and are associated with longstanding costs to society, for instance related to education and health care (Belfer, 2008). Furthermore, experiencing mental health problems during childhood or adolescence is associated with an increased risk of having a mental health disorder in adulthood (Mulraney et al., 2021). In order to reduce the burden and costs of mental health problems, as well as prevent persistent problems in adulthood, it is

important to provide accessible and effective mental health services (McGorry et al., 2011). Moreover, as some adolescents are hard to reach (e.g., adolescents with lower educational levels; Bonevski et al., 2014) and many adolescents, in particular ethnic minorities, do not receive treatment for their (emerging) mental health problems (Merikangas et al., 2011), it is essential to promote equal access to mental health care for adolescents, regardless of their ethnic identity or educational background.

Stress and mental health

Perceived stress often reflects psychological stress, which is the condition or feeling (i.e., mental or emotional strain or tension) that results from demanding situations or circumstances, of which the individual perceives that it exceeds their personal, psychological, or social resources (Lazarus, 1966). Symptoms of perceived stress encompass worrying, exhaustion, or concentration problems (Schraml et al., 2011; Valizadeh et al., 2012). At a physiological level, situations or circumstances that are appraised as threatening or challenging (i.e., stressors), evoke a stress response. First, in response to a stressor, the fight-or-flight response is triggered. To ensure that an individual is alert and attentive and can quickly respond to the stressor, (involuntary) physiological changes occur, including increased blood pressure (BP), heart rate (HR), and respiratory rate (Charmandari et al., 2005; Jezova et al., 2004). After the passing of the stressor, the body returns to its normal state (Charmandari et al., 2005). Second, the stress response triggers the release of the hormone cortisol that influences many bodily functions, such as the immune system, the metabolism of the body, and the regulation of emotions and mood (Tsigos & Chrousos, 2002), necessary to respond to stressors (Nesse et al., 2016). Chronic or high levels of stress can dysregulate the stress system by persistently activating the stress response, consequently causing the body to stay in the fight-or-flight modus (i.e., constant state of alertness; Charmandari et al., 2005), which has been associated with negative outcomes, such as increased mental health problems (Charmandari et al., 2005; Miller & O'Callaghan, 2002; Snyder et al., 2017). Overall, stress is an important factor contributing to adolescents' vulnerability to mental health problems (Romeo, 2010), which makes it a promising target to promote adolescent mental health.

School and social stress

The most common and intense negative stressors experienced by adolescents are related to the family (e.g., issues with parents), the school (e.g., school pressure), the self (e.g., health issues), and peers (e.g., romantic issues; Núñez-Regueiro & Núñez-Regueiro, 2021). It is not surprising that causes of stress in adolescents are often related to the

school and social situations (Anniko et al., 2019; Núñez-Regueiro & Núñez-Regueiro, 2021), as adolescents spend most of their time at school (Hofferth, 2009) and the social environment is increasingly important (in particular peer interaction; de Goede et al., 2009). School-related stressors encompass, for example, school pressure (e.g., taking exams), school performance (e.g., keeping up with school work), and academic difficulties (e.g., poor grades; Anniko et al., 2019; Núñez-Regueiro & Núñez-Regueiro, 2021). In the Netherlands, one third of adolescents in secondary school experience stress and pressure from school (Kleinjan et al., 2020; Stevens et al., 2018). Moreover, worldwide increases in school stress have been demonstrated in the last years, especially in higher income countries (Cosma et al., 2020, 2021; Stevens et al., 2018). Stressors related to social situations include issues or arguments with parents (e.g., being punished or misunderstood by parents), romantic issues (e.g., break up), and being bullied or teased by peers (Anniko et al., 2019; Núñez-Regueiro & Núñez-Regueiro, 2021). In the Netherlands, one in ten adolescents experience stress related to social problems, such as problems or disagreements at home or quarrels with others (Kleinjan et al., 2020). Interpersonal relationships can play a dual role: Relationships with others can cause stress (e.g., conflicts), while at the same time they can act as social support sources to protect against stress (e.g., help-seeking behavior, receiving help; Camara et al., 2017). However, almost half of adolescents experience limited family and peer support worldwide (i.e., 28% and 40%, respectively; Inchley et al., 2020; Stevens et al., 2018). Given that stressors related to school and social situations are most salient in adolescents (Núñez-Regueiro & Núñez-Regueiro, 2021), school and social stress could be important targets to improve adolescents' mental health, for example by increasing coping or interpersonal skills to deal with school or social stressors.

COVID-19 pandemic

One major stressor of the past two years was the global outbreak of the coronavirus disease 2019 (COVID-19) pandemic and accompanied government measures to prevent the spread of the virus, which affected society at large. Governments enforced lockdowns, including social distancing measures, travel limitations, prohibition of public gatherings, and closing of public spaces, drastically changing the daily lives of individuals. Adolescents might be especially susceptible to these changes, as they are vulnerable to stressful or negative experiences (Blakemore, 2019). For instance, during adolescence, the social environment becomes increasingly important, in particular the interaction with and influence of peers (Blakemore & Mills, 2014; de Goede et al., 2009). However, due to the social distancing measures, together with the closing of public spaces (e.g.,

schools, sport clubs) and the advice for parents to work from home, adolescents and their families were forced to spend most of their time together, at home. Hence, adolescents' possibilities for (physical) social experiences outside the family home were limited. The COVID-19 pandemic and accompanying measures, including the uncertainty about the restrictions, the changing demands regarding school, and the restrictions on physical peer interactions, could be stressful and concerning for adolescents, which might result in negative consequences for their mental health. Previous research conducted at the beginning of the COVID-19 pandemic indicated that adolescents were very concerned about the pandemic, in particular related to school and social situations (Ellis et al., 2020; Magson et al., 2020; Muñoz-Fernández & Rodríguez-Meirinhos, 2021). Research in the first months of the pandemic suggests that the COVID-19 pandemic had a negative impact on adolescent mental health, as increased distress, depressive, and anxiety symptoms were observed in adolescents from before to during the COVID-19 pandemic (Hussong et al., 2021; Magson et al., 2020; Munasinghe et al., 2020; Rogers et al., 2021).

Nevertheless, it is likely that not all adolescents experience negative mental health consequences of the COVID-19 pandemic, and some might even benefit from the enforced measures. One might expect educational, social, and mental health challenges for adolescents during the COVID-19 pandemic (Dvorsky et al., 2020), as schools were closed and families were forced to spend most of their time together (e.g., causing more conflicts or arguments). Moreover, some adolescents might be especially prone to negative consequences of the COVID-19 pandemic, such as adolescents with elevated symptoms of stress, anxiety, or depression, as these adolescents tend to worry about uncertain and unpredictable situations. Indeed, previous research showed that having mental health problems before the pandemic predicted higher levels of COVID-19-related burden and internalizing problems during the pandemic (Brailovskaia & Margraf, 2020; Hafstad et al., 2021). Nonetheless, adolescents that struggle in the traditional school environment might excel in the remote (home) learning environment (Dvorsky et al., 2020). Furthermore, some adolescents might elude negative challenges as the home confinement might provide opportunities for them, such as more time for their family or personal activities (e.g., discovering new hobbies or talents; Dvorsky et al., 2020). In other words, some adolescents might be resilient to the negative effects of the pandemic. Resilience is defined as the capacity to successfully adapt or recover from significant adversity (e.g., threatening situations, such as a natural disaster), preventing problem development of at-risk youth (Masten, 2007). For example, adolescents with specific characteristics or resources, such as high levels of self-esteem or social support, might

be able to counteract the potential negative effects on their mental health, as they can effectively cope with the consequences of the pandemic. How adolescents experience and deal with the pandemic might have consequences for future challenges, such as school or mental health problems (Wade et al., 2020). Therefore, it is important to acquire longitudinal insights about prepandemic factors that affect levels of (mental health) problems, to identify adolescents who might need help and support (i.e., adolescents at risk for later adverse outcomes). Yet, information about the influence of psychological functioning before the pandemic, as well as longitudinal effects in youth, is limited in the COVID-19 pandemic literature (Singh et al., 2020; Wade et al., 2020).

School-based intervention programs to reduce stress

To counteract the potential negative effects of stress and related mental health problems in adolescents, several interventions have been developed to address stress, with some of these interventions implemented in schools (Rew et al., 2014). The school environment can be a powerful context to address psychological needs of adolescents, given that adolescents spend a lot of time at school (Hofferth, 2009) and schools are important for stimulating adolescents' emotional, social, and cognitive development (Roeser et al., 2000). As not all young people receive mental health care (Merikangas et al., 2011), some adolescents with psychological needs may only come into contact with youth (mental health) care very late or with serious problems (e.g., after receiving a clinical diagnosis). Schools may stimulate the use of mental health care, as intervention programs implemented within schools have the potential to reach large and diverse groups of adolescents, for instance adolescents with less apparent problems or adolescents who are unlikely to search for care outside the school context (i.e., traditional mental health settings; Stephan et al., 2007). Moreover, school-based intervention programs increase the accessibility to mental health care by reducing barriers, such as transportation and stigma associated with seeking support (Stephan et al., 2007). As such, schools may promote equal opportunity and access to mental health care for adolescents, regardless of their ethnic identity or educational background.

School-based intervention programs are strategies that are implemented in school settings to improve the (mental) health and well-being of students, for instance intervention programs to reduce problem behavior (e.g., depression, anxiety, drug or alcohol use, bullying). Three main types of approaches can be distinguished: Universal, targeted/selected, and indicated/intensive interventions (Kratochwill et al., 2004). First, universal interventions take a whole school or class approach, and are aimed at

populations independent of risk status (e.g., all students in a class or school), for example anti-bullying programs or early literacy instruction (Kratochwill et al., 2004). Advantages are that individuals are not labeled or stigmatized and that it prepares for subsequent targeted interventions. Yet, universal interventions are expensive, have generally small benefits for individuals, and may have the largest effect for participants with the lowest risk (Offord, 2000). Second, selected interventions target groups who are at risk of developing problems, for instance reading programs or programs targeting depression or anxiety (Kratochwill et al., 2004). Advantages are the possibility of addressing problems at an early stage (i.e., before they become severe) and the potential of being efficient, because the program is directed only at the at-risk group. However, disadvantages include potential labeling and stigmatization, as well as difficulties with screening and identifying the at-risk group (Offord, 2000). Third, indicated interventions target individuals with detectable risk factors (e.g., symptoms of mental health problems), who need more intensive and comprehensive care (Kratochwill et al., 2004).

Given that some form of stress is often faced and experienced by adolescents, focusing on stress as a starting point to talk about and improve mental health might be an appealing approach to promote adolescents' mental health. Targeting stress may be a promising way to reduce stigma of seeking mental health care and may lower the threshold for adolescents to accept and use such psychological support. This may contribute to earlier support for adolescents with psychological needs. Hence, school-based intervention programs focusing on stress reduction may be more appealing for adolescents than mental health interventions targeting anxiety or depression, as stress-reduction programs are likely less stigmatizing and may be perceived by adolescents as an approachable, low-threshold, and encouraging way to address their psychological needs. Some of the developed intervention programs to address heightened stress levels in adolescents target stress reduction directly, while other programs address stress reduction as an indirect or secondary target. To reduce stress and promote mental health of adolescents, different approaches are used, including mindfulness (i.e., bringing attention to the present moment through meditation and awareness), relaxation exercises (e.g., muscle, visualization-based, or progressive relaxation), and cognitive-behavioral techniques (e.g., emotion regulation, problem-solving; Rew et al., 2014). Although school-based intervention programs show potential in reducing stress (Kraag et al., 2006; Rew et al., 2014), not all studies show positive results (Feiss et al., 2019). Furthermore, the neurobiological effects of stress-reduction intervention programs are not yet clearly understood (Pascoe, Thompson, Jenkins, et al., 2017), in particular

programs for adolescents. Additionally, in order to develop effective intervention programs and select the best program for a specific population, it is important to investigate moderators of program effectiveness to detect which intervention programs or components work best and which subgroups benefit the most (Kraemer et al., 2002). Overall, more robust knowledge about the effectiveness of school-based intervention programs promoting adolescent mental health, by reducing psychological and physiological stress, is necessary.

Targeted school-based skills-training programs to reduce school or social stress

School-based intervention programs addressing school or social stress may be particularly promising to prevent adolescent mental health problems, as the most salient stressors for adolescents encompass stress related to school and social situations (Núñez-Regueiro & Núñez-Regueiro, 2021). Although previous research demonstrated that targeted school-based intervention programs (focusing on general stress and depression) were more effective than universal intervention programs (Feiss et al., 2019; Stice et al., 2009; Werner-Seidler et al., 2017), knowledge about the effectiveness of targeted school-based skills-training programs addressing specific forms of stress (i.e., school and social stress) is scarce.

Programs to improve skills to deal with performance anxiety, a form of anxiety which is positively associated with school-based distress (Fernández-Sogorb et al., 2021), may be beneficial for adolescents to improve their mental health. Previous research showed the potential of school-based intervention programs, consisting of biofeedback and cognitive and/or behavioral frameworks, in reducing test anxiety (i.e., a situation-specific form of (performance) anxiety; von der Embse et al., 2017) and improving mental health outcomes, such as stress, internalizing problems, and self-esteem (Bradley et al., 2010; O’Driscoll & McAleese, 2021; Putwain & von der Embse, 2021; Soares & Woods, 2020; von der Embse et al., 2013; Weems et al., 2014; Yahav & Cohen, 2008). However, methodological issues, such as the frequent use of uncontrolled or nonrandomized study designs, limit the robustness of previous studies’ results. Furthermore, available research focuses mainly on test anxiety, leaving results for the more general measure of performance anxiety unknown. With regard to social stress, learning or improving skills to initiate and maintain positive social relationships (e.g., communication, assertiveness) may improve adolescents’ mental health (Eskin, 2003), as dysfunctional relationships and factors that disrupt the relationship or interaction with others can trigger stress

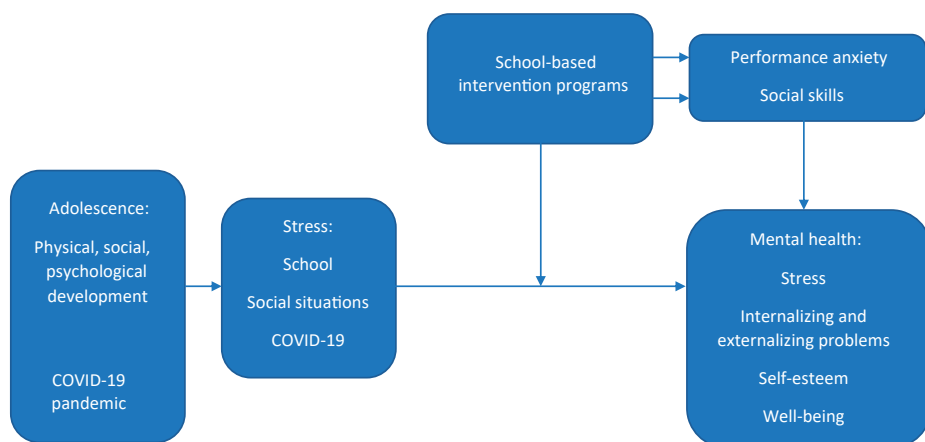
(Ditzen & Heinrichs, 2014; Juth & Dickerson, 2013). Previous studies demonstrated the potential of school-based programs to improve social and emotional skills, as well as mental health outcomes, such as emotional distress and internalizing problems (Durlak et al., 2011; Gaspar et al., 2018; Schonert-Reichl & Lawlor, 2010). However, only universal intervention programs (i.e., aimed at the entire student body) were examined. Taken together, knowledge about the effectiveness of specific, targeted school-based intervention programs promoting adolescent mental health, addressing either skills to deal with performance anxiety or social skills, is scarce.

The present dissertation

The current dissertation is part of a larger project focusing on mental health in adolescents, aiming to improve the use of mental health care for a diverse group of adolescents (in terms of ethnic identity and educational background), by offering accessible and low-threshold intervention programs at schools. In order to address the gaps in the current literature, the present dissertation aims to increase the knowledge on the effectiveness of school-based intervention programs promoting adolescent mental health by targeting (school or social) stress, as well as investigate the impact of the COVID-19 pandemic on adolescents' mental health. Figure 1.1 presents the conceptual model of the current dissertation. The first goal is to provide an overview of the effectiveness of school-based intervention programs, by conducting two meta-analyses. The results of the effectiveness of such programs on reducing adolescents' psychological and physiological stress levels are reported in *Chapter 2* and *3*, respectively. The second goal is to gain insight into the effectiveness of two targeted school-based skills-training programs promoting adolescent mental health, by addressing either school stress (i.e., skills to deal with performance anxiety) or social stress (i.e., social skills). Two randomized controlled trials (RCTs) were conducted in a diverse sample of adolescents (e.g., regarding ethnic identity and educational level), to evaluate the effectiveness of these skills-training programs on program and mental health outcomes (*Chapters 4-6*). *Chapter 4* contains the study protocol, which describes the effectiveness study in detail, including the study design and the used instruments. Challenges and lessons learned in implementing and evaluating these school-based skills-training programs are discussed in *Chapter 5*. The findings of the effectiveness of both skills-training programs (i.e., addressing either performance anxiety or social skills) on program and mental health outcomes are reported in *Chapter 6*. An unexpected mental health risk for adolescents was the COVID-19 pandemic and accompanied government measures, which occurred during implementation and data collection of the effectiveness study. Our third goal

is, therefore, to examine the effects of the COVID-19 pandemic on adolescents' mental health. *Chapters 7 and 8* present the findings of the impact of the COVID-19 pandemic on adolescents' COVID-19-related concerns and mental health, respectively. Finally, *Chapter 9* contains a discussion of the findings of the current dissertation, as well as its strengths and limitations, and provides scientific and practical implications and recommendations for future research.

Figure 1.1 Conceptual model of the current dissertation





CHAPTER 2

Can Schools Reduce Adolescent Psychological Stress?

This chapter is adapted from:

van Loon, A. W. G., Creemers, H. E., Beumer, W. Y., Okorn, A., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2020). Can schools reduce adolescent psychological stress? A multilevel meta-analysis of the effectiveness of school-based intervention programs. *Journal of Youth and Adolescence*, 49, 1127-1145.

Author contributions:

AL conceived of the study, participated in the design, data collection, and analysis for the study, and drafted the manuscript; HC conceived of the study, participated in its design and coordination and drafted the manuscript; WB participated in data collection and interpretation and helped to draft the manuscript; AO participated in the data collection and interpretation and helped to draft the manuscript; SV, NS, AM, and MW participated in interpretation of the data and contributed to drafts of the manuscript; JA conceived of the study, participated in its design and coordination and drafted the manuscript. All authors read and approved the final manuscript.

ABSTRACT

Increased levels of psychological stress during adolescence have been associated with a decline in academic performance, school dropout and increased risk of mental health problems. Intervening during this developmental period may prevent these problems. The school environment seems particularly suitable for interventions and over the past decade, various school-based stress reduction programs have been developed. The present study aims to evaluate the results of (quasi-)experimental studies on the effectiveness of school-based intervention programs targeting adolescent psychological stress and to investigate moderators of effectiveness. A three-level random effects meta-analytic model was conducted. The search resulted in the inclusion of $k = 54$ studies, reporting on analyses in 61 independent samples, yielding 123 effect sizes ($N = 16,475$ individuals). The results indicated a moderate overall effect on psychological stress. Yet, significant effects were only found in selected student samples. School-based intervention programs targeting selected adolescents have the potential to reduce psychological stress. Recommendations for practice, policy and future research are discussed.

Keywords: Psychological Stress; Meta-Analysis; Adolescent; School-based Intervention Programs.

INTRODUCTION

Stress – the condition or feeling that results when individuals perceive that the demands of a situation exceed their personal, psychological or social resources (Lazarus, 1966) – seems to be a significant worldwide problem for both adolescents (Klinger et al., 2015) and adults (Schaufeli et al., 2009). In adolescence, a developmental period characterized by increased stress-sensitivity (Romeo, 2013), high levels of stress have been linked to various negative associates, including reductions in academic performance (Kaplan et al. 2005), school drop-out (Dupéré et al., 2015), increased mental health problems (Snyder et al., 2017), and reduced well-being (Chappel et al., 2014). In order to prevent adverse development, it is important to address heightened stress levels during adolescence. Over the past decade, various school-based intervention programs have been implemented to reduce adolescent stress and accompanying effectiveness studies have been conducted. As knowledge on the overall effectiveness of such programs and factors influencing their effectiveness is limited, it is important to conduct an extensive meta-analysis. The current multilevel meta-analytic study therefore examined the effectiveness of school-based intervention programs in reducing adolescent psychological stress and which study, sample and intervention characteristics influence program effectiveness.

The school environment seems particularly suitable for intervention programs to reduce stress. Adolescents spend a substantial part of their time – on average six hours per school day – in school (Hofferth, 2009), which makes the school an important context for cognitive development, as well as the development of social skills and emotional control, relevant for adequately dealing with stress (Resurrección et al., 2014). Since enhanced social and emotional functioning is beneficial for academic performance and school success (Zins et al., 2007), schools may benefit from implementing interventions that aim to improve social and emotional functioning. Moreover, school-based mental health services have been associated with a lower stigma and a greater utilization rate, especially among ethnic minority adolescents (Stephan et al., 2007). As such, school-based intervention programs provide a promising environment for low-threshold care, with the potential to also reach adolescents who are reluctant to search for care outside the school environment.

Over the past decade, various school-based intervention programs targeting adolescent stress have been developed. Some of these programs directly target stress, while other programs address stress as an indirect treatment aim. Moreover, to reduce stress and

improve well-being of adolescents, these programs offer different approaches and apply various hypothesized mechanisms of change. For example, mindfulness (i.e., bringing non-judgmental attention to the present moment through meditation techniques and awareness exercises), relaxation exercises (e.g., progressive relaxation, muscle relaxation, visualization-based relaxation) and life skills training, comprising different cognitive-behavioral techniques (e.g., emotion regulation, problem-solving, conflict resolution), are often used (Rew et al., 2014). In terms of effectiveness, some studies on school-based stress intervention programs have yielded positive results (e.g., De Wolfe & Saunders, 1995; Jellesma & Cornelis, 2012; White, 2012), whereas other studies indicated that interventions were not effective in reducing stress (e.g., Lau & Hue, 2011; Terjestam et al., 2016; Lang et al., 2017).

The conflicting results of earlier studies are an important reason to conduct a meta-analysis to assess the effectiveness of school-based intervention programs in reducing adolescent psychological stress. Reportedly, there are only three reviews of the literature in this area (Feiss et al., 2019; Kraag et al., 2006; Rew et al., 2014). In their meta-analytic review, Kraag et al. (2006) investigated the effectiveness of school-based universal intervention programs targeting stress in children and adolescents. They demonstrated that these programs were effective in decreasing stress symptoms. Such promising results were supported by a narrative review on the effectiveness of stress reduction interventions in adolescents from community and clinical populations (Rew et al., 2014). In contrast, Feiss et al. (2019) showed that school-based stress prevention programs did not reduce stress symptoms in adolescents. In addition to generating conflicting findings, previous reviews bear a number of limitations. First, particularly the reviews by Kraag et al. (2006) and Rew et al. (2014) suffer from low quality of the included studies, limiting the robustness of their results. Second, Kraag et al. (2006) and Feiss et al. (2019) performed a traditional meta-analysis, a technique that does not allow the inclusion of multiple relevant effect sizes within studies. Third, Feiss et al. (2019) focused on school-based programs in the United States and based their meta-analysis on only four studies that assessed the effectiveness of such programs in terms of stress reduction. As such, their results do not inform us about the overall effectiveness of school-based intervention programs targeting stress in adolescents.

Because of these limitations, as well as the widespread implementation of school-based stress reduction programs and accompanying effectiveness studies since publication of the comprehensive review by Kraag et al. (2006), it is important to update the findings

and conduct a new extensive meta-analysis. Consistent with Feiss et al. (2019), the present study included intervention programs in general adolescent populations (i.e., community samples) as well as selected adolescent populations (i.e., samples based on self-selection or screening, for instance on high stress or anxiety levels), given the potential of targeted interventions to be more efficient and to address problems early on (Offord, 2000). Indeed, Feiss et al. (2019) demonstrated that targeted interventions yielded greater reductions in stress than universal interventions. Furthermore, the current study advances previous literature by performing a multilevel meta-analysis to fully exploit the available research data (i.e. allowing the inclusion of all relevant effect sizes per study) and generate more statistical power (Assink & Wibbelink, 2016). This increased power ensures that extensive moderator analyses can be conducted. Investigating moderators is of crucial importance to better understand study results and to detect which interventions or components work best and which subgroups benefit most (Kraemer et al., 2002). This knowledge is necessary for the development of effective interventions and the selection of the best intervention for a specific population.

Based on previous meta-analyses on the effectiveness of intervention programs in youth, various study, sample and intervention characteristics may moderate program effectiveness. In terms of study characteristics, type of stress measured, publication year, publication status, study quality, the (in)dependence of authors, type of control condition, study design and timing of measurements were deemed important to consider. With regard to type of stress, effectiveness may vary across specific types of stress, such as school stress (e.g., pressure from study and worrying about grades or workload) or social stress (i.e., stress that stems from interpersonal relationships or from the social environment in general, such as the adolescents' home life). Whether the study was performed recently or not might moderate the effectiveness, since the likelihood of reporting null-results has increased over the last two decades (Kaplan and Irvin 2015). However, previous research demonstrated no difference in publication year (Zoogman et al., 2015). Larger effects have been found for published versus unpublished studies (Conley et al., 2016), lower versus higher quality studies (Kraag et al., 2006), studies with quasi-experimental designs versus randomized controlled trials (RCTs) (Suter & Bruns, 2009) and studies by researchers who developed the intervention program they studied versus independent researchers (Petrosino & Soydan, 2005). Moreover, comparison with active versus passive control groups may impact findings of effectiveness studies (Feiss et al., 2019), and should therefore be considered. Furthermore, it is important to not

only focus on post-intervention assessments, but also on follow-up assessments to investigate the long-term effects of school-based intervention programs.

Additionally, sample characteristics may affect the magnitude of the effects of school-based programs on stress reduction, for example age, gender distribution, socioeconomic status (SES) and ethnicity. A higher likelihood of effectiveness of intervention programs has been found in older versus younger samples and in samples with a higher proportion of females (Stice et al., 2009). Participants with low socioeconomic or minority backgrounds might respond differently to school-based intervention programs, possibly related to the implementation of the program. More specifically, schools in disadvantaged areas often suffer from various problems, such as high levels of unemployment, high staff turnover, poor facilities and lack of resources (Harris & Chapman, 2004). This might make it more difficult to adequately implement intervention programs, resulting in lower effectiveness (Durlak et al., 2011). Furthermore, interventions in selected high-risk samples versus community samples (Stice et al., 2009), and targeted compared to universal intervention programs (Feiss et al., 2019) have been found to be more effective, suggesting that intervention programs generate more positive changes if problems are more severe at the start of the intervention. Moreover, it is possible that the selection method for including participants moderates program effectiveness. Inclusion based on self-selection might be more effective than inclusion based on screening, because it is likely that self-selected participants are more motivated to attend and actively participate in an intervention program (Stice et al., 2009).

Finally, there are some intervention characteristics that may affect the effectiveness of school-based intervention programs targeting psychological stress, including intensity, type of instructors and components and focus of the program. Previous meta-analyses demonstrated larger effects for less intensive interventions (Stice et al., 2009), and interventions delivered by external professionals (e.g. mental health professionals) as opposed to professionals working at the involved schools (Werner-Seidler et al., 2017). Moreover, techniques taught in intervention programs may affect effectiveness, with problem solving and emotional coping skills showing larger effects compared to relaxation techniques (Kraag et al., 2006). Whether or not the intervention directly addresses stress reduction might influence program effectiveness, because intervention programs with a direct focus on stress reduction may generate larger effects than interventions that address stress indirectly.

Current study

Given the increased number of school-based intervention programs targeting psychological stress in adolescents, and the limited knowledge on their overall effectiveness and factors influencing program effectiveness, it is important to conduct a new extensive meta-analysis. The current multilevel meta-analysis therefore aimed to determine the effectiveness of different school-based intervention programs in reducing psychological stress in adolescents. The second aim was to investigate which study (i.e., type of stress, publication year, publication status, study quality, study design, (in)dependence of authors, type of comparison condition, timing of measurements and time to follow-up), sample (i.e., age, gender, SES, ethnicity, target group and selection method), and intervention characteristics (i.e., intensity, type of instructor, components and focus of intervention) moderate the effectiveness of these programs.

School-based intervention programs were expected to reduce psychological stress in adolescents (Kraag et al., 2006). Larger effects were expected for published versus unpublished studies (Conley et al., 2016), for lower versus higher quality studies (Kraag et al., 2006), for studies by researchers who developed the intervention program they studied versus independent researchers (Petrosino & Soydan, 2005), for studies with quasi-experimental designs versus RCTs (Suter & Bruns, 2009) and for studies with active compared to passive control groups (Feiss et al., 2019). Larger effects were also expected for older, female samples (Stice et al., 2009), for samples with lower proportions of participants with low socioeconomic and minority backgrounds, and for selected samples, particularly based on self-selection (Stice et al., 2009). Furthermore, less intensive programs (Stice et al., 2009), intervention programs given by external professionals as opposed to professionals working at the involved schools (Werner-Seidler et al., 2017), having problem solving and emotional coping skills versus relaxation techniques as a component (Kraag et al., 2006), and that directly versus indirectly addressed stress reduction were expected to have larger effects. For type of stress, publication year and timing of measurements no hypotheses were formulated.

METHODS

The current study adhered to PRISMA guidelines (Moher et al., 2009).

Selection criteria

Available studies were searched that investigated the effects of school-based intervention programs on psychological stress in adolescents, meeting the following inclusion criteria: 1) studies had to evaluate the effectiveness of a school-based intervention program promoting psychosocial functioning (e.g., stress reduction, mental health, well-being, or coping skills), 2) studies had at least one psychological stress outcome, measured with self-report questionnaires, 3) studies had to target adolescents, with a mean age of 10 to 18 years old at the start of the intervention, 4) studies had to compare an experimental group and a control group, 5) studies had to include pre- and post-intervention assessment measures and/or follow-up assessment measures, 6) studies had to be written in English and 7) studies had to have available statistics suitable for performing meta-analyses (i.e., statistics to extract an effect size).

Search strategy

Through a systematic computer search, relevant publications were identified using the search engines Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, Education Resources Information Center (ERIC), PsycINFO and Cochrane. The search period was – since records began – up until June 2019, and four search terms were used. The search strings were “intervention* or program*” in combination with “stress or distress” in combination with “adolesc* or child or children or youth” in combination with “controlled clinical trial or controlled trial or random* or experiment* or comparison group* or controls or control condition* or control group* or control subject* or no treatment group* or waiting list or wait list or waitlist or treatment as usual or care as usual”. In addition, not statements were used to exclude studies that involved oxidative stress, distress syndrome, parenting stress, immunization, vaccination or venipuncture, studies that involved animals, infants, toddlers, preschool or kindergarten, studies about pregnancy, neonatal and prenatal, and study protocols, reviews and meta-analyses. Google Scholar was used to check the first 100 hits for missing relevant publications and to search for grey literature (i.e., unpublished work). Furthermore, a manual search through the reference lists of the identified publications, relevant review (Rew et al., 2014) and meta-analyses (Feiss et al., 2019; Kraag et al., 2006) was conducted.

Coding of studies

A detailed coding system was used to register study characteristics, outcome variables and moderators. All studies were coded by the first author. A subsample of the studies was double coded by either of two other researchers and responses of the two coders were compared (Inter-rater reliability (IRR) was 89,8% for a subset of 42,6% of the studies). Inconsistent responses were discussed with a fourth researcher to reach consensus. Effect sizes were coded for psychological stress (e.g., perceived stress, symptoms of stress). Positive effect sizes reflect improvements in functioning in the intervention group when compared to the control group. The following study, sample, and intervention characteristics were coded as moderators.

Study characteristics were type of stress outcome (school stress versus social stress), publication year (as a continuous variable), publication status (published or not published), study design ((cluster) RCT or quasi-experimental study, with RCT defined as randomly allocating participants to the experimental or control group, cluster RCT defined as randomly allocating groups of participants, and quasi-experimental design defined as a controlled study without random assignment of groups), type of comparison condition (passive control versus active control, with passive control defined as no intervention, regular school activities and waitlist control, and active control defined as treatment-as-usual and other interventions), the independence of the authors (whether or not the authors owned or (co-)developed the intervention), timing of measurements (whether the measurement was post-intervention or at follow-up, with post-intervention defined as measurement immediately after completion of the intervention and follow-up defined as measurement after the post-intervention measurement), time to follow-up (in weeks) since completion of the intervention (as a continuous variable), and study quality (as a continuous variable). The Quality Assessment Tool for Quantitative Studies (Thomas et al., 2004) was used to assess study quality, based on the characteristics selection bias, study design, confounders, blinding, data collection methods (validity and reliability) and withdrawals and dropout. Each variable was scored with 0 (not accounted for/missing), 1 (somewhat accounted for) and 2 (completely accounted for). Using these six variables, a total quality score was calculated for each study (range 0-12).

Sample characteristics were target group (non-selected or selected student samples, with non-selected students defined as samples of students from the general population and selected students defined as samples of students who self-selected or were selected based on prior screening), selection method (self-selection versus selection based on

prior screening, such as participants self-selecting for an optional program or participants screened on high stress or anxiety levels), percentage of boys (as a continuous variable), percentage of low SES (i.e., low income, analyzed as a continuous variable), percentage of minorities (i.e., non-Caucasian, analyzed as a continuous variable) and mean age of the adolescents (if mean age was not reported, the midpoint of the age range was used, analyzed as a continuous variable).

Intervention characteristics were whether or not the intervention included the most often used stress reduction techniques (Rew et al., 2014), i.e., mindfulness (yes or no), relaxation exercises (yes or no) and cognitive-behavioral techniques (yes or no), intensity of the intervention (session duration multiplied by frequency of sessions; if session duration was reported as “a lesson”, the average of 45 minutes was used, analyzed as a continuous variable), type of instructors (specialized instructors or other instructors, including school personnel or researchers) and program target (whether stress reduction was a direct target of the intervention program or an indirect program target, based on the presence or absence of components that directly target stress management). Interventions with stress reduction as a direct program target included components to train mindfulness, yoga, relaxation or coping skills to manage stress, whereas interventions with stress reduction as an indirect program target included activities such as gardening or swimming, or components to train general coping or social skills. Program integrity (i.e., whether the intervention was applied according to protocol) was initially coded, but eventually not included as a moderator because few studies reported information about program integrity.

Analysis of effect sizes

Using an online effect size calculator (Wilson, n.d.), Cohen’s d ’s were calculated for each effect size indicating the effectiveness of school-based intervention programs on psychological stress on the basis of differences between adolescents receiving an intervention program and adolescents in a control group. In most cases, Cohen’s d was calculated based on means and standard deviations (SD) or standard errors (SE). Group differences were computed for both pre- and post-intervention and pre-intervention d ’s were subtracted from post-intervention d ’s to account for baseline differences between groups (e.g., van der Stouwe et al., 2014). When there were no means and SD/SE reported (13,8% of the total number of effect sizes), Cohen’s d was calculated based on mean difference scores, t -, F - or chi-square values. A small effect size was considered $d = 0.20$, a moderate effect size $d = 0.50$ and a large effect size $d = 0.80$ (Cohen, 1988). Dummy

variables were computed for the categorical moderators and continuous moderators were mean centered.

A three-level meta-analytic model was used in R to calculate an overall effect size and to conduct moderator analyses (Assink & Wibbelink, 2016), thereby taking into account the dependency of multiple effect sizes from the same study (van den Noortgate et al., 2013). Three levels of variance were included in the model: the sampling variance of each effect size (level 1), the within-study variance of effect sizes in the same study (level 2) and the between-study variance of effect sizes from different studies (level 3). The overall effect was estimated using an intercept-only model for psychological stress. The analysis was repeated after removal of outliers (i.e., extreme effect sizes, with an Interquartile Range (IQR) > 3) (Elbaum et al., 2000). Separate log-likelihood tests were performed to test if there was significant variance within (level 2) and between (level 3) studies (i.e., significant heterogeneity). If there was significant heterogeneity for at least one of the levels, moderator analyses were performed. In that case, possible moderators were included in the three-level intercept model (Assink & Wibbelink, 2016). The Knapp and Hartung-method (Knapp & Hartung, 2003) was applied, resulting in a decreased risk of Type 1-errors (Assink & Wibbelink, 2016). Moderators were only included if there were at least three effect sizes for the specific moderator and at least one effect size per category of the moderator.

Publication bias

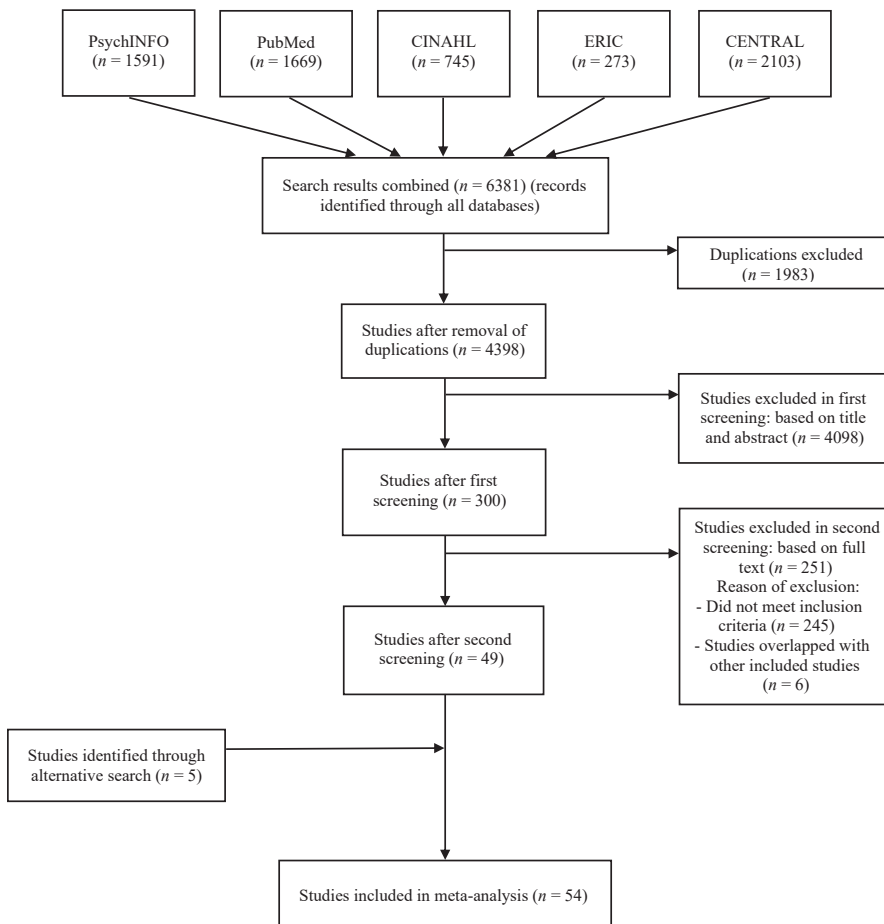
It is important to consider publication bias when conducting a meta-analytic study, because it is more likely that studies with positive results are published compared to studies that have negative or non-significant results, which could result in an underrepresentation of studies with minimal or negative effects. First, Rosenthal's fail-safe test was performed, indicating no publication bias when the fail-safe N exceeds the critical value (derived by the formula $5 \times k + 10$, where k is the number of studies) (Rosenthal, 1979). The critical value represents the number of studies with null results needed to make the overall result nonsignificant. Second, the funnel plot was visually inspected to detect asymmetry, which is an indication for publication bias. Third, in accordance with the Egger's asymmetry test (Egger et al., 1997), a multilevel analysis was conducted with the sampling variance as a moderator to detect small study biases. Fourth, a trim and fill analysis was performed to test the influence of missing effect sizes on the results by repeating the meta-analysis after imputing the missing effect sizes (Duval & Tweedie, 2000b, 2000a).

RESULTS

Study selection

As displayed in the flowchart (Figure 2.1), the electronic search identified 4,398 unique hits for all databases after the removal of duplicates. After first selection by screening the title and abstract of the publications, 300 studies were potentially eligible. Following full text screening, 55 studies met the inclusion criteria. Of these 55 studies, six studies were excluded because they were earlier versions of included studies. The alternative search yielded 5 additional studies, which resulted in a final number of $k = 54$ included studies, reporting on analyses in 61 independent samples, yielding $N = 123$ effect sizes based on $N = 9,196$ participants in an intervention group and $N = 7,279$ participants in a control group.

Figure 2.1 Flow chart



All studies included in this meta-analytic review were issued between 1989 and 2019. Almost all studies were published, only 3 studies were not (i.e., dissertations). School or social stress, as an alternative to general stress, were examined in only 8 studies (based on 8 independent samples; 5 for school stress and 3 for social stress). Studies were (clustered) RCTs (37 studies, 41 independent samples) or quasi-experimental (17 studies, 20 samples). Most studies (32 studies, 36 samples) used a passive control group. About half of the studies was written by independent authors (26 studies, 27 samples). Only few studies (17 studies, 17 samples) included follow-up measurements, ranging from 4 to 48 weeks after the post-intervention assessment, with a mean of 17 weeks. Study quality ranged from 1 to 11, with a mean score of 6. Almost half (26 studies, 29 samples) included selected students, while the other half (28 studies, 32 samples) included non-selected, community sample students. Of the selected student samples, 16 were generated by screening and 13 by self-selection. Across samples, average age ranged between 10,3 and 17,7 years with an overall mean of 14,6 years. The mean percentage of boys was 41,4% (based on 58 samples), the mean percentage of minorities was 52,8% (based on 22 samples) and the mean percentage of low SES was 42,2% (based on 20 samples). With regard to the intervention programs, 47 studies (53 samples) directly focused on stress reduction, while the other studies did not. In terms of intervention components, mindfulness was included in 19 studies (21 samples), relaxation techniques in 21 studies (25 samples) and cognitive behavioral techniques in 25 studies (28 samples). The intensity of the intervention programs ranged from 100 to 9900 minutes, with a mean of 1015 minutes (based on 53 samples). Interventions were delivered by specialized instructors in 20 studies (22 samples) and by other instructors (e.g., school personnel, researchers) in 30 studies (35 samples). Details of the selected studies are provided in Table 2.1.

Table 2.1 Detailed description of the selected studies

Authors	N	Age range, mean age (SD), grade, gender, ethnicity ^a	Study design	Target group (selection)	Intervention	Program target (stress reduction)	Stress outcome ^b
Bennet and Dorjee (2016)	24	16-18 years, 17.70 (0.73) 11-12 th grade, 58% boys	Quasi-experimental	Self-selected (voluntary)	Mindfulness-based stress reduction	Direct	Psychological stress (DASS, 7 items), perceived stress (body barometer, 1 item)
Bluth et al. (2016)	27	17.0 9-12 th grade, 59% boys, 82% minorities	RCT	Self-selected (voluntary)	Learning to BREATHE	Direct	Perceived stress (PSS, 10 items)
Burckhardt et al. (2016)	63	15-18 years 10-11 th grade, 61% boys	Cluster RCT	Screened (high depression, anxiety, stress levels)	Strong Minds	Direct	Stress levels (DASS, 7 items)
Butzer et al. (2017)	209	12.64 (0.33) 7 th grade, 37% boys, 47% minorities	Cluster RCT	Community	Kripalu Yoga in the schools	Direct	Perceived stress (PSS, 10 items)
Campbell et al. (2019)	1007	13-19 years, 15.96 (1.17) 9-12 th grade, 50% boys, 30% minorities	Quasi-experimental	Community	.b (the Mindfulness in Schools Project)	Direct	Perceived stress (PSS, 9 items)
Carreres-Ponsoda et al. (2017)	30	16-18 years, 16.80 50% boys	RCT	Self-selected (voluntary)	Mindfulness-based stress reduction	Direct	Perceived stress (PSS, 14 items)
Carter et al. (2018)	64	13-16 years, 14.70 (0.74) 9-10 th grade, 45% boys, 22% minorities	Cluster RCT	Self-selected (self-identified and identified by others)	The Best of Coping program	Direct	Stress appraisal of challenge, threat and resources (SAMA, 4, 7 and 3 items)
Cross et al. (2018)	2945	13.0 8-9 th grade, 50% boys	Cluster RCT	Community	Friendly Schools Program	Indirect	Stress scores (DASS, 7 items)
Da Silva et al. (2019)	20	11-14 years, 12.10 (1.50) 70% boys	RCT	Screened (ADHD)	Swimming-learning program	Indirect	Perceived stress (PSS, 14 items)

Table 2.1 (Continued)

Authors	N	Age range, mean age (SD), grade, gender, ethnicity^a	Study design	Target group (selection)	Intervention	Program target (stress reduction)	Stress outcome^b
De Anda (1998)	54	12-14 years, 13.00 30% boys, 53% minorities	Quasi-experimental	Self-selected (voluntary)	Cognitive-behavioral stress management program	Direct	Degree of experienced stress (ASCM, 4 items)
Dowling et al. (2019)	675	15-18 years, 15.87 (0.69) 5 th grade, 50% boys	Cluster RCT	Community	MindOut program	Direct	Levels of symptoms related to stress (DASS, 7 items)
Ebrahimi et al. (2015)	40	14-18 years, 16.48 (1.10) 100% boys	Quasi-experimental	Self-selected (voluntary)	Spiritual intelligence training	Direct	Stress scores (DASS, 7 items)
Eggert et al. (1995)	105	15.86 (1.01) 9-12 th grade, 42% boys, 72% minorities	Quasi-experimental	Screened (suicide risk)	Personal growth class	Direct	Perceived stress and pressure from others (4 items)
Eslami et al. (2016)	126	16.33 (7.02) 0% boys	RCT	Community	Assertiveness training program	Direct	Stress levels (DASS, 7 items)
Fridrici and Lohaus (2009)	904	12-18 years 8-9 th grade, 50% boys	Cluster RCT	Community	Stress prevention intervention	Direct	General stress (3 items)
Fung et al. (2019)	145	13-15 years, 13.99 (0.36) 9 th grade, 32% boys, 97% minorities	RCT	Screened (depressive symptoms)	Learning to breathe	Direct	Perceived stress (PSS, 9 items)
Garcia et al. (2011)	41	13-16 years, 14.80 (0.72) 9-10 th grade, 0% boys, 100% minorities	RCT	Self-selected (voluntary)	Project Wing's Girl's group	Direct	Perceived stress (PSS, 14 items), level of stress symptoms (DASS, 14 items)
Goodman and Newman (2014)	60	9 th or 12 th grade 0% boys	RCT	Self-selected (voluntary)	Digital storytelling	Direct	Experienced daily stress (ASQ, 31 items)

Table 2.1 (Continued)

Authors	N	Age range, mean age (SD), grade, gender, ethnicity^a	Study design	Target group (selection)	Intervention	Program target (stress reduction)	Stress outcome^b
Hampel et al. (2008)	320	10-14 years, 11.70 (1.18) 5-8 th grade, 50% boys	Quasi-experimental	Community	Anti-stress training	Direct	Interpersonal, academic stress (7 items)
Hiebert et al. (1989) Study 1	79	13-14 years 8 th grade, 48% boys	Cluster RCT	Community	Progressive relaxation	Direct	Stress symptoms (SOSI, 59 items)
Hiebert et al. (1989) Study 2	22	17-18 years 11-12 th grade, 63% boys	Quasi-experimental	Self-selected (elective module)	Progressive relaxation	Direct	Stress symptoms (SOSI, 59 items)
Jamali et al. 2016	100	13-14 years, 13.50 (1.01) 50% boys	RCT	Community	Life skills training	Indirect	Perceived stress (10 items)
Jellesma and Cornelis (2012)	54	8-13 years, 10.58 (1.58) 3 th /6 th grade, 65% boys	Cluster RCT	Community	Mind Magic Program	Direct	Psychological, mental stress (10-point scale)
Jose and Sajeena (2017)	60	8-10 th grade	Cluster RCT	Self-selected	Yoga therapy	Direct	Perceived stress (PSS, 10 items)
Khalsa et al. (2012)	100	15-19 years, 16.80 (0.60) 11-12 th grade, 58% boys, 10% minorities	Cluster RCT	Community	Yoga Ed program	Direct	Perception of stress (PSS, 10 items), social stress (BASC, 13 items)
Kiselica et al. (1994)	48	9 th grade, 54% boys, 0% minorities	Cluster RCT	Screened (anxiety symptoms)	Stress inoculation training	Direct	Stress symptoms (SOSI, 118 items)
Kraag et al. (2009)	1437	10.30 (0.64) 5-6 th grade, 50 % boys	Cluster RCT	Community	Learn Young, Learn Fair	Direct	Physiological, psychological stress symptoms (MUSIC)
Kuyken et al. (2013)	522	12-16 years, 14.80 (1.50) 70% boys, 28% minorities	Quasi-experimental	Community	Mindfulness in Schools Program	Direct	Perceived stress (PSS, 10 items)
Lai et al. (2016)	2304	14-16 years, 15.40 (1.00) 8-10 th grade, 51% boys	Quasi-experimental	Community	The Little Prince is Depressed	Direct	Stress levels (DASS, 7 items)

Table 2.1 (Continued)

Authors	N	Age range, mean age (SD), grade, gender, ethnicity ^a	Study design	Target group (selection)	Intervention	Program target (stress reduction)	Stress outcome ^b
Lang et al. (2017)	122	16.22 (1.12) 65% boys	Cluster RCT	Community	EPHECT coping training	Direct	Perceived stress (ASQ, 30 items)
Lau and Hue (2011)	48	14-16 years, 15.83 38% boys 0% minorities	Quasi-experimental	Self-selected (voluntary)	Mindfulness program	Direct	Perceived stress (PSS, 10)
Lee et al. (2018)	20	10-11 years, 10.50	RCT	Screened (emotional and behavioral problems)	Horticulture-related activities	Indirect	Stress levels: social, school stress (PSS, 10 items)
Livheim et al. (2015)	32	14-15 years 28% boys	RCT	Screened (depressive symptoms)	Acceptance and Commitment Therapy	Direct	Perceived stress (PSS, 10 items), stress levels (DASS, 7 items)
Manjushambika et al. (2017)	65	11-17 years, 14.50 42% boys	Quasi-experimental	Screened	Jacobson's Progressive Muscle Relaxation	Direct	Educational stress (ESSA, 16 items)
Marsland et al. (2018)	70	8-14 years, 10.65 (1.49) 3-8 th grade, 54% boys, 70% minorities	RCT	Screened (asthma)	I Can Cope	Direct	Perceived stress (PSS, 10 items)
Metz et al. (2013)	216	16.45 (0.95) 10-12 th grade, 34% boys, 11% minorities	Quasi-experimental	Community	Learning to Breathe	Direct	Perceived stress level (1 item)
Noggle et al. (2012)	51	17.20 (0.70) 11-12 th grade, 46% boys, 8% minorities	Cluster RCT	Community	Kripula yoga	Direct	Perceived stress (PSS, 10 items)
Norlander et al. (2005)	95	11.31 (1.09) 44% boys	Quasi-experimental	Community	Relaxation	Direct	Experienced stress levels (10 items)

Table 2.1 (Continued)

Authors	N	Age range, mean age (SD), grade, gender, ethnicity^a	Study design	Target group (selection)	Intervention	Program target (stress reduction)	Stress outcome^b
Puolakanaho et al. (2019)	205	15.27 (0.39) 9 th grade, 51% boys	RCT	Community	Youth COMPASS	Direct	Overall stress (1 item), school stress (4 items)
Quach et al. (2016)	149	12-15 years, 13.18 (0.72) 7-9 th grade, 38% boys, 99% minorities	RCT	Community	Mindfulness meditation and hatha yoga	Direct	Perceived stress (PSS, 10 items)
Reiss (2013)	40	16-18 years, 17.25 (0.54) 12 th grade, 65% boys	Quasi-experimental	Self-selected (voluntary)	Mindfulness meditation treatment	Direct	Perceived stress (PSS, 10 items)
Rentala et al. (2019)	60	16-19 years, 17.13, 0% boys	RCT	Screened (high stress levels)	Holistic group health promotion program	Direct	Stress levels (DASS, 7 items), educational stress (ESSA, 16 items)
Ruiz-Aranda et al. (2012)	147	13-16 years, 14.18 (0.64) 40% boys	RCT	Community	Emotional intelligence education program	Indirect	Social stress (BASC, 13 items)
Sibinga et al. (2013)	41	11-14 years, 12.50 7-8 th grade, 100% boys, 95% minorities	RCT	Community	Mindfulness-based stress reduction	Direct	Perceived stress (PSS, 10 items)
Sibinga et al. (2016)	300	12.00 5-8 th grade, 49% boys, 100% minorities	Cluster RCT	Community	Mindfulness-based stress reduction	Direct	Perceived stress (PSS, 6 items)
Silbert and Berry (1991)	145, 178	14-18 years, 15.00 10 th grade, 50% boys, 70% minorities	Quasi-experimental	Screened, community	Suicide prevention unit	Indirect	Subjective experience of stress (SSS, 14 items)
Singhal et al. (2014)	19	13-18 years 9 th grade, 0% boys	Quasi-experimental	Screened (sub-clinical depression)	Coping skills program	Direct	Academic stress (SAAS)

Table 2.1 (Continued)

Authors	N	Age range, mean age (SD), grade, gender, ethnicity ^a	Study design	Target group (selection)	Intervention	Program target (stress reduction)	Stress outcome ^b
Singhal et al. (2018)	120	13-18 years 8 th , 9 th and 11 th grade	Cluster RCT	Screened (sub-clinical depression)	Coping skills program	Direct	Academic stress (SAAS)
Solar (2013)	10	14-18 years, 16.00 (1.25) 9-12 th grade, 70% boys, 30% minorities	RCT	Screened (emotional / learning disability or other health impairment)	Mindfulness meditation	Direct	Perceived stress (PSS, 10 items)
Terjestam (2011)	393	12-15 years, 13.90 7-9 th grade, 48% boys	Cluster RCT	Community	Meditation based technique for stillness	Direct	General stress (3 items)
Terjestam et al. (2010)	119	13-14 years, 13.18 7 th grade, 49% boys	Quasi-experimental	Community	Qigong	Direct	General stress (3 items)
Terjestam et al. (2016)	307	5 - 8 th grade 52% boys	Cluster RCT	Community	Compas program	Direct	Stress levels (General Stress Scale, 3 items)
Van der Gucht et al. (2018)	390	13-20 years, 15.40 (1.20) 9-11 th grade, 37% boys	Cluster RCT	Community	Mindfulness group training	Direct	Stress symptoms (DASS, 7 items)
Van Ryzin and Roseth (2018)	1449	7 th grade 52% boys, 24% minorities	Cluster RCT	Community	Cooperation in the classroom	Indirect	Perceived stress (PSS, 4 items)
Zafar and Khalily (2015)	100	12-18 years 50% boys	RCT	Screened (high depression, anxiety, stress levels)	Didactic therapy	Direct	Stress levels (DASS, 14 items)

Note. DASS = Depression Anxiety Stress Scale; RCT = Randomized Controlled Trial; PSS = Perceived Stress Scale; SAMA = Stress Appraisal Measure for Adolescents; ASCM = The Adolescent Stress and Coping Measure; ASQ = Adolescent Stress Questionnaire; SOSI = Symptoms of Stress Inventory; MUSIC = Maastricht University Stress Instrument for Children; BASC = Behavior Assessment System for Children and Adolescents; ESSA = Education Stress Scale for Adolescents; SAAS = Scale for Academic Stress.

^a Percentage of minorities (i.e., non-Caucasian)

^b Descriptions of authors.

Overall effect

Test statistics for the overall effect can be found in Table 2.2. The overall effect size of school-based intervention programs on psychological stress was moderate ($d = 0.543$, $p < .001$), indicating that intervention programs are effective in reducing psychological stress. The heterogeneity test revealed that there was significant within-study and between-study variance ($p < .0001$).

Sensitivity analysis

To account for the possible influence of outliers, the meta-analysis was repeated after removal of ten outliers (i.e., ten extreme positive effect sizes). This yielded a smaller but still significant effect on psychological stress ($d = 0.276$, $SE = 0.064$, $p < .001$).

Publication bias

The Rosenthal fail-safe test revealed that there was no indication of publication bias because the fail-safe N exceeded the critical value (see Table 2.2). However, the funnel plot (see Figure 2.2) demonstrated asymmetry and the regression analysis of the sampling variance was significant ($p < .001$), indicating publication bias. The trim and fill analysis revealed that 26 effect sizes were missing on the left side of the distribution and results after imputation demonstrated a significant but very small overall effect on psychological stress ($d = 0.068$, $SE = 0.011$, $p < .0001$), thereby supporting the suggestion that studies with positive results are overrepresented, resulting in an inflation of the overall effect.

Table 2.2 Result for the overall mean effect size

Outcome	<i>N</i> studies (samples)	<i>N</i> ES	<i>N</i> participants	Mean <i>d</i> (SE)	95% CI	<i>t</i> -value	LRT	% var	Fail-safe <i>N</i> (cv)
Psychological stress	54 (61)	123	16,475	0.543 (0.133)	0.279-0.806	4.082***	Level 2: 16.32*** Level 3: 100.41***	Level 1: 1.5% Level 2: 1.2% Level 3: 97.3%	16,223 (280)

Note. *N* studies (samples) = number of studies and independent samples; *N* ES = number of effect sizes; mean *d* = mean effect size Cohen's *d*; SE = standard error; CI = confidence interval, *t*-value = difference in mean *d* with zero; LRT = likelihood-ratio test for level 2 and level 3; % var = percentage of variance explained; Fail-safe *N* (cv) = Fail-safe number and Rosenthal's critical value in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Moderator analyses

The results of the moderator analyses on psychological stress are reported in Table 2.3. Significant results are described here.

Study characteristics. The type of stress and timing of measurements moderated the effect, yielding significant effects for school stress, but not for social stress. Larger effects were found at follow-up compared to post-intervention.

Sample characteristics. The target group moderated the effect, demonstrating significant effects in selected student samples, but not in non-selected samples.

Intervention characteristics. No intervention characteristics moderated the effects.

Figure 2.2 Funnel plot for psychological stress

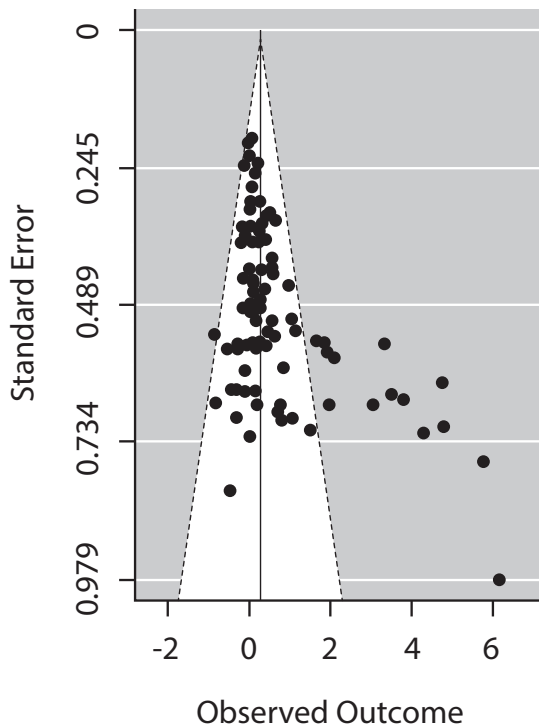


Table 2.3 Results for the moderator analyses on psychological stress

Moderator	<i>N</i> samples	<i>ME</i> S	<i>B</i> ₀ (95% CI)	<i>t</i> ₀	<i>B</i> ₁ (95% CI)	<i>t</i> ₁	<i>F</i> (<i>df</i> ₁ , <i>df</i> ₂)	<i>p</i>
<i>Study characteristics</i>								
Type of stress							<i>F</i> (1, 13) = 4.754	.048
School stress (RC)	5	10	2.739 (1.465-4.012)	4.646***				
Social stress	3	5	0.531 (-1.247-2.309)	0.646	-2.207 (-4.394- -0.020)	-2.180*		
Publication year (continuous)	61	123	0.539 (0.276-0.801)	4.061***	0.020 (-0.013-0.054)	1.198	<i>F</i> (1, 121) = 1.436	.233
Publication status							<i>F</i> (1, 121) = 1.557	.215
Published (RC)	58	114	0.579 (0.310-0.848)	4.266***				
Not published	3	9	-0.210 (-1.433-1.012)	-0.340	-0.789 (-2.041-0.463)	-1.248		
Design							<i>F</i> (1, 121) = 0.566	.453
(Cluster) RCT (RC)	41	74	0.613 (0.291-0.936)	3.765***				
Quasi-experimental	20	49	0.400 (-0.060-0.859)	1.723	-0.213 (-0.775-0.348)	-0.752		
Type of comparison condition							<i>F</i> (1, 121) = 1.336	.250
Passive control (RC)	36	80	0.671 (0.328-1.014)	3.872***				
Active control	25	43	0.359 (-0.051-0.769)	1.732	-0.312 (-0.847-0.223)	-1.156		
Authors							<i>F</i> (1, 108) = 1.115	.293
Independent (RC)	27	54	0.665 (0.292-1.038)	3.534***				
Dependent	25	56	0.380 (-0.003-0.763)	1.967	-0.285 (-0.820-0.250)	-1.056		
Time of measurements							<i>F</i> (1, 121) = 6.693	.011
Post-intervention (RC)	44	93	0.522 (0.257-0.786)	3.906***				
Follow-up	17	30	0.672 (0.390-0.953)	4.724***	0.150 (0.035-0.265)	2.587*		

Table 2.3 (Continued)

Moderator	N samples	NES	B ₀ (95% CI)	t ₀	B ₁ (95% CI)	t ₁	F(df ₁ , df ₂)	p
Time to follow-up (continuous)	17	30	0.964 (0.037-1.891)	2.131*	0.006 (-0.017-0.028)	0.504	F(1, 28) = 0.254	.618
Study quality (continuous)	61	123	0.546 (0.280-0.812)	4.063***	0.019 (-0.096-0.134)	0.327	F(1, 121) = 0.107	.744
<i>Sample characteristics</i>								
Target group							F(1, 121) = 7.065	.009
Selected (RC)	29	58	0.908 (0.537-1.280)	4.844***				
Not-selected	32	65	0.234 (-0.104-0.572)	1.370	-0.674 (-1.177--0.172)	-2.658**		.083
<i>Selection method</i>								
Screened (RC)	16	31	1.406 (0.676-2.135)	3.860***				
Self-selected	13	27	0.443 (-0.370-1.256)	1.091	-0.963 (-2.055-0.129)	-1.766		
% boys (continuous)	58	119	0.491 (0.245-0.737)	3.949***	0.000 (-0.009-0.010)	0.096	F(1, 117) = 0.009	.924
% low SES (continuous)	20	41	0.233 (0.015-0.451)	2.163*	-0.000 (-0.004-0.004)	-0.034	F(1, 39) = 0.001	.973
% minorities (continuous)	22	41	0.110 (0.007-0.213)	2.164*	0.001 (-0.001-0.003)	0.986	F(1, 39) = 0.972	.330
Mean age (continuous)	61	123	0.548 (0.284-0.813)	4.101***	0.039 (-0.090-0.169)	0.601	F(1, 121) = 0.361	.549
<i>Intervention characteristics</i>								
Component mindfulness							F(1, 121) = 1.644	.202
Yes (RC)	21	31	0.360 (-0.020-0.740)	1.874				
No	40	92	0.633 (0.341-0.926)	4.281***	0.274 (-0.149-0.696)	1.282		
Component relaxation							F(1, 121) = 3.288	.072
Yes (RC)	25	42	0.828 (0.422-1.233)	4.040***				
No	36	81	0.345 (0.008-0.682)	2.025*	-0.483 (-1.010-0.044)	-1.813		

Table 2.3 (Continued)

Moderator	<i>N</i> samples	<i>NES</i>	B_0 (95% CI)	t_0	B_1 (95% CI)	t_1	$F(df_1, df_2)$	<i>p</i>
Component cognitive-behavioral							$F(1, 121) = 2.613$	.109
Yes (RC)	28	78	0.772 (0.388-1.156)	3.983***				
No	33	45	0.345 (-0.010-0.700)	1.923	-0.427 (-0.950-0.096)	-1.617		
Intensity (continuous)	53	100	0.489 (0.222-0.756)	3.632***	-0.000 (-0.000-0.000)	-0.256	$F(1, 98) = 0.065$	.799
Type of instructors							$F(1, 110) = 2.445$	.121
Specialized (RC)	22	47	0.603 (0.271-0.934)	3.601***				
Other	35	65	0.270 (0.010-0.53)	2.056*	-0.333 (-0.754-0.089)	-1.564		
Program target							$F(1, 121) = 0.089$	.765
Direct (RC)	53	111	0.559 (0.274-0.844)	3.879***				
Indirect	8	12	0.440 (-0.289-1.170)	1.196	-0.118 (-0.902-0.665)	-0.299		

Note. *N* samples = number of independent samples; *NES* = number of effect sizes; B_0 = mean effect size Cohen's *d*; CI = confidence interval; B_1 = estimated regression coefficient; *t*-values = difference in mean *d* with zero; *F*-value = omnibus test of regression coefficients; *p* = *p*-value of omnibus test; RC = reference category. .05. ***p* < .01. ****p* < .001.

DISCUSSION

In order to prevent adverse adolescent development resulting from high levels of stress, it is important that heightened stress levels are addressed early on. Although various school-based intervention programs have been implemented to reduce adolescent stress, little is known on their overall effectiveness and factors influencing their effectiveness as previous reviews investigating stress reduction in adolescents through school-based intervention programs have generated conflicting and selective findings (Feiss et al., 2019; Kraag et al., 2006; Rew et al., 2014). In this comprehensive multilevel meta-analytic review, the extent to which school-based intervention programs are effective in reducing adolescent psychological stress was examined. In addition, study (e.g., publication status, study design), sample (e.g., age, target group) and intervention characteristics (e.g., intensity, components) were investigated as moderators of effectiveness. The current meta-analysis showed that school-based intervention programs had a moderate overall effect on reducing psychological stress. Significant program effects were only observed in selected student samples and not in community samples. Based on a subsample of studies with specific measures of school and social stress (instead of or in addition to general measures of stress), interventions were particularly effective in reducing school stress, not social stress. In addition, larger effects were found at follow-up compared to post-intervention.

The overall finding that school-based intervention programs are effective in reducing adolescent stress is consistent with the conclusion of Kraag et al. (2006). However, Kraag et al. (2006) only focused on universal interventions delivered to students from the general population, showing that this group benefits from school-based interventions. In contrast, based on the moderator analyses, the present study suggests that school-based interventions targeting psychological stress are not effective in community samples, and that only selected students benefit from such interventions. These contrasting findings may be explained by the difference between the two studies in age groups. In Kraag et al. (2006) participants were between 9 and 14 years, while in the current study participants were between 10 and 18 years old (with a mean age of 15 years). A difference in effectiveness of universal programs between age groups might be explained by the changing importance of the class environment with age. Specifically, while primary school students spend every day with the same teacher and classmates with whom they generally develop close relationships and feel comfortable (Coffey, 2013), students in secondary school typically develop fewer close relationships, especially

with their teachers (Tobbell & O'Donnell, 2013). Consequently, the class environment in secondary school may be less safe to learn new skills than in primary school (i.e., for older compared to younger adolescents). This may result in smaller effectiveness of universal programs in secondary schools or older adolescents. Indeed, for a universal school-based intervention program targeting anxiety, it has been demonstrated that effectiveness was lower for secondary compared to primary school students (Barrett et al., 2005). Additionally, the contrasting findings may be explained by methodological differences between Kraag et al. (2006) and the current study. First, Kraag et al. (2006) included both psychological and physiological stress symptoms. Possibly, large positive effects in terms of physiological outcomes, which are not included in the present study, may explain the difference in findings. Second, Kraag and colleagues computed the effect sizes as the difference in mean change from pretest to posttest between the treatment and control group. This is in contrast with the current study that used group differences (i.e., between the intervention and control group) for both pre- and post-intervention assessments, thus correcting for pre-intervention differences between groups. The results of Kraag and colleagues could be influenced by baseline differences between the intervention and control groups. Third, Kraag et al. (2006) showed publication bias for the effect on stress symptoms, which suggests that their effect on stress reduction was overestimated.

Finding only significant effects for selected student samples compared to non-selected samples is in line with earlier research on school-based stress reduction programs (Feiss et al., 2019). Moreover, previous studies demonstrated that targeted programs were more effective than universal school-based depression programs (Werner-Seidler et al., 2017). This is probably associated with the difference in baseline symptoms between students of the general population and selected students, with selected students demonstrating higher levels of problem severity. Recent research demonstrated that program improvement is more evident in students with a high level of baseline problems (Stjerneklar et al., 2019). Moreover, selected students may be more motivated to actively participate in the intervention than students from the general population because they experience distress about their problems, resulting in larger program effects (Stice et al., 2009).

Based on a subsample of included studies, the results indicated that school-based intervention programs particularly affected school stress (e.g., study pressure, workload, worry on grades) and not social stress. A possible explanation is that adolescents can

relate more to study-related stress and may apply their school-learned skills particularly in the context of study situations rather than social situations. Additionally, in the present study, three of five studies (i.e., 7 of 10 effect sizes) that measured school stress examined an intervention program containing a specific component on dealing with academic stress, while none of the three studies that measured social stress examined an intervention program with a specific component on dealing with social stress. The matching of a specific program component with a similar outcome variable might explain the observed larger effects for school stress. Yet, as perceived school-related stress affects many adolescents worldwide (Klinger et al., 2015), it is promising that school-based interventions have the potential to alleviate school-related stress. At the same time, given the limited number of studies and accompanying effect sizes with specific measures of school stress and social stress (i.e., 15 effect sizes), this finding should be interpreted with caution. To better understand the impact of intervention programs on stress reduction, future studies are recommended to include measures of stress that match the type of stress targeted in the intervention program studied.

Follow-up assessments yielded larger effects in terms of reductions in psychological stress than assessments at post-intervention. On the one hand, this might indicate a sleeper effect, i.e., improved longer term outcomes, which has been suggested for reductions in depressive symptoms that are only expected at a later stage when adolescents have experienced challenging situations (Spence & Shortt, 2007). This sleeper effect may also apply to reductions in psychological stress following universal and selective interventions, as larger effects at follow-up were likely in both selected and non-selected student samples. Yet, recent meta-analyses demonstrated marginal evidence for a sleeper effect of psychotherapy interventions (Flückiger & Del Re, 2017). On the other hand, finding larger effects at follow-up may be due to differences in sample composition between studies with and without follow-up assessments. In the current study, studies with follow-up assessments included more females and more selected student samples than studies with only post-intervention measurements (68% vs. 56% females and 63% vs. 42% selected samples), characteristics that have been associated with larger program effects (Stice et al., 2009).

Limitations

Several limitations need to be considered in this meta-analysis. First, although efforts were made to minimize publication bias by including grey literature and contacting authors of included studies for unpublished work, publication bias was indicated and

might have inflated the overall estimates. Even though the validity of the available methods to detect publication bias is questioned for multilevel meta-analyses (Assink & Wibbelink, 2016), making these specific results difficult to interpret, it is important to keep in mind that the program effects might be overestimated.

Second, extreme positive effect sizes (i.e., outliers) were observed. A sensitivity analysis was therefore conducted to account for their possible influence, by repeating the meta-analysis after the removal of outliers. Although the effect on psychological stress was smaller after correction, it remained significant. This indicates that the outliers moderately overestimated the overall effect. To further understand the impact of outliers, the included studies with extreme scores were examined. These studies were all based on selected rather than community student samples, had higher proportions of female participants and more often included follow-up assessments; factors that were found to be associated with larger effects in the present study and in previous research (Stice et al., 2009). As such, extreme scores seem to result from combinations of characteristics associated with larger effects.

Lastly, limited information was available for some of the study, sample, and intervention characteristics, including percentage of SES, percentage of minorities and program integrity. This limited the possibilities to conduct moderator analyses. It is important that future intervention studies report sufficient information about the study, sample, and intervention characteristics in order to be able to determine what works for whom in school-based intervention programs targeting stress.

Recommendations for future research

The present multilevel meta-analytic study evaluated the effectiveness of school-based intervention programs targeting adolescent psychological stress. In addition to new insights into the effectiveness of school-based intervention programs targeting psychological stress in adolescents, the current study generates recommendations for future research. It is recommended that future studies report information about program integrity (i.e., whether the intervention program was implemented as originally planned). As non-significant or negative results may be caused by incorrect program implementation, and not by an ineffective program, information about the program implementation is necessary to draw correct conclusions about the effectiveness of intervention programs. Furthermore, although no significant effects were found for universal interventions, contradicting earlier findings (Kraag et al., 2006), it is still

important to examine them. Universal interventions reach larger groups of adolescents, including adolescents with (emerging) problems who do not search for care outside the school environment. It is of great importance to identify if adolescents with (emerging) problems benefit from universal interventions, or to examine how universal intervention programs can be adjusted to achieve the desired results for adolescents in need (e.g., improvement in functioning, effective referral). Overall, further research is necessary to identify the working mechanisms of effective school-based intervention programs targeting adolescent stress, for specific types of stress (e.g., school stress, social stress).

CONCLUSION

Previous reviews have investigated the reduction of adolescent stress through school-based intervention programs, however, these studies have yielded conflicting and selective findings. To overcome these limitations, the present multilevel meta-analytic study examined the effectiveness of school-based intervention programs in reducing psychological stress in adolescents and examined study, sample and intervention characteristics as moderators of effectiveness. The current study showed that school-based intervention programs were effective at reducing adolescent psychological stress, particularly for selected student samples. Furthermore, findings based on a small subsample of studies suggest that interventions were particularly effective in reducing school stress rather than social stress. Lastly, larger effects were found at follow-up compared to post-intervention, although this finding likely results from the sample composition of studies including follow-up assessments. Since heightened stress is an increasing mental health issue among adolescents (Walburg, 2014), it is important that governments and schools are aware of the availability and potential of school-based intervention programs to reduce psychological stress in adolescents, and implement such programs in practice. This pertains particularly to interventions directed at students who self-select or enroll following a screening, as they benefit most from such interventions. School-based intervention programs aimed at reducing adolescent stress are scarce compared to programs aimed at reducing anxiety or depressive symptoms (Feiss et al., 2019). Yet, teaching adolescents skills to adequately deal with stress is of interest to both adolescents and schools, since addressing psychological stress through school-based intervention programs may prevent emerging mental health issues that likely also affect school performance.



CHAPTER 3

The Effects of School-Based Interventions on Physiological Stress in Adolescents

This chapter is adapted from:

van Loon, A. W. G., Creemers, H. E., Okorn, A., Vogelaar, S., Miers, A., Saab, N., Westenberg, P. M., & Asscher, J. J. (2021). The effects of school-based interventions on physiological stress in adolescents: A meta-analysis. *Stress and Health, 38*(2), 187-209.

Author contributions:

AL conceived and participated in the design of the study, conducted the search and extracted data, performed data analysis and drafted the manuscript. HE conceived and participated in the design of the study, coordinated the study and drafted the manuscript. AO participated in data collection and interpretation of the study, and critically revised the manuscript. SV, AC, NS, and MW participated in interpretation of the data and critically revised the manuscript. JA conceived and participated in the design of the study, coordinated the study and drafted the manuscript. All authors read and approved the final manuscript.

ABSTRACT

Chronic stress is associated with dysregulations in the physiological stress system, resulting in diverse negative developmental outcomes. Since adolescence is a period characterized by increased stress-sensitivity, and schools are an important environment for the developing adolescent, school-based interventions promoting psychosocial functioning are of particular interest to prevent adverse outcomes. The present study therefore aimed to investigate the effectiveness of such interventions on HPA-axis (i.e., cortisol) and cardiovascular (i.e., blood pressure (BP) and heart rate (HR)/heart rate variability (HRV)) parameters of stress in adolescents, and examined moderators of effectiveness. The search resulted in the inclusion of $k = 9$ studies for cortisol, $k = 16$ studies for BP, and $k = 20$ studies for HR/HRV. The results indicated a significant small overall effect on reducing BP, but no significant effect for HR/HRV. For cortisol, large methodological variation in the few primary studies did not allow for quantitative analyses, but a qualitative review demonstrated inconsistent results. For BP and HR/HRV, larger effects were observed for intervention programs with a mindfulness and/or meditation component, for interventions without a cognitive-behavioral component and for interventions with a higher intensity. Providing adolescents with techniques to improve indicators of physiological stress may prevent emerging mental health problems.

Keywords: Physiological stress; Meta-Analysis; Adolescents; School-based Intervention Programs.

INTRODUCTION

Worldwide, stress seems to be a notable problem for children, adolescents, and adults (Klinger et al., 2015; Schaufeli et al., 2009; Valizadeh et al., 2012). Stress is the condition or feeling that results when the demands of a situation exceed the personal, psychological or social resources of an individual (Lazarus, 1966). In adolescence, a period characterized by psychosocial and physiological changes and increased stress-sensitivity (Romeo, 2013; van den Bos et al., 2014), high levels of stress are associated with various negative outcomes, including reduced academic performance (Arsenio & Loria, 2014; Kaplan, Liu, & Kaplan, 2005; Liu & Lu, 2011) and mental health problems, such as depression and anxiety (de Bruin et al., 2018; Jayanthi et al., 2015; Snyder et al., 2017; Walburg, 2014). In order to prevent adverse outcomes, it is important to address heightened stress levels during adolescence.

Perceived stress often reflects psychological stress, with symptoms such as worrying, exhaustion, and concentration problems (Schraml et al., 2011; Valizadeh et al., 2012). At a physiological level, situations appraised as threatening or challenging, evoke a stress response. Two major systems are responsible for the stress response, respectively the autonomic nervous system (ANS) and the hypothalamic pituitary adrenal (HPA) axis (Charmandari et al., 2005; Romeo, 2013). In response to a stressor, the first system triggers the fight-or-flight response through the sympathetic nervous system (SNS) and the adrenal glands, activating involuntary body functions such as breathing, blood pressure (BP), and heartbeat. Physiological changes, including increased systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiratory rate (Charmandari et al., 2005; Jezova et al., 2004), ensure that an individual is alert and attentive and can quickly respond to the stressor. After the stressor has passed, the body returns to its normal state through the parasympathetic nervous system (PNS) (Charmandari et al., 2005). Heart rate variability (HRV), which is the variation over time of the period between heartbeats, is an indicator of stress that reflects the balance between sympathetic and parasympathetic activity (Acharya et al., 2006). The second (slower) system (i.e., the HPA axis), regulates the release of the hormone cortisol that influences many bodily functions, including the immune system, the body's metabolism, and the regulation of mood and emotions (Tsigos & Chrousos, 2002), necessary for responding to stressful situations (Nesse et al., 2016). Chronic stress can dysregulate the stress system by persistently activating the SNS and HPA-axis, causing the body to stay in a constant state of alertness (i.e., "fight-or-flight response") (Charmandari et al., 2005). Moreover, as a result of chronic

stress, the negative feedback mechanism that controls the stress response fails to work. Consequently, the stress-induced production of cortisol is not stopped, causing levels of physiological stress to remain high (Mariotti, 2015). As a dysregulated stress system results in diverse negative consequences, including metabolic, autoimmune, cardiovascular, and psychiatric disorders (Charmandari et al., 2005; Miller & O'Callaghan, 2002), it is important to intervene at an early stage to improve ANS and HPA-axis functioning.

Various intervention programs have been developed to address heightened stress levels in adolescents, offering different approaches to reduce stress. Some of these programs target stress reduction directly, whereas others address stress reduction as an indirect or secondary program target. Often used approaches include mindfulness, meditation, relaxation exercises, and cognitive-behavioral techniques (Rew et al., 2014). Although these approaches are commonly used as a form of stress management, the neurobiological effects of such programs are still not clearly understood (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Bauer, 2015; Pascoe & Crewther, 2016). Recent reviews in diverse populations – community and clinical samples involving youth and adults – showed that mindfulness, meditation, and yoga interventions can improve HPA-axis and cardiovascular parameters of stress, manifested in reductions in cortisol, HR, SBP, and DBP (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Bauer, 2015; Pascoe & Crewther, 2016) and increased HRV (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017). Yet, only a limited number of studies targeted adolescents, who are particularly vulnerable to stress and the adverse effects of prolonged stress (Romeo, 2013), and may, therefore, be an important target group. In particular, school-based intervention programs are of interest to examine, as schools are an important environment for adolescents' cognitive, social, and emotional development (Roeser et al., 2000), and provide a promising domain for low-threshold care (Stephan et al., 2007). Previous reviews demonstrated that school-based intervention programs reduced stress (Kraag et al., 2006; Rew et al., 2014; van Loon et al., 2020). However, these reviews primarily focused on psychological stress. Overall, a synthesis on the effects of intervention programs on physiological parameters of stress is lacking, in particular for school-based intervention programs in adolescents. Moreover, when examining the effectiveness of school-based intervention programs on stress, physiological stress should not be ignored given the negative consequences of a dysregulated stress system (Charmandari et al., 2005; Miller & O'Callaghan, 2002), including mental health problems such as anxiety and depression (Romeo, 2013). The current study, therefore,

aims to investigate the effectiveness of school-based intervention programs promoting psychosocial functioning on indicators of physiological stress in adolescents.

Previous research demonstrated that various characteristics influenced the effectiveness of school-based intervention programs on stress outcomes, including type of intervention (Feiss et al., 2019; van Loon et al., 2020) and study quality (Kraag et al., 2006). In order to detect which interventions or components are most effective in improving HPA-axis and cardiovascular parameters of stress and which subgroups benefit the most (Kraemer et al., 2002), it is important to investigate moderators. We therefore selected several intervention, sample, and study characteristics as moderators of program effectiveness, based on previous meta-analyses investigating the effects of intervention programs in adolescents.

In terms of intervention characteristics, program intensity might moderate the effectiveness, since larger effects on depressive symptoms have been found for depression prevention programs with shorter durations (i.e., less than 12 hours) (Stice et al., 2009). Furthermore, content of the intervention might moderate effectiveness, as larger effects on stress outcomes have been found for school-based programs that taught problem solving and emotional coping skills compared to relaxation techniques (Kraag et al., 2006).

In addition, several sample characteristics could influence the effectiveness of school-based programs on physiological stress, including age, gender, ethnicity, and type of intervention. Larger effects for depressive symptoms have been found for samples with older adolescents, a higher proportion of females, and more participants from ethnic minorities (Stice et al., 2009), and for targeted and selected high-risk samples as opposed to non-selected, community samples (Feiss et al., 2019; Stice et al., 2009; van Loon et al., 2020).

Lastly, study characteristics might moderate the effectiveness, for instance publication year, since recent publications are more likely to report null-results (Kaplan & Irvin, 2015). Moreover, in earlier meta-analyses examining the effects of intervention programs in adolescents, larger effects were observed for lower versus higher quality studies (Kraag et al., 2006), for studies with quasi-experimental designs compared to randomized controlled trials (RCTs) (Suter & Bruns, 2009), for active versus passive control groups

(Feiss et al., 2019), and for follow-up compared to post-intervention measurements (van Loon et al., 2020), demonstrating that these characteristics require attention.

In the present study, we aimed to investigate the effectiveness of school-based intervention programs on HPA-axis and cardiovascular parameters of stress in adolescents. In particular, we examined the effects on cortisol, BP (i.e., SBP and DBP), and HR/HRV (i.e., HR, pulse rate and HRV (low frequency (LF), high frequency (HF) and coherence)). We expected that school-based intervention programs would reduce cortisol, BP, and HR (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Bauer, 2015), while HRV was expected to increase (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017). In addition, we examined which intervention (i.e., components, intensity), sample (i.e., target group, gender, minority background, and age), and study characteristics (i.e., type of HR and BP measurement, type of stress outcome, publication year, study design, type of comparison condition, timing of outcome measurement, and study quality) moderate the effectiveness.

METHODS

Selection criteria

In the current study, studies were included if the following inclusion criteria were met: 1) studies evaluating the effectiveness of a school-based intervention program promoting psychosocial functioning (including stress reduction, mental health or coping skills), 2) studies had at least one physiological stress-related outcome (i.e., cortisol, SBP, DBP, HR, pulse rate or HRV), 3) studies had to target adolescents (sample between 10 and 18 years old at the start of the intervention), 4) studies had to compare an experimental group with a control group, 5) studies had to have a pre-intervention physiological measurement and a post- and/or follow-up physiological measurement in one of the domains of interest (i.e., cortisol, BP, HR or HRV), 6) the manuscript had to be written in English, and 7) studies had to report sufficient statistics for performing a meta-analysis. Studies evaluating an intervention that primarily focused on improving physical health and only aimed to promote psychosocial functioning by improving physical health through physical activity or exercise were excluded.

Search strategy

Relevant publications were identified using the search engines Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, Education Resources Information Center (ERIC), PsycINFO, and Cochrane Central Register of Controlled Trials (CENTRAL), with the search period up until May 2020. The search strings were “intervention* or program*” in combination with “stress or autonomic nervous system or ANS or sympathetic nervous system or SNS or parasympathetic nervous system or PNS or hypothalamus-pituitary-adrenal axis or hypothalamic pituitary adrenal axis or HPA-axis or HPA axis or cortisol or blood pressure or pulse rate or heart rate or variability” in combination with “adolesc* or child or children or youth” in combination with “controlled clinical trial or controlled trial or clinical trial or random* or experiment* or comparison group* or controls or control condition* or control group* or control subject* or no treatment group* or waiting list or wait list or waitlist or treatment as usual or care as usual” in combination with “school*”. Additionally, not statements (i.e., oxidative stress, distress syndrome, parenting stress, immunization, vaccination, venipuncture, animals, infants, toddlers, preschool, kindergarten, pregnancy, neonatal, prenatal, study protocols, reviews and meta-analyses) were used to exclude studies that did not fit the inclusion criteria. Search hits were subjected to a first screening based on title and abstract, performed by the first author. Hits that were deemed eligible for inclusion, were subjected to a second screening, based on full-text, by the first author. A subset of hits of the first and second screening (13%) was also screened by the third author, which revealed no discrepancies. Google Scholar was used to check the first 100 hits for grey literature (i.e., unpublished research) and missing relevant publications, and we conducted a manual search through the reference lists of the included publications and relevant reviews (Feiss et al., 2019; Kraag et al., 2006; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Bauer, 2015; Pascoe & Crewther, 2016; Rew et al., 2014; van Loon et al., 2020). If a manuscript that seemed relevant did not provide the statistics needed to calculate an effect size or did not report data of interest, authors were contacted to provide the missing information.

Coding of studies

Study characteristics, outcome variables, and moderators were registered using a detailed coding sheet. All studies were coded by the first author. The third author coded a subsample of studies (i.e., double coded studies) and responses of both researchers were compared (inter-rater reliability (IRR) was 87% for a subsample of 13% of the studies). Effect sizes were coded for three categories of parameters of physiological stress: cortisol

(reflecting HPA-axis functioning), BP (i.e., SBP and DBP, reflecting ANS functioning) and HR/HRV (i.e., HR, pulse rate, and HRV, reflecting ANS activity). We included studies that investigated basal functioning (i.e., measurements during a resting period), ambulatory monitoring (i.e., 24-h measurements at regular intervals reflecting activity of everyday life), and stress reactivity (i.e., responses to a stress inducing task, including stress reactivity and recovery). Stress reactivity was based on difference scores (Allen et al., 2014; Linden et al., 1997), calculated by subtracting pre-stressor or baseline levels from levels during anticipation and/or performance of the stress task. Stress recovery was calculated by subtracting levels during performance of the stress task from recovery levels (i.e., after completion of the stress task) (Kudielka et al., 2004). A reduction from baseline to post-intervention or follow-up measurement reflected an improvement for the parameters cortisol, SBP, DBP, HR, and pulse rate, while an increase from baseline to post-intervention or follow-up measurement reflected an improvement for the parameter HRV (i.e., HRV and the components LF, HF, and coherence), for both basal functioning and ambulatory monitoring, as well as stress reactivity. High frequency HRV reflects PNS activity, while overall HRV, coherence, and LF reflect both sympathetic and parasympathetic activity. An increased HRV therefore indicates a more balanced and coherent (i.e., healthy) system (Acharya et al., 2006; McCraty et al., 2009).

The following characteristics were coded as moderators (i.e., intervention, sample and study characteristics).

Intervention characteristics were whether or not the intervention included specific stress reduction components, i.e., mindfulness and/or meditation (yes or no), relaxation exercises (yes or no), yoga (yes or no), and cognitive-behavioral techniques (yes or no), and intensity of the intervention (session duration multiplied by the frequency of sessions, analyzed as a continuous variable).

Sample characteristics were target group (non-selected versus selected student samples, with selected students defined as included based on self-selection or screening), percentage of boys (as a continuous variable), percentage of minorities (i.e., non-Caucasian, analyzed as a continuous variable), and mean age of the adolescents (as a continuous variable).

Study characteristics were type of HR measurement (heart or pulse rate vs. HRV), type of BP measure (SBP vs. DBP), type of stress outcome (basal functioning, stress

reactivity, or ambulatory monitoring), publication year, study design ((cluster) RCT or quasi-experimental study), type of comparison condition (passive control versus active control), timing of outcome measurement (at post-intervention or at follow-up), and study quality (as a continuous variable). Study quality was assessed using the Quality Assessment Tool for Quantitative Studies (Thomas et al., 2004). Six variables were used, including selection bias, study design, confounders, blinding, validity of data collection methods, and withdrawals and dropouts. Using these variables – each scored with 0 (missing/not accounted for), 1 (somewhat accounted for) or 2 (accounted for) – a total study quality score was calculated (with a range of 0-12 per study).

Analysis of effect sizes

An online effect size calculator (Wilson, n.d.) was used to calculate Cohen's d 's for each effect size, indicating the effectiveness of school-based intervention programs on physiological parameters of stress, based on the difference between adolescents receiving an intervention program relative to adolescents in a control group. An improvement favoring the intervention group over the control group was expressed in a positive effect size. Both pre- and post-intervention or follow-up measurement group differences were computed and pre-measurements d 's were subtracted from post-intervention or follow-up measurement d 's to take into account baseline differences between groups (e.g., van der Stouwe et al., 2014). For instance, a larger reduction in BP from baseline to post-intervention for the intervention group compared to the control group reflects intervention effectiveness and is expressed in a positive Cohen's d . Conversely, for HRV, a larger increase from baseline to post-intervention for the intervention group compared to the control group reflects intervention effectiveness (i.e., expressed in a positive Cohen's d). For most of the cases, Cohen's d was calculated based on means and standard deviations (SD) or mean difference scores. When those were not reported (35.8% of the total number of effect sizes), Cohen's d was calculated based on least-square or marginal means and standard errors (SE). Some effect sizes were calculated on transformed data, including log transformations, slopes, and area under the curve (9.9% of the total number of effect sizes). According to Cohen (Cohen, 1988), a small effect size was considered $d = 0.20$, a moderate effect size $d = 0.50$, and a large effect size $d = 0.80$. For categorical moderators dummy variables were computed, and continuous moderators were centered around their mean.

Overall effect size and moderator analyses were conducted with a three-level meta-analytic model in R (Assink & Wibbelink, 2016), taking into account the dependency

of multiple effect sizes from one study (van den Noortgate et al., 2013). The first level included the sampling variance of each effect size (level 1), the second included the within-study variance of effect sizes of the same study (level 2), and the third included the between-study variance of effect sizes from different studies (level 3). An intercept-only model was used to estimate the overall effect. Extreme effect sizes (interquartile range (IQR) > 3) (Elbaum et al., 2000) were adjusted by winsorizing them (i.e., replacing the outlier by the lowest or highest score within the normal range) (Spruit et al., 2020). Significant heterogeneity was assessed by performing log-likelihood tests on level 2 (variance within studies) and level 3 (variance between studies). Moderator analyses were performed if there was significant heterogeneity for at least one of the levels, by including the potential moderators in the three-level model (Assink & Wibbelink, 2016).

Publication bias

When conducting meta-analyses, it is important to take into account the influence of publication bias (i.e., studies with positive results are more likely to be published compared to studies with negative or non-significant results). We examined indicators of publication bias by calculating the fail-safe N (i.e., if the fail-safe N exceeds the critical value, calculated by the formula $5 \times k + 10$, no publication bias is indicated) (Rosenthal, 1979), by visually exploring funnel plots, and conducting a multilevel analysis with the sampling variance as a moderator. In addition, we performed trim and fill analyses to examine asymmetry and the effect of missing effect sizes on the results (Duval & Tweedie, 2000b, 2000a).

RESULTS

Study selection

As displayed in the flowchart (Figure 3.1), the electronic search identified 2,329 unique hits for all databases after the removal of duplicates. After first selection by screening the title and abstract of the publications, 172 studies were potentially eligible. After full text screening, 19 studies met the inclusion criteria. Seven additional manuscripts seemed relevant, but were excluded because they did not include sufficient statistics to calculate an effect size and authors could not provide the missing data. Of the 19 included studies, authors from five studies provided additional information. The alternative search yielded 11 additional studies, which resulted in a final number of $k = 30$ included studies and $N = 162$ effect sizes for all physiological stress outcomes, based on a total of $N =$

4460 participants, with $N = 2634$ participants in the intervention group and $N = 1826$ participants in the control group. Details of the selected studies are provided in Table 3.1.

Figure 3.1 Flow chart

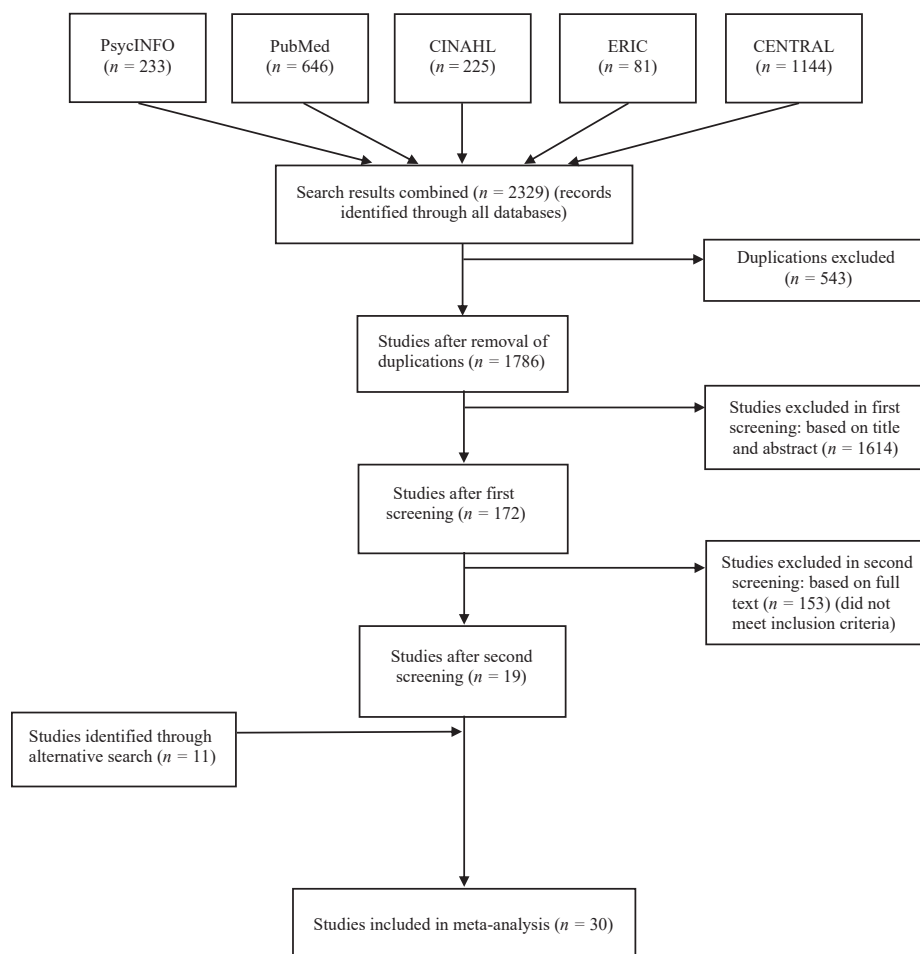


Table 3.1 Detailed description of the selected studies

Reference	N	Mean age, % boys, ethnicity ^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences ^b
Barnes et al. (2001)	33	16.6, 54% boys, 97% minorities	Transcendental meditation (n = 15)	Lifestyle education (n = 18)	RCT	Screened (high SBP)	Resting SBP, DBP, HR (supine position, relaxed for 15 min [three measurements]) SBP, DBP, HR (during 10-min car-driving and social stressor [readings every other minute])	Lower resting SBP, decreases in SBP and HR reactivity (car stressor) and SBP reactivity (social stressor) at post-intervention
Barnes et al. (2004a)	100	16.2, 63% boys, 100% minorities	Transcendental meditation (n = 50)	Lifestyle education (n = 50)	Cluster RCT	Screened (high SBP)	Ambulatory SBP, DBP, HR (daytime, 6 AM – 11 PM [every 20 min] and nighttime, 11 PM – 6 AM [every 30 min])	Decrease in daytime SBP at post-intervention and follow-up
Barnes et al. (2004b)	73	12.3, 53% boys, 52% minorities	Concentration type meditation (n = 34)	Health education (n = 39)	Cluster RCT	Community	Resting SBP, DBP, HR (recordings for 10 min [average of last three readings]) Ambulatory SBP, DBP, HR (daytime school, 8 AM – 3 PM [every 20 min], daytime after school, 3 PM – 10 PM [every 20 min] and nighttime, 12 PM – 6 AM [every 30 min])	Decreases in resting SBP, ambulatory daytime after school SBP, DBP and HR at post-intervention

Table 3.1 (Continued)

Reference	N	Mean age, % boys, ethnicity ^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences ^b
Barnes et al. (2012)	170	15.6, 46% boys, 91% minorities	Williams LifeSkills (n = 91)	Health education (n = 79)	Cluster RCT	Community	Ambulatory SBP, DBP (daytime school, 8 AM – 3 PM [every 30 min], daytime after school, 3 PM – 10 PM [every 20 min], and nighttime, 10 PM – 6 AM [every 20 min])	None
Bayne-Smith et al. (2004)	439	16.1, 0% boys, 89% minorities	Physical Activity and Teenage Health (n = 310)	Traditional PE (n = 129)	RCT	Community	Resting SBP, DBP (two measurements after 5-15 min of rest in seated position [only second reading recorded])	Reduced SBP and DBP at post-intervention
Benson et al. (1994)	37	15.5	Health curriculum (n = 21)	Waitlist (n = 16)	RCT	Community	SBP, DBP, HR (resting baseline and during MAT)	None
Bradley et al. (2010)	98	15.3, 47% boys, 52% minorities	Heart Rhythm Coherence Biofeedback training (n = 50)	Waitlist control (n = 48)	Cluster RCT	Community	Resting HR, HRV (HF power, LF power, coherence) [continuous recordings over a 4-min resting period] HR, HRV (HF power, LF power, coherence) [continuous recordings over a 4-min stress preparation period, before SCWC task]	Reduced HR and increased HRV measures at post-intervention

Table 3.1 (Continued)

Reference	N	Mean age, % boys, ethnicity ^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences ^b
Calvete et al. (2019)	503	Grade 8 (13.6), 9 (14.6), 10 (15.8), 52% boys	Incremental Personality Theory (grade 8 <i>n</i> = 87,9 <i>n</i> = 132, 10 <i>n</i> = 44)	Educational control (grade 8 <i>n</i> = 77, 9 <i>n</i> = 125, 10 <i>n</i> = 38)	RCT	Community	Salivary cortisol (sample collected at mean time of 11:02 AM)	None (only pre- and two follow-up measurements)
Chang et al. (2013)	67	12.5, 51% boys	Laughing Qigong (<i>n</i> = 34)	Read books or did homework (<i>n</i> = 33)	Quasi-experiment	Community	Salivary cortisol (cotton swabs in mouth for 2 min) Resting HR, HRV (HF, LF), SBP, DBP (measured in supine position)	None
Ewart et al. (1987)	110	14.7, 60% boys, 61% minorities	Progressive Muscle Relaxation (<i>n</i> = 51)	Assessment only (<i>n</i> = 59)	RCT	Screened (high BP)	Resting SBP, DBP (measurements after at least 10 min rest [average of nine measurements over 20-min period])	Reduced SBP at post-intervention
Fishbein et al. (2016)	69	16.7, 46% boys, 91% minorities	Mindful Yoga (<i>n</i> = 30)	Regular classes (<i>n</i> = 39)	RCT	Self-selected	HR, HRV (pre-stressor rest, baseline during SCT with no tone, during SCT with tone, recovery period) Resting HR	None
Flores (1995)	49	12.6, 0% boys, 87% minorities	Dance for Health + health education (<i>n</i> = 26)	Usual PA (<i>n</i> = 23)	Cluster RCT	Community	Resting HR	Reduced resting HR at post-intervention

Table 3.1 (Continued)

Reference	N	Mean age, % boys, ethnicity ^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences ^b
Gregoski et al. (2011)*	166	15.0, 41% boys, 100% minorities	Breathing Awareness Meditation (n = 53); Life skills training (LST) (n = 69)	Health education control (n = 44)	Cluster RCT	Screened (high SBP)	Ambulatory SBP, DBP, HR (daytime school, 7 AM – 3 PM [every 30 min], after school, 3 PM – 10 PM [every 20 min], and nighttime, 12 AM – 7 AM [every 30 min])	Decreased daytime school and nighttime SBP (BAM) and increased daytime school HR (LST) at post-intervention
Hagins et al. (2013)	30	10.8, 57% boys, 50% minorities	Yoga (n = 15)	PE (n = 15)	RCT	Community	SBP, DBP, HR (two successive measurements after 5 min rest [mean initial rest], at halfway point and at the end of MAT or MTT [end of stressor 1 and 2], and recovery values at the end of 5 and 10 min of rest [mean recovery rest])	None
Killen et al. (1988)	1130	15.0, 100/0% boys, 31% minorities	Special intervention (boys n = 345, girls n = 267)	Control (boys n = 277, girls n = 241)	Cluster RCT	Community	Resting SBP, DBP, HR (three measurements at 1-min intervals after sitting quietly for 3 min [means of 2 nd and 3 rd measurement])	Reduced resting HR and increased DBP for boys and girls at follow-up (only pre- and follow-up measurements)

Table 3.1 (Continued)

Reference	N	Mean age, % boys, ethnicity^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences^b
Lindblad et al. (2007)	43	12.0, 47% boys	Music education (<i>n</i> = 16)	Normal curriculum (<i>n</i> = 27)	Quasi-experiment	Community	Saliva cortisol (collected by swabs, taken at awakening, 30 minutes after awakening, one hour after lunch, and before going to bed in the evening) [means log of saliva cortisol]	None
Markham (2004)	66	14.6, 73% boys, 25% minorities	Positive emotional refocusing (<i>n</i> = 41)	Waitlist (<i>n</i> = 25)	RCT	Community	Resting HRV (coherence, HF, LF) (baseline period of 7 min [pre-stressor])	None
McClendon and Scott (2018)	22	14.8, 23% boys, 100% minorities	Yoga (<i>n</i> = 11)	Indoor track (<i>n</i> = 11)	Quasi-experiment	Community	Resting HR, SBP, DBP (prior to the start of any PA)	None
Ørntoft et al. (2016)	494	11.1, 49% boys	FIFA 11 for Health (<i>n</i> = 354)	PE (<i>n</i> = 140)	Cluster RCT	Community	Resting SBP, DBP (measurements following at least 10 min of rest [average of three measurements]) Resting HR (measurements following at least 10 min of rest, 15 s intervals over entire resting period [lowest HR value])	Decreased SBP at post-intervention

Table 3.1 (Continued)

Reference	N	Mean age, % boys, ethnicity ^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences ^b
Osborne et al. (2007)	22	13.9, 39% boys	Music Performance Enhancement Program (n = 13)	Behavior exposure only (n = 9)	RCT	Screened (music anxiety)	HR (5 min prior to the start [pre-stressor], during performance (start and end), and ending 5 min after musical performance [recovery period], recorded continuously)	None
Salazar (2017)	95	15.8, 32% boys, 23% minorities	Mindfulness (n = 40)	Regular PE (n = 55)	Quasi-experiment	Self-selected	Resting PR (wait 30 sec to receive a PR reading)	Lower PR at post-intervention and follow-up
Schonert-Reichl et al. (2015)	99	10.2, 56% boys	Mindfulness-based education school-emotional learning (n = 48)	Social responsibility program (n = 51)	Cluster RCT	Community	Salivary cortisol (dental cotton roll in mouth for 1 min, collected three times within 1 day at 9 AM, 11:30 AM and 2:30 PM, relative to awakening [slope difference scores – cortisol change across the day])	Improved stress physiology at post-intervention
Sibinga et al. (2013)	30	12.5, 100% boys, 95% minorities	Mindfulness-based stress reduction (n = 19)	Health education (n = 11)	RCT	Community	Salivary cortisol (collected at two successive days at awakening, 60 min post-awakening, 2:30 PM, and bedtime [AUC _g approach])	None

Table 3.1 (Continued)

Reference	N	Mean age, % boys, ethnicity^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences^b
Sieverdes et al. (2014)	28	12.3, 43% boys, 43% minorities	Hatha Yoga (n = 14)	Music and art classes (n = 14)	RCT	Community	Resting HR (rest for 10 min [4 readings]) Resting SBP, DBP (rest for 10 min [averaging last 3 readings]) Salivary cortisol (bedtime, upon awakening, before leaving the bed and 30 and 60 min afterwards [AUC analysis])	None
Skoradal et al. (2018)	392	11.1, 53% boys	FIFA 11 for Health (n = 292)	Normal curriculum (n = 100)	Cluster RCT	Community	Resting SBP, DBP (assessments after 15-20 min rest [average of three consecutive measurements]) Resting HR (assessments after 15-20 min rest [lowest HR recording])	Decreased SBP at post-intervention
Telles and Srinivas (1998)	24	14.1	Yoga (n = 12)	PA (gardening) (n = 12)	Cluster RCT	Screened (impaired vision)	Resting HR (assessments for 10 min after an initial 15-min period of rest [counting the QRS complexes in successive 60-sec epochs, continuously]) Salivary cortisol	None
Tomette (2015)	17	16.0, 36% boys, 63% minorities	Healthy Living (n = 11)	Chemistry course (n = 6)	Quasi-experiment	Self-selected	Salivary cortisol	Increased salivary cortisol at post-intervention

Table 3.1 (Continued)

Reference	N	Mean age, % boys, ethnicity ^a	Intervention	Comparison group	Study design	Target group	Stress outcomes	Significant differences ^b
Weigensberg et al. (2009)	12	16.0, 50% boys, 100% minorities	Interactive guided imagery (n = 6)	Nonintervention control group (n = 6)	RCT	Screened (overweight)	Salivary cortisol (cotton swab in mouth for 2 min [samples collected at beginning (4 PM) and end of each session (5.30 PM)])	Decreases in salivary cortisol from pre- to post sessions
Wright et al. (2011)*	121	15.0, 41% boys, 100% minorities	Breathing awareness meditation (n = 35), Life skills training (n = 42)	Health education (n=44)	Cluster/RCT	Screened (high SBP)	Ambulatory SBP, DBP, HR (24-hour)	None (only pre- and follow-up measurements)
Yoo et al. (2016)	42	10.0, 48% boys	Mind-subtraction meditation (n = 23)	Reading sessions (n = 19)	Quasi-experiment	Community	Salivary cortisol (collection during afternoon hours of 2 to 4 [within one minute intervals, participants spat three times in cups])	Lowered salivary cortisol at post-intervention

Note. AUC = area under the curve, AUCg = Area-under the curve with respect to ground, DBP = Diastolic Blood Pressure, HR = Heart Rate, HRV = Heart Rate Variability, HF = high frequency, LF = low frequency, MAT = Mental Arithmetic Task, MTT = Mirror Tracing Task, PA = physical activity, PE = physical education, PR = Pulse Rate, RCT = Randomized Controlled Trial, SBP = Systolic Blood Pressure, SCT = Stroop-Change Task, SCW = Stroop Color-Word task, VLF = very low frequency.

*Articles have overlapping samples (i.e., in analyses defined as same sample), sample size of Wright et al., (2011) is not included in the total sample size.

^a Percentage of minorities (i.e., non-Caucasian); ^b Significant differences reported in the included studies (favoring the intervention group over the control group)

Characteristics of the included studies investigating cortisol

Cortisol was reported in $k = 9$ studies with $N = 17$ effect sizes. Included studies were issued between 2007 and 2019 and only one study was not published (i.e., dissertation). The average age ranged between 10.0 and 16.0 years with a mean age of 13.2 years. The mean percentage of boys was 53.4% and the mean percentage of minorities was 75.3% (based on 4 studies). The study quality ranged from 1 to 10, with a mean score of 6.5. The intervention programs had an average duration of 10 weeks, and the intensity of the programs ranged from 60 to 4040 minutes (with a mean of 1040 minutes). All studies measured cortisol during a resting period (no studies with a stress inducing task or ambulatory monitoring). Most studies had a cognitive-behavioral component ($n = 6$), a relaxation component ($n = 5$) or a mindfulness/mediation component ($n = 4$) in their intervention, while only two studies included a yoga component. Few studies reported that the intervention included homework ($n = 2$), the other studies researched interventions that did not include homework or did not report about this intervention characteristic ($n = 7$). Two studies were performed in selected student samples (one based on screening and one based on self-selection), the other studies were performed in non-selected community samples ($n = 7$). Cortisol was measured and analyzed in various ways. Some studies collected cortisol samples only once a day ($n = 5$), while others collected samples multiple times a day ($n = 4$), for instance at awakening, after awakening, and bedtime. The timing of the measurements also differed, $n = 4$ studies collected samples that were taken in the morning (after waking up), $n = 2$ studies during lunchtime, $n = 5$ studies in the afternoon, and $n = 3$ studies in the evening (before going to bed). Two studies did not give information about the timing of sample collection. Researchers used cotton wads/swabs to measure cortisol ($n = 4$), let students spit in cups ($n = 2$) or vials ($n = 2$), or did not provide information ($n = 1$). Furthermore, different ways to analyze the data were reported, including using means and *SDs* or *SEs* of cortisol levels ($n = 5$), area under the curve analyses ($n = 2$), log transformations ($n = 1$), or slope difference scores ($n = 1$).

Because cortisol measurements varied considerably across the few included cortisol studies ($k = 9$), in terms of sample collection (e.g., cotton swabs, spitting in cups), number of samples, timing of sample collection (e.g., morning, afternoon), and analytic approach (e.g., area under the curve, slopes), it was not considered meaningful to quantitatively analyze the cortisol findings. Hence, we did not conduct a multilevel meta-analysis for cortisol, but instead provided an overview of study findings.

Characteristics of the included studies investigating blood pressure

Blood pressure was reported in $k = 16$ studies and $N = 84$ effect sizes. Included studies were issued between 1987 and 2018 and all studies were published (i.e., no dissertations). The average age ranged between 10.8 and 16.6 years with a mean age of 14.3 years. The mean percentage of boys was 48.8% (based on 80 effect sizes) and the mean percentage of minorities was 78.7% (based on 74 effect sizes). The study quality ranged from 3 to 11, with a mean score of 8.4. The intervention programs had an average duration of 11 weeks, and the intensity of the programs ranged from 360 to 3360 minutes (with a mean of 1500 minutes). Some studies reported that the researched intervention included homework ($n = 8$), the other studies focused on interventions that did not include homework or did not report about this intervention characteristic ($n = 12$). Only five studies selected students based on screening, and included students with a high BP (four studies specifically focused on high SBP). The other studies ($n = 11$) were performed in non-selected community samples.

Characteristics of the included studies investigating heart rate/HRV

Heart rate/HRV was reported in $k = 20$ studies and $N = 61$ effect sizes. Included studies were issued between 1988 and 2018 and only two studies were not published (i.e., dissertations). The average age ranged between 10.8 and 16.7 years with a mean age of 14.4 years. The mean percentage of boys was 48.2% (based on 58 effect sizes) and the mean percentage of minorities was 69.3% (based on 48 effect sizes). The study quality ranged from 1 to 11, with a mean score of 6.7. The intervention programs had an average duration of 12 weeks, and the intensity of the programs ranged from 210 to 3360 minutes (with a mean of 1400 minutes). Most studies reported that the intervention included homework ($n = 10$), the other studies focused on interventions that did not include homework or did not report about this intervention characteristic ($n = 6$). The majority of the studies ($n = 12$) were performed in non-selected community samples, samples of the other studies included students based on self-selection ($n = 2$) or screening based on high SBP ($n = 4$), impaired vision ($n = 1$) or music anxiety ($n = 1$).

Overall effects

Based on review, overall effectiveness of school-based intervention programs on cortisol was not indicated. Results of the primary studies for cortisol were inconsistent. On the one hand, three studies demonstrated that school-based intervention programs were effective in improving cortisol at post-intervention, indicated by lowered cortisol levels (i.e., measured once in the afternoon in both studies) and a steep slope diurnal

pattern (i.e., measured multiple times during the day). On the other hand, one study demonstrated increased mean cortisol levels at post-intervention (i.e., measured once). Five studies showed that school-based intervention programs were not effective in improving cortisol levels at post-intervention and follow-up (i.e., two studies measured cortisol once, two studies measured cortisol multiple times a day and one study measured cortisol multiple times over two days).

The multilevel meta-analyses for the effectiveness of school-based intervention programs on blood pressure yielded a significant yet small overall effect ($d = 0.173$, $SE = 0.069$, $p = .014$). Overall, school-based intervention programs were effective in reducing BP. Five outliers were winsorized. There was significant within-study variance ($p < .0001$), demonstrating heterogeneity.

The overall effect size for HR/HRV was not significant ($d = 0.134$, $SE = 0.105$, $p = .209$). Three outliers were winsorized. There was significant within-study ($p < .0001$) and between-study variance ($p < .05$), demonstrating heterogeneity. The overall effect sizes are reported in Table 3.2.

Table 3.2 Result for the overall mean effect sizes

Outcome	<i>N</i> studies	<i>NES</i>	<i>N</i> participants	Mean <i>d</i> (<i>SE</i>)	95% CI	<i>t</i> -value	LRT	% var	Fail-safe <i>N</i> (<i>cv</i>)
Blood pressure	16 (16)	84	3291	0.173 (0.069)	0.035- 0.311	2.498*	Level 2: 215.58*** Level 3: 0.20	Level 1: 11.3% Level 2: 85.5% Level 3: 3.2%	2117 (90)
Heart rate	20 (20)	61	2995	0.134 (0.105)	-0.077- 0.344	1.270	Level 2: 159.98*** Level 3: 5.32*	Level 1: 11.3% Level 2: 69.7% Level 3: 18.9%	281 (110)

Note. *N* studies (samples) = number of studies and independent samples; *NES* = number of effect sizes; mean *d* = mean effect size Cohen's *d*; *SE* = standard error; CI = confidence interval, *t*-value = difference in mean *d* with zero; LRT = likelihood-ratio test for level 2 and level 3; % var = percentage of variance explained; Fail-safe *N* (*cv*) = Fail-safe number and Rosenthal's critical value in parentheses.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Sensitivity analyses

To account for the possible influence of specific studies or effect sizes, we repeated the meta-analyses after removal of potential influences. First, we repeated the meta-analyses after removal of the stress recovery effect sizes for BP and HR/HRV, as stress recovery is less clearly understood in relation to stress reactivity (i.e., there is no consensus on how to operationalize stress recovery as indicator of stress) (Linden et al., 1997). Results yielded similar results for BP ($d = 0.234$, $SE = 0.064$, $p < .001$) and HR/HRV ($d = 0.153$, $SE = 0.112$, $p = .179$). Second, we repeated the meta-analyses after removal of eight reactivity effect sizes (for both BP and HR/HRV). These effect sizes were generated using baseline or recovery levels that were also used to calculate another effect size in the same study, and were excluded to account for overlap between effect sizes within studies. Results were similar for BP ($d = 0.209$, $SE = 0.063$, $p = .001$) and HR/HRV ($d = 0.141$, $SE = 0.117$, $p = .232$).

Publication bias

For BP, the Rosenthal fail-safe test demonstrated there was no indication of publication bias. However, the funnel plot appeared to be slightly asymmetrical and the regression analysis of the sampling variance was significant ($p < .05$). Nevertheless, the trim and fill analysis did not reveal any missing effect sizes, suggesting that there was no indication of publication bias.

For HR/HRV, the Rosenthal fail-safe test demonstrated that there was no indication of publication bias. Moreover, the funnel plot appeared to be symmetrical and the regression analysis of the sampling variance was not significant ($p = .801$). Likewise, the trim and fill analysis revealed no missing effects sizes, suggesting that there was no indication of publication bias.

Moderator analyses

Table 3.3 and 3.4 report the results of the moderator analyses on cardiovascular (i.e., BP and HR/HRV) parameters of stress. Only significant results are described here.

Intervention characteristics. For BP, components and intensity moderated the effects. Larger effects were found for intervention programs with a mindfulness and/or meditation component compared to programs without this component and for interventions with a relaxation component versus interventions without a relaxation component. Interventions with a yoga component were not effective, as opposed to interventions without a yoga component. Smaller effects were observed for intervention

programs with a cognitive-behavioral component versus interventions without this component. Additionally, larger effects were found for interventions with a higher intensity. For HR/HRV, significant positive effects were found for intervention programs with a mindfulness and/or meditation component, but not for intervention programs without this component. Furthermore, interventions with a cognitive-behavioral component were not effective compared to interventions without this component. In addition, larger effects were observed for interventions with a higher intensity.

Sample characteristics. There were no significant moderators for HR/HRV and BP.

Study characteristics. For BP, significant effects were found for (cluster) RCTs, but not for quasi-experimental designs.

Table 3.3 Results for the moderator analyses on blood pressure

Moderator	N samples	MES	B ₀ (95% CI)	t ₀	B ₁ (95% CI)	t ₁	F (df ₁ , df ₂)	P
<i>Intervention characteristics</i>								
Component mindfulness								
Yes (RC)	6	52	0.859 (0.489-1.230)	4.619***			F (1, 82) = 46.824	<.001
No	10	32	-0.335 (-0.663--0.008)	-2.038*	-1.195 (-1.542--0.848)	-6.843***		<.001
Component relaxation								
Yes (RC)	11	66	0.531 (0.151-0.911)	2.778**			F (1, 82) = 44.734	<.001
No	5	18	-0.702 (-1.134--0.269)	-3.227**	-1.233 (-1.599--0.866)	-6.693***		
Component yoga								
Yes (RC)	3	14	-0.271 (-0.602-0.061)	-1.623		2.936**	F (1, 82) = 8.617	.004
No	13	70	0.254 (0.125-0.383)	3.925***	0.525 (0.169-0.881)		F (1, 82) = 44.734	<.001
Component cognitive-behavioral								
Yes (RC)	8	36	-0.463 (-0.866--0.060)	-2.285*				
No	8	48	0.757 (0.344-1.170)	3.647***	1.220 (0.857-1.583)	6.688***		
Intensity (continuous)	16	84	0.209 (-0.211-0.629)	0.989	0.001 (0.001-0.001)	6.322***	F (1, 82) = 39.972	<.001
<i>Sample characteristics</i>								
Target group								
Selected (RC)	5	36	0.252 (0.041-0.463)	2.372*			F (1, 82) = 0.862	.356
Non-selected	11	48	0.124 (-0.050-0.298)	1.414	-0.128 (-0.402-0.146)	-0.928		
% boys (continuous)	15	80	0.180 (0.035-0.324)	2.467*	-0.002 (-0.010-0.006)	-0.409	F (1, 78) = 0.167	.684
% minorities (continuous)	12	74	0.190 (0.052-0.327)	2.754**	0.005 (-0.000-0.011)	1.838	F (1, 72) = 3.379	.070
Mean age (continuous)	16	84	0.180 (0.057-0.304)	2.906**	0.063 (-0.002-0.128)	1.916	F (1, 82) = 3.672	.059

Table 3.3 (Continued)

Moderator	N samples	NES	B_0 (95% CI)	t_0	B_1 (95% CI)	t_1	F (df ₁ , df ₂)	p
<i>Study characteristics</i>								
Type of BP measurement								
SBP (RC)	16	42	0.241 (0.056-0.425)	2.591*			$F(1, 82) = 1.186$	.279
DBP	16	42	0.106 (-0.079-0.290)	1.138	-0.135 (-0.381-0.112)	-1.089		
Stress outcome measure								
Basal functioning (RC)	12	28	0.132 (-0.082-0.346)	1.227				
Ambulatory monitoring	5	42	0.286 (0.116-0.455)	3.354**	0.154 (-0.119-0.427)	1.120		
Stress reactivity	3	14	-0.076 (-0.407-0.256)	-0.453	-0.208 (-0.602-0.187)	-1.046		
Publication year (continuous)	16	84	0.169 (0.026-0.313)	2.346*	-0.001 (-0.017-0.015)	-0.121	$F(1, 82) = 0.015$	.904
Study design								
(Cluster) RCT (RC)	14	80	0.212 (0.082-0.342)	3.235**			$F(1, 82) = 5.488$	.022
Quasi-experimental	2	4	-0.521 (-1.130-0.088)	-1.703	-0.733 (-1.356--0.111)	-2.343*		
Comparison condition								
Passive control (RC)	6	16	0.048 (-0.240-0.336)	0.333			$F(1, 82) = 0.986$	.324
Active control	10	68	0.211 (0.058-0.364)	2.743**	0.163 (-0.163-0.489)	0.993		
Timing of outcome measurement								
Post-intervention	10	58	0.198 (0.032-0.364)	2.371*			$F(1, 82) = 0.605$	.439
Follow-up	6	22	0.085 (-0.169-0.340)	0.667	-0.112 (-0.400-0.175)	-0.778		
Study quality (continuous)	16	84	0.176 (0.036-0.316)	2.505*	0.022 (-0.033-0.077)	0.801	$F(1, 82) = 0.642$	.425

Note. N samples = number of independent samples; NES = number of effect sizes; B_0 = mean effect size Cohen's d ; CI = confidence interval; B_1 = estimated regression coefficient; t -values = difference in mean d with zero; F -value = omnibus test of regression coefficients; p = p -value of omnibus test; RC = reference category; SBP = systolic blood pressure; DBP = diastolic blood pressure; RCT = randomized controlled trial.

.05. ** $p < .01$. *** $p < .001$.

Table 3.4 Results for the moderator analyses on heart rate

Moderator	<i>N</i> samples	<i>MES</i>	<i>B</i> ₀ (95% CI)	<i>t</i> ₀	<i>B</i> ₁ (95% CI)	<i>t</i> ₁	<i>F</i> (<i>df</i> ₁ , <i>df</i> ₂)	<i>P</i>
<i>Intervention characteristics</i>								
Component mindfulness								
Yes (RC)	7	28	0.391 (0.059-0.723)	2.359*			<i>F</i> (1, 59) = 4.219	.044
No	13	33	-0.030 (-0.316-0.255)	-0.212	-0.421 (-0.832--0.011)	-2.054*		
Component relaxation								
Yes (RC)	12	36	0.230 (-0.051-0.510)	1.639			<i>F</i> (1, 59) = 1.130	.292
No	8	25	0.012 (-0.318-0.342)	0.072	-0.218 (-0.628-0.192)	-1.063		
Component yoga								
Yes (RC)	6	16	0.187 (-0.235-0.610)	0.887			<i>F</i> (1, 59) = 0.083	.775
No	14	45	0.117 (-0.133-0.367)	0.937	-0.071 (-0.561-0.420)	-0.561		
Component cognitive-behavioral								
Yes (RC)	11	30	-0.066 (-0.341-0.209)	-0.481			<i>F</i> (1, 59) = 5.414	.023
No	9	31	0.382 (0.084-0.680)	2.569*	0.448 (0.063-0.834)	2.327*		
Intensity (continuous)	20	61	0.132 (-0.071-0.335)	1.298	0.000 (0.000-0.001)	2.999**	<i>F</i> (1, 59) = 8.996	.004
<i>Sample characteristics</i>								
Target group								
Selected (RC)	8	29	0.010 (-0.299-0.320)	0.068			<i>F</i> (1, 59) = 1.084	.302
Non-selected	12	32	0.226 (-0.049-0.501)	1.645	0.216 (-0.199-0.630)	1.041		
% boys (continuous)	18	58	0.133 (-0.094-0.360)	1.178	-0.005 (-0.018-0.007)	-0.814	<i>F</i> (1, 56) = 0.663	.419
% minorities (continuous)	14	48	0.139 (-0.112-0.389)	1.114	-0.007 (-0.016-0.001)	2.895	<i>F</i> (1, 46) = 2.895	.096
Mean age (continuous)	20	61	0.136 (-0.080-0.352)	1.259	0.005 (-0.111-0.121)	0.085	<i>F</i> (1, 59) = 0.007	.932

Table 3.4(Continued)

Moderator	N samples	NES	B_0 (95% CI)	t_0	B_1 (95% CI)	t_1	F (df ₁ , df ₂)	p
<i>Study characteristics</i>								
Type of HR measurement								
Heart or pulse rate (RC)	19	46	0.121 (-0.112-0.353)	1.039			$F(1, 59) = 0.078$	.781
HRV	4	15	0.181 (-0.218-0.580)	0.908	0.060 (-0.371-0.492)	0.279		
Stress outcome measure								
Basal functioning (RC)	16	27	0.189 (-0.081-0.458)	1.402				
Ambulatory monitoring	4	15	-0.098 (-0.525-0.329)	-0.459	-0.287 (-0.786-0.212)	-1.149		
Stress reactivity	6	19	0.204 (-0.150-0.557)	1.153	0.015 (-0.394-0.423)	0.073		
Publication year (continuous)	20	61	0.123 (-0.088-0.334)	1.164	-0.013 (-0.039-0.013)	-0.969	$F(1, 59) = 0.938$	.337
Study design								
(Cluster) RCT (RC)	17	54	0.128 (-0.103-0.358)	1.109			$F(1, 59) = 0.028$	.867
Quasi-experimental	3	7	0.181 (-0.406-0.768)	0.617	0.053 (-0.578-0.684)	0.168		
Comparison condition								
Passive control (RC)	9	30	0.124 (-0.186-0.434)	0.798			$F(1, 59) = 0.011$	.916
Active control	11	31	0.147 (-0.154-0.448)	0.975	0.023 (-0.409-0.455)	0.106		
Timing of outcome measurement								
Post-intervention (RC)	15	54	0.094 (-0.131-0.318)	0.834				
Follow-up	5	7	0.387 (-0.093-0.867)	1.614	0.294 (-0.208-0.795)	1.172		
Study quality (RC)	20	61	0.128 (-0.081-0.337)	1.228	-0.035 (-0.105-0.035)	-1.001	$F(1, 59) = 1.002$	.321

Note. N samples = number of independent samples; NES = number of effect sizes; B_0 = mean effect size Cohen's d ; CI = confidence interval; B_1 = estimated regression coefficient; t -values = difference in mean d with zero; F -value = omnibus test of regression coefficients; p = p -value of omnibus test; RC = reference category; HRV = heart rate variability; RCT = randomized controlled trial.
.05. ** $p < .01$. *** $p < .001$.

DISCUSSION

In the current study, we examined the effectiveness of school-based intervention programs in improving HPA-axis (i.e., cortisol) and cardiovascular (i.e., SBP/DBP and HR/HRV) parameters of stress in adolescents. For BP and HR/HRV, multilevel meta-analyses were conducted to investigate the effectiveness of school-based intervention programs on cardiovascular parameters of stress. This multilevel approach is favorable, as it takes into account the dependency of multiple effect sizes from the same study, allowing the inclusion of all relevant effect sizes and thus generate more power (Assink & Wibbelink, 2016). Results demonstrated that school-based intervention programs had a small overall effect on reducing BP in adolescents, while the overall effect for HR/HRV was not significant. For cortisol, we did not analyze the data using a multilevel meta-analysis due to the large variation in methodology in the small number of included primary studies. An overview of the findings of the included studies showed that cortisol results were inconsistent, likely caused by the large methodological variation. Additionally, we investigated intervention (i.e., components, intensity), sample (i.e., target group, gender, minority background, and age), and study (i.e., type of HR and BP measurement, type of stress outcome, publication year, study design, type of comparison condition, timing of outcome measurement, and study quality) characteristics as moderators of effectiveness. For BP and HR/HRV, several moderators influenced the effectiveness of school-based intervention programs. Larger effects were observed for intervention programs with a mindfulness and/or meditation component, for interventions without a cognitive-behavioral component and for interventions with a higher intensity. For BP, significant program effects were only demonstrated in (cluster) RCTs and not in studies with a quasi-experimental design. Also for BP only, larger effects were found for intervention programs with a relaxation component while programs with a yoga component were not effective compared to programs without a yoga component.

The overall finding that intervention programs are effective in improving BP is consistent with previous literature that showed improved cardiovascular parameters of stress in community and clinical samples comprising mainly adults (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Bauer, 2015). As such, the present study demonstrates that indicators of physiological stress (i.e., SBP and DBP) are also malleable by intervention programs in adolescents. In the current study, both cardiovascular parameters of stress demonstrated improvements after school-based intervention programs, although only BP showed a significant

improvement. This indicates that BP might be a more susceptible target for school-based intervention programs than HR/HRV. A previous study in healthy adults also observed significant reductions in BP, but not HR, after a slow pace breathing exercise (Pramanik et al., 2009). Likewise, another study demonstrated larger effects for SBP as opposed to HR after slow, deep breathing in patients with hypertension (Bhavanani et al., 2011), suggesting that BP might be more sensitive to change. Thus, BP seems to be an important parameter to include when studying the effectiveness of interventions to reduce stress in adolescents. That said, the absence of a significant overall effect for HR/HRV is in contrast with most previous findings based on mainly adult samples (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Bauer, 2015). This may suggest developmental differences in responsiveness to intervention programs targeting stress reduction, at least with respect to HR/HRV, that require further examination in future research. Alternatively, a methodological explanation for the non-significant overall effect for HR/HRV could be the specific intervention programs examined in relation to HR/HRV compared to BP. Characteristics of these programs (i.e., less intensive, less often consisted a mindfulness and/or meditation component), had smaller effects in the current study, and may therefore explain the diverging findings for HR/HRV. In addition, the previous meta-analytic studies that demonstrated improved HR/HRV focused predominantly on mindfulness and meditation programs (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017). Finally, the lack of a significant overall effect for HR/HRV might be the result of the smaller number of included effect sizes for this indicator, resulting in less statistical power to detect significant effects.

In the relatively small number of studies with cortisol measurement included in this review, HPA-axis functioning was measured in different ways, with variations in sample collection, number of samples, timing of sample collection, and analytic approach. Because this hampers comparability, no meta-analysis was performed for this outcome. Across the nine studies and ways of cortisol measurements, findings were inconsistent. Furthermore, the studies that showed significant intervention effects did not notably differ from the studies that demonstrated no effects (e.g., in methodology, type of intervention program). In a recent meta-analysis investigating the effects of mindfulness-based interventions on cortisol in healthy adults, it was also observed that results might have been influenced by variation in the assessment of cortisol, including sample collection strategy, total days of measurements, and indicators of assessment (Sanada et al., 2016). Salivary cortisol levels are often used as an indicator of stress, especially in

children and adolescents, because the collection of salivary samples is relatively easy and noninvasive, as well as inexpensive (Hanrahan et al., 2006). However, it must be taken into account that many factors can influence the measurement of salivary cortisol. Previous research showed that the time and location of sampling, type of assay used, and units of measurements might impact the accuracy and reliability of measurements. Future studies should take into account this complexity of cortisol measurements, and make sure that uniform procedures and methods are used to obtain cortisol levels, and that the data-collection is well documented. Before incorporating measurements of salivary cortisol, researchers must develop a rigorous protocol for sample collection, including standardizing the time for sample collection and using multiple days of measurements (Hanrahan et al., 2006; Sanada et al., 2016). In this way, results will be more comparable across studies and it will be possible to draw more accurate conclusions.

Moderator analyses demonstrated that for both BP and HR/HRV, larger effects were observed for intervention programs with a mindfulness and/or meditation component and smaller effects were found for intervention programs with a cognitive-behavioral component. For BP only, larger effects were found for intervention programs with a relaxation component. These findings contradict results of a previous meta-analysis examining the effectiveness of school programs for children and adolescents (Kraag et al., 2006), demonstrating larger effects for components to enhance problem solving and emotional coping skills compared to relaxation techniques. However, results of Kraag et al. (2006) were based on a small number of studies, examined only universal interventions and mainly reflected psychological stress. Hypothetically, cognitive-behavioral techniques may have more impact on psychological stress, and techniques as mindfulness, meditation, and relaxation might be more effective in improving physiological parameters of stress. Although the neurobiological effects of mindfulness, meditation, and relaxation techniques are not yet clearly understood, recent reviews provide evidence that they are associated with biological changes in BP and HR (Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Crewther, 2016), specifically in programs that focus on breathing (Pascoe & Crewther, 2016). A homeostatic state is characterized by relaxed breathing, and since breathing is one of the actions of the ANS that can be individually controlled, it is plausible that such techniques have more impact on improving physiological parameters of stress than cognitive-behavioral techniques (Pascoe & Crewther, 2016). Another explanation could be that some intervention programs, especially programs with a cognitive-behavioral component, first lead to changes in psychological stress, and only after some additional time lead to changes in physiological

stress. This suggests that short-term effects (i.e., post-intervention) may be less likely and smaller than long-term effects (i.e., follow-up). However, moderator analyses did not confirm this line of reasoning, as there were no differences between post-intervention and follow-up effects. Unfortunately, only few studies included follow-up measurements. To draw accurate conclusions about long-term effects on physiological parameters of stress, it is necessary that future intervention studies include both post-intervention and follow-up measurements. Previous research demonstrated that perceived stress reflects activity of the HPA-axis as well as the ANS, but only to a certain extent (Oldehinkel et al., 2011), which may explain diverging findings in terms of psychological and physiological stress. Since few intervention studies measure both psychological and physiological stress, future studies should investigate the mutual relationship between both indicators of stress, to discover their association over time. Finally, in the current study intervention programs with a cognitive-behavioral component often reflected broad and generic programs (e.g., stress management as a small part of the program, or adolescents were taught general coping skills). As such, stress reduction was often a secondary or indirect program aim, which might explain the observed smaller effects for intervention programs with a cognitive-behavioral component.

For BP only, significant effects were only observed for programs without a yoga component, and not for programs with a yoga component. This contradicts earlier research, which demonstrated that yoga practices improved regulation of the SNS (Pascoe, Thompson, & Ski, 2017; Pascoe & Bauer, 2015). However, as these results were observed in predominantly adult samples, it is possible that yoga interventions are not or less effective for adolescents in reducing physiological parameters of stress. Indeed, a previous study demonstrated that adolescents with irritable bowel syndrome benefitted less from a yoga intervention than young adults with this disorder (Evans et al., 2014), possibly related to the challenge of motivating adolescents. Future research should investigate these potential developmental differences in response to yoga interventions. Alternatively, it could be that variations in focus of yoga-interventions, such as physical postures, controlled breathing or meditation techniques, accounted for the results. Since programs that focus on breathing have been proven beneficial (Pascoe & Crewther, 2016), it is plausible that yoga programs that only involve physical postures yield smaller effects on physiological parameters of stress than programs with a predominant focus on controlled breathing and meditation. Indeed, the included studies with a yoga component (i.e., examining BP) consisted of both physical postures and controlled breathing or meditation, with physical postures as the main focus. Nevertheless, this

finding should be interpreted with caution, because it was based on a small sample (i.e., 3 studies, 14 effect sizes).

For BP and HR/HRV, larger effects were observed for intervention programs with a higher intensity. Visual inspection of the data showed that interventions with an intensity of 1000 minutes or more (at least 17 hours) were more beneficial (i.e., generated higher effect sizes). This is in contrast with Stice et al. (2009), demonstrating larger effects on depressive symptoms for prevention (i.e., coping skills) programs for children and adolescents with shorter durations. It is possible that higher intensity programs are necessary to improve physiological parameters of stress, whereas psychological effects of stress are more easily (i.e., faster) obtained, and thus require less intensive programs. In fact, in the present study, smaller effects were observed for intervention programs with a cognitive-behavioral component, and these programs were less intensive than programs without a cognitive-behavioral component. Accordingly, the importance of program intensity might correlate with the type of intervention program. Mindfulness, meditation, and relaxation techniques may need longer periods of time to master than cognitive-behavioral techniques. Hence, mindfulness, meditation, and relaxation programs that are more intensive might be more effective in improving physiological parameters of stress. Indeed, a recent review demonstrated that programs involving more hours of meditation seemed to be more beneficial than programs with fewer meditation hours (Pascoe & Crewther, 2016).

Finding only significant effects on BP for (cluster) RCTs and not for quasi-experimental designs contradicts a previous meta-analysis that investigated the effectiveness of interventions for children and adolescents with emotional and behavioral disorders (Suter & Bruns, 2009). In this meta-analysis, larger effects were demonstrated for studies with a quasi-experimental design versus RCTs, although methodological factors other than treatment allocation may have influenced the results (Suter & Bruns, 2009). Besides these considerations, the current finding that (cluster) RCTs are more effective should be interpreted with caution, because only two studies examining BP were quasi-experimental (i.e., 4 effect sizes).

Limitations and recommendations for future research

Some limitations need to be considered in this review. First, limited information was available for some of the study, sample, and intervention characteristics, including study population (i.e., rural or urban), percentage of socio-economic status, and program

integrity. This lack of information prevented us from conducting moderator analyses. In order to determine what characteristics are beneficial and which programs work for specific subsamples, we recommend future intervention studies to report sufficient information about study, sample, and intervention characteristics. For example, program integrity is very important to take into account, because non-significant or negative results might be due to incorrect program implementation instead of an ineffective program (Lane et al., 2004).

Second, methodological differences were observed for assessments of physiological parameters of stress, especially for sampling of cortisol. Differences were observed in sample collection, timing of sample collection, number of samples, and approach of analyzing the data. Future studies should be aware of methodological differences and provide detailed protocols about their data collection to account for this.

Third, studies were included that measured basal functioning, stress reactivity, and ambulatory monitoring. Although there was no significant moderator effect demonstrated for these different measures, it is possible that this influenced the effects. Also, only a small number of studies, and for cortisol not a single study, included stress reactivity. Yet, it is important that future studies also investigate reactivity, to further assess the potential of stress reduction programs to improve stress reactivity. However, as cardiovascular parameters of stress (i.e., HR and BP) are affected immediately and throughout stress exposure, while cortisol takes longer to reach peak levels (i.e., post-stress) (Allen et al., 2014; Linden et al., 1997), it is important to take these differences into account by measuring at multiple timepoints. Additionally, only some of our included studies measured HRV (i.e., 25% of the ES). Since HRV is a reliable indicator of ANS activity related to stress (Kim et al., 2018), we encourage future studies to include HRV measurements as physiological stress outcomes.

Fourth, only few studies included follow-up measurements. By including long-term assessments, potential sleeper effects (i.e., improved longer term outcomes) could be observed. For instance, previous research of an 8-week mindfulness intervention in cancer patients demonstrated linear salivary cortisol decreases over the course of the study (i.e., post-intervention, 6-month follow-up, and 12-month follow-up). Yet, linear decreases were not observed for BP and HR (Carlson et al., 2007), suggesting that the timing of physiological effects of intervention programs differs across parameters.

Further research in this area is needed to advance our understanding of the timing and sequencing of intervention effects across physiological parameters of stress.

Finally, although we found no significant differences between active and passive control conditions, one should be aware that the type of control condition can influence effect estimates of psychosocial interventions (Karlsson & Bergmark, 2015). As such, type of control condition is crucial to take into consideration when interpreting intervention effects.

Overall, to increase the knowledge on physiological effects of (school-based) intervention programs, it is crucial that researchers conduct physiological measurements in a more uniform way to improve comparability of future studies. In this way, researchers will be able to systematically determine the role of physiological stress parameters and their change as a result of intervention programs, demonstrating which programs are most beneficial. In addition, preferably, researchers should include participants from various age groups (e.g., children, adolescents, adults) and educational levels, include both physiological and psychological stress outcomes, and include measurements immediately after the intervention as well as follow-up measurements after completion of the intervention.

CONCLUSIONS

The present review demonstrated that school-based intervention programs promoting psychosocial functioning have the potential to improve ANS indicators of stress. Since chronic stress is a mental health issue among adolescents (Walburg, 2014) and a dysregulated stress system is associated with mental health problems (Charmandari et al., 2005), it is important to address heightened stress levels in adolescents and give them tools to adequately cope with stress. Previous research focused mainly on psychological stress, demonstrating that school-based intervention programs reduce adolescent psychological stress (Kraag et al., 2006; van Loon et al., 2020). The current study is a valuable addition to the literature as it demonstrates that school-based intervention programs promoting psychosocial functioning have the potential to also improve physiological parameters of stress. Future researchers should, therefore, add physiological outcomes in studies on the effectiveness of stress reducing programs. Moreover, governments and schools should be aware of the availability of such school-based intervention programs, and implement them. Particularly, to improve functioning

of the ANS, one of the major stress systems, intervention programs should include a mindfulness, meditation or relaxation component, since these components were most effective. In addition, programs with a higher intensity should be encouraged. Providing adolescents with techniques to reduce physiological stress through school-based intervention programs may prevent emerging mental health problems.



CHAPTER 4

The Effectiveness of School-Based Skills-Training Programs Promoting Mental Health in Adolescents: A Study Protocol for a Randomized Controlled Study

This chapter is adapted from:

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2019). The effectiveness of school-based skills-training programs promoting mental health in adolescents: A study protocol for a randomized controlled study. *BMC Public Health*, *19*(1), 1-12.

Author contributions:

All authors (AL, HC, SV, NS, AM, MW and JA) are steering committee members and have contributed to the design of the study. AL coordinates and AL and SV conduct the data collection during the study. AL wrote the manuscript, HC and JA provided feedback. SV, NS, AM and PW critically reviewed the manuscript. All authors have read and approved the final manuscript.

ABSTRACT

Background: Adolescence is a period of elevated stress sensitivity, which places adolescents at increased risk of developing mental health problems such as burnout, depression, anxiety, and externalizing problems. Early intervention of psychological needs and low-threshold care addressing such needs may prevent this dysfunctional development. Schools may provide an important environment to identify and address psychological needs. The aim of this protocol is to describe the design of a study aiming to evaluate the effectiveness of low-threshold school-based skills-training programs promoting the mental health of adolescents and to examine moderators of the effectiveness.

Method/design: A Randomized Controlled Trial will be conducted to examine the effectiveness of two school-based skills-training programs aiming to promote mental health by improving either skills to deal with performance anxiety or social skills. A multi-informant (i.e., students, parents, and trainers) and multi-method (i.e., questionnaires and physiological measurements) approach will be used to assess program targets (skills to deal with performance anxiety or social skills), direct program outcomes (performance or social anxiety) and mental health outcomes (i.e., stress, internalizing and externalizing problems, self-esteem and well-being), as well as specific moderators (i.e., student, parent and program characteristics, social support, perfectionism, stressful life events, perceived parental pressure, positive parenting behavior, treatment alliance and program integrity).

Discussion: The current study will provide information on the effectiveness of school-based skills-training programs. It is of crucial importance that the school environment can provide students with effective, low-threshold intervention programs to promote adolescents' daily functioning and well-being and prevent the emergence of mental health problems that negatively affect school performance.

Trial registration: Dutch Trial Register number NL7438. Registered 12 December 2018.

Keywords: Intervention; Randomized Controlled Trial; Effectiveness; School-Based Skills-Training Programs; Social Skills; Performance Anxiety; Mental Health; Stress.

BACKGROUND

Adolescence is a phase of rapid growth and development in physical and psychological domains (Christie & Viner, 2005). During adolescence many changes occur simultaneously, including puberty and the transition to high school. At the same time, adolescence is a period of increased stress sensitivity (Andersen & Teicher, 2008; Fuhrmann et al., 2015; Romeo, 2013), which contributes to adolescents' increased risk for mental health problems, such as burnout, depression, anxiety and externalizing problems (de Bruin et al., 2018; Jayanthi et al., 2015; Snyder et al., 2017; Walburg, 2014) and which may negatively affect the well-being of adolescents (Burger & Samuel, 2017; Chappel et al., 2014; Kiang & Buchanan, 2014) and later developmental outcomes (Lupien et al., 2009). Stress also has a negative effect on academic performance (Arsenio & Loria, 2014; Kaplan et al., 2005; Liu & Lu, 2011) and can result in school absenteeism or dropout (Dupéré et al., 2015). Addressing psychological needs at an early stage, for instance to deal with stress and stress-inducing factors, is of crucial importance to prevent the development of mental health problems, school dropout and dysfunction later in life. An environment particularly suitable to help vulnerable adolescents is the school environment. Intervening in the school-context may be particularly beneficial to schools as well-being and mental health have been positively associated with academic functioning (Suldo et al., 2011).

A promising avenue to reach adolescents with psychological needs is by focusing on stress. As experiencing stress is part of normative development during adolescence (Romeo, 2013), interventions focusing on the reduction of stress may be experienced by adolescents as a low-threshold and appealing way to address their psychological needs. Stress has been defined as the condition or feeling that results when individuals perceive that the demands of a situation exceed the individual's personal, psychological, or social resources (Lazarus, 1966). During adolescence, performance pressure as well as social situations at school may trigger feelings of stress, also referred to as academic and social stress (Nicolai et al., 2013).

Academic stressors that are frequently reported by adolescents are related to tests, grades, homework, expectations about school, expectations about their career and future life plans (de Anda et al., 2000). Academic stress is related to performance anxiety, where individuals experience fear of failure, the fear to be unable to meet certain expectations of themselves or others, or test anxiety. Improving skills to deal with academic stress through intervention programs can reduce stress in the school

environment (Regehr et al., 2013; Saunders et al., 1996). Social stressors originate from an individual's social environment and are caused by factors that disrupt the relationship with others, such as social rejection, isolation, disagreements or bullying (Juth & Dickerson, 2013). Dysfunctional social interactions can trigger stress (Ditzen & Heinrichs, 2014), hence, improving social skills by teaching adolescents to better communicate with others, might reduce perceived social stress.

The ability to cope with stress is very important and requires cognitive and behavioral efforts to control or reduce stressful experiences (Lazarus & Folkman, 1984). One way to thus counter the negative effects of adolescents' stress is addressing either academic or social stress by offering preventative skills-training programs that provide adolescents with tools to effectively cope with stress and regulate emotions (Compas et al., 2014). In order to effectively help adolescents who perceive academic or social stress and to promote their mental health, this protocol describes a study to examine the effectiveness of two school-based skills-training programs targeting skills to deal with performance anxiety or social skills.

Several studies implemented skills-training programs targeting performance anxiety, mainly focusing on test anxiety. Recent studies in secondary school students reported decreased test anxiety compared to controls after interventions targeting a combination of coping skills, relaxation techniques and study skills (Bradley et al., 2010; Putwain & Pescod, 2018; Weems et al., 2014; Yahav & Cohen, 2008; Yeo et al., 2016). A reduction was also found in physiological stress (Bradley et al., 2010; Yahav & Cohen, 2008), internalizing problems (Weems et al., 2014) and behavioral problems (Yahav & Cohen, 2008), as well as increased self-esteem (Yahav & Cohen, 2008).

Recent studies demonstrated increased positive social behavior and improved social skills in secondary school students after mindfulness or social and emotional skills based interventions compared to controls (Durlak et al., 2011; Schonert-Reichl & Lawlor, 2010). A reduction was found for perceived stress (Durlak et al., 2011), problem behaviors (Durlak et al., 2010; Schonert-Reichl & Lawlor, 2010) and internalizing problems (Harrell et al., 2009), as well as increased self-esteem (Durlak et al., 2010; Harrell et al., 2009; Schonert-Reichl & Lawlor, 2010).

In sum, previous studies targeting skills to deal with performance anxiety and social skills in secondary school students demonstrated promising results, for academic and social

stress as well as for mental health outcomes. However, previous research shows several limitations. First, only few studies performed a randomized controlled trial (RCT) (Harrell et al., 2009; Putwain & Pescod, 2018), which means that in non-randomized studies there might be confounding factors or bias. Second, only few studies used a targeted small-group intervention (Harrell et al., 2009; Putwain & Pescod, 2018; Weems et al., 2014), which means that in studies with universal interventions there might be minimal or no effect for at-risk students because their greatest effect is on low-risk students, who are not the desired target (Offord, 2000). Moreover, these studies had relatively small sample sizes ($N = 74$ and $N = 56$) (Harrell et al., 2009; Putwain & Pescod, 2018) which precludes clear conclusions about the effects, or targeted youth that experienced a traumatic event (Weems et al., 2014), precluding conclusions about non-clinical community samples. Third, only a few studies investigated mixed-samples of students from diverse ethnic backgrounds (Bradley et al., 2010; Putwain & Pescod, 2018; Schonert-Reichl & Lawlor, 2010), which is important to be able to draw conclusions that generalize to the whole population (Bonevski et al., 2014). Hence, there is still insufficient evidence for the effectiveness of skills-training programs, especially for students in mixed-ethnicity community samples. Additionally, little is known about potential moderators of the effectiveness of school-based skills training programs, likely due to power issues. Which students benefit from such training programs and which factors contribute to their effectiveness?

Moderators are student, parent and program characteristics that are likely to affect the effectiveness of the training programs. Student characteristics that may affect the effectiveness of the skills-training programs include demographic characteristics (i.e., age, gender, ethnicity, educational level and socioeconomic status (SES)) and social support, perfectionism, stressful life experiences, severity of problems, perceived parental pressure and basal stress levels.

For instance, high levels of social support have been positively associated with well-being and mental health in children and adolescents (Chu et al., 2010; Rothon et al., 2011). Moreover, high levels of social support have been associated with a more beneficial psychological treatment outcome in clinical samples (Beckner et al., 2010; Thrasher et al., 2010). High occurrence of stressful life events has been associated with stress-related psychopathology and negative mental health outcomes, such as anxiety, depression and risk behavior (Fox et al., 2010; Low et al., 2012; Meng et al., 2011) and predicts adverse treatment outcome (Nanni et al., 2012). On the one hand, high social support and low

occurrence of stressful life events are associated with more beneficial outcomes. On the other hand, several studies showed larger program effects for adolescents with high initial problem severity (Henderson et al., 2010; Menting et al., 2013). Following this line of reasoning, it may also be possible that students with low social support or with high occurrence of stressful life events profit most from the skills-training programs, because the sessions provide them with tools that are not provided by their social network.

Perceived stress positively correlates with perfectionism (Flett et al., 2016) and perceived parental pressure (Sibnath et al., 2015), which have been associated with mental health problems such as anxiety and depression (Limburg et al., 2017; O'Connor et al., 2010; Quach et al., 2013). Previous studies showed that perfectionism and maternal rejection (i.e., less emotional warmth), the latter associated with parental pressure (Quach et al., 2013), are related to less beneficial treatment outcomes in children and adolescents with anxiety or depression (Festen et al., 2013; Mitchell et al., 2013; Nobel et al., 2012; Zuroff et al., 2000). It is therefore expected that students with higher levels of perfectionism or students who perceive more parental pressure may benefit less from the skills-training programs.

Parent characteristics that may affect the effectiveness of the skills-training program include demographic characteristics (i.e., educational level) and positive parenting behavior. Positive parenting behavior increases adolescents' social competence reflecting positive functioning at school including peer competence and attachment to school (Taylor et al., 2016), and improves the relationship between parent and adolescent (Pinquart, 2013). Because of this warm relationship, parents may be more involved in the life of their child and students may feel more confident to talk about the program at home. It is therefore expected that the skills-training programs are more effective for students with parents that show more positive parenting behavior.

Additionally, program characteristics, i.e., treatment alliance, program integrity and trainer characteristics such as ethnicity, experience and perceived competence, may moderate the effectiveness of the skills-training programs. Treatment alliance is the perceived bond between the participant of the skills-training program and the group leader (i.e., trainer), which is demonstrated to be positively associated with treatment outcome in depressive patients (Zuroff et al., 2000) and in children and adolescents with anxiety disorders (Anderson et al., 2012; Liber et al., 2010). Hence, it is expected that high participant-trainer alliance contributes to a more beneficial outcome. Program integrity

refers to the extent to which a program is implemented as originally planned, and is reported by very few studies (Pereplechikova et al., 2007). Finding non-significant effects may not be caused by an ineffective program, but because a program is not carried out as intended (Asscher et al., 2014). Therefore, it is important to examine program integrity in order to correctly draw conclusions on the effectiveness of the skills-training programs.

In sum, the current protocol describes a study that will be conducted to examine the effectiveness of two types of targeted school-based skills-training programs addressing skills to deal with performance anxiety (program 1) and social skills (program 2). In order to overcome some of the limitations of previous studies, small-group skills-training programs are evaluated in a mixed-ethnicity community sample of students with different educational levels, where students self-select to one of the skill-training programs. For each program, a RCT is performed to examine if these low-threshold interventions reduce performance or social anxiety and promote students' mental health. Both skills-training programs will be compared to a control waitlist condition. As illustrated in Figure 4.1, it is expected that the performance anxiety skills-training program will improve skills to reduce performance anxiety (i.e. coping skills, including negative thought restructuring and managing emotions), resulting in a reduction in students' performance anxiety (i.e. fear of failure and test anxiety) and in improved mental health (i.e. reduced stress and internalizing and externalizing problems, and increased well-being and self-esteem). Additionally, we expect that the performance anxiety skills-training program will directly reduce performance anxiety and improve mental health. It is expected that the social skills-training will improve students' social skills and thereby reduce their social anxiety and improve their mental health (i.e. reduced stress and internalizing and externalizing problems, and increased well-being and self-esteem). In addition, we expect that the social skills training program will directly reduce social anxiety and improve mental health (see Figure 4.1). The second aim is to investigate the moderators of the effectiveness of both skills-training programs on all outcomes. This is important because it is likely that the skills-training programs are not equally effective for all students. Student, parent and program characteristics will be examined as potential moderators. The final aim of this study is to evaluate if the school-based skills-training programs are experienced as sufficiently accessible, meaningful and helpful by the students, their parents and the trainers. Figure 4.1 shows a conceptual model of the research design.

Figure 4.1 Conceptual model of the research design

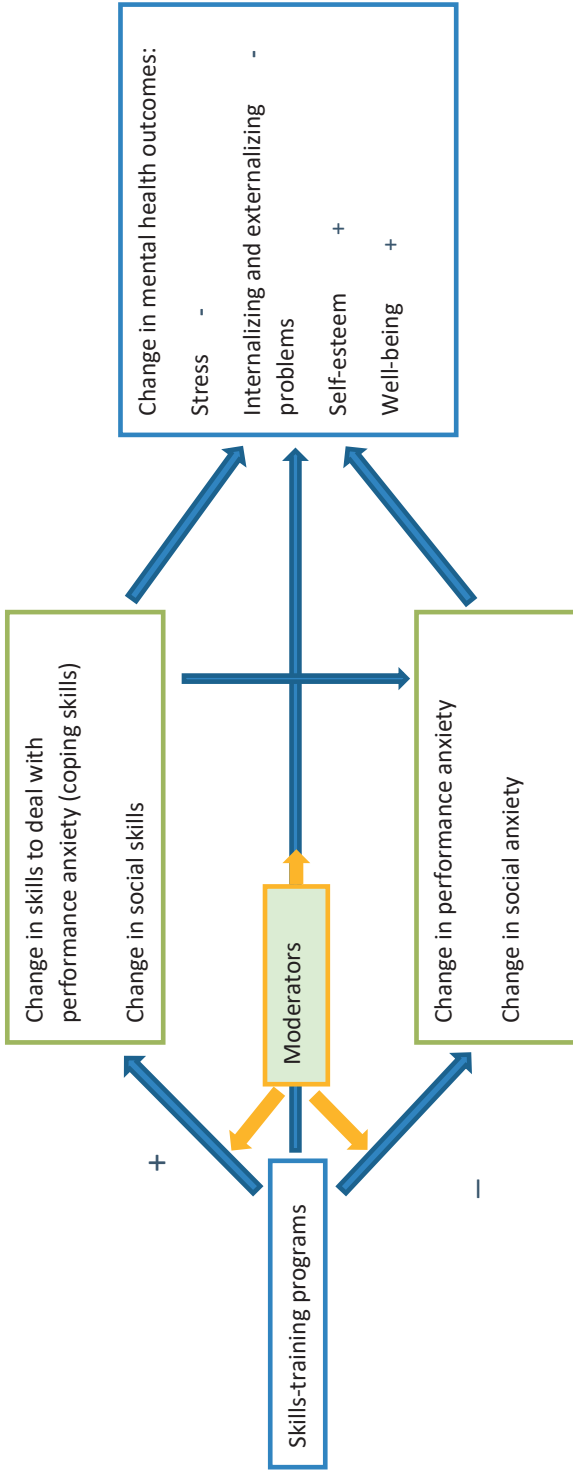
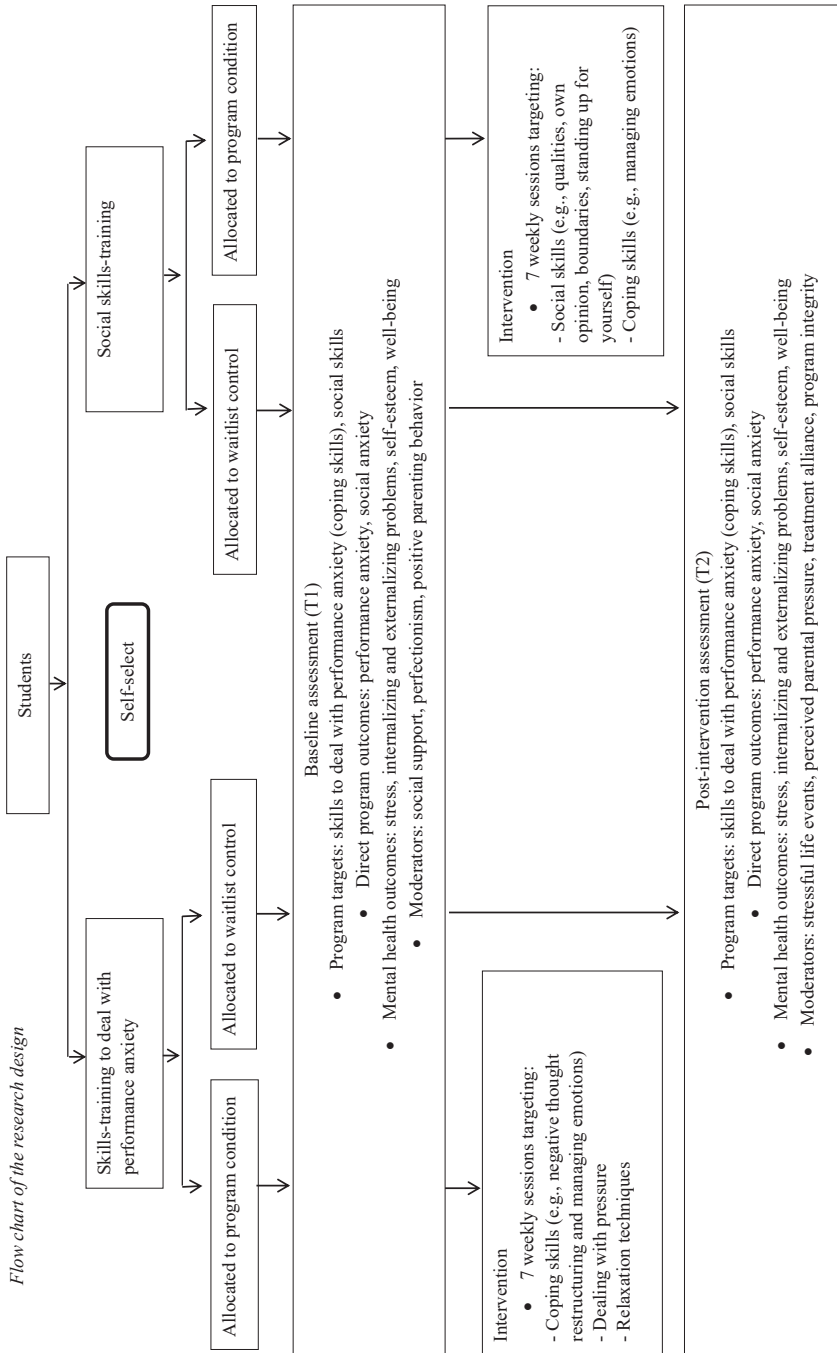


Figure 4.2 Flow chart of the research design



METHODS AND DESIGN

Design

A RCT will be conducted for both school-based skills-training programs targeting: 1) skills to deal with performance anxiety and 2) social skills. For each skills-training program, students who have indicated interest in attending a training at their school, will be randomized by the first author (stratified for education level) into the experimental group in which the training starts immediately or into a waitlist control group that receives the training approximately eight weeks later (see Figure 4.2), using computerized randomization in a 1:1 ratio. We will use a multi-method (questionnaires and physiological data) and a multi-informant (students, parents and trainers) design and will recruit a mixed-ethnicity sample of students from different educational levels.

Data collection

Questionnaires assessing program targets (i.e., skills to deal with performance anxiety or social skills), specific goals of the skills-training programs (i.e., performance or social anxiety) and mental health (i.e., stress, internalizing and externalizing behavior, well-being and self-esteem) will be completed by students and parents prior to the start (T1) and after completion of the interventions in the experimental group (T2). Trainers complete questionnaires about program content (to assess program integrity) after each training session. Additionally, in a subsample of students (approximately $N = 40$ students per skills-training program), physiological parameters will be measured during a resting period to assess the basal stress levels of students (i.e., heart rate, heart rate variability and skin conductance measurements with wearables).

Student and parent characteristics (i.e., demographics including gender, age, ethnicity and education level, and expectations about the program) are assessed prior to the interventions, as well as trainer characteristics (i.e., demographics including gender, age, ethnicity, education level, and level of experience and perceived competence). Lastly, after completion of the intervention, students, parents and trainers will evaluate the skills-training program.

The design of this study has been approved by the Ethical Committee Psychology of Leiden University (CEP18-1105/419) and is registered in the Dutch Trial Register (number NL7438). To maintain participant confidentiality, all records that contain names or other

personal identifiers will be stored separately from the collected data identified by code numbers.

Study sample

For each school-based skills-training program we aim to include $N = 130$ students to ensure there is enough power for the analyses ($N = 65$ for both the experimental and waitlist control group). A total of $N = 260$ students will be included. This sample size is sufficient to investigate the effectiveness of the interventions and potential moderators, with a power of .80, an alpha of .05 and a medium effect size of .25 (Faul et al., 2007).

Participants are mixed-ethnicity students in the first, second, and third year of secondary schools (7th, 8th and 9th Grade students) of at least three schools in the Netherlands that offer education at various levels (from vocational education level to preparatory university education level). The students will be between 11 and 16 years old.

Recruitment

Schools

So far, three Dutch urban secondary schools have been recruited. Possibly, additional schools will be recruited via the researchers' contacts and networks. Schools that show interest will receive information about the study and will be asked to participate.

Participants

This study will be performed in the context of a Response to Intervention model (RTI) that aims to identify vulnerable students and provide them with appropriate interventions (Kearney & Graczyk, 2014). Before entering the current study, focusing on the effectiveness of school-based skills-training programs, classes of students receive educative information about stress and are asked about their own stress levels (i.e., Tier 1 of the RTI model: universal intervention targeting all students). After these three educative lessons, students will be asked to indicate if they would like to learn more about dealing with academic or social stress by following a skills-training program. Students will be asked to self-select to one of the school-based skills-training programs (i.e., skills to deal with performance anxiety or social skills), if needed assisted by parents or teachers (i.e., Tier 2 of the RTI model: targeted intervention directed at self-selected at-risk students). Students who self-select to a Tier 2 intervention are asked to participate in the current study.

The skills-training programs are offered by schools via their own care system or by external youth care organizations. The interventions are implemented at school by trained teachers or professionals. Students and parents receive written information about the different skills-training programs that are offered and receive an information letter about the corresponding research study. Trainers also receive an information letter about the study. Students and parents will be asked to provide active informed consent for the student's participation in the study. If students or parents do not give consent to participate, the student will not receive the skills-training program offered by the study but will receive help via the schools' own care system. Active informed consent will also be obtained from parents and trainers for their participation. After receiving consent, students will be randomized into the experimental condition or the waitlist condition. Figure 4.2 shows the flow chart of the design of the study.

Interventions

Students in the experimental condition of each skills-training program will participate in seven 45-minute small-group sessions during consecutive weeks. Weekly sessions will take place at the school of the students and the sessions will be delivered by an experienced trainer or trained teacher in small groups. The performance anxiety skills-training program consists of cognitive coping strategies (e.g., negative thought restructuring and managing emotions), relaxation techniques and dealing with pressure. The social skills training program consists of social skill building (e.g., identifying personal qualities, giving own opinions, setting boundaries, and standing up for yourself) and cognitive coping strategies (e.g., managing emotions).

Waitlist-control group

The waitlist group will not receive any training during the implementation of the intervention in the experimental group and will only complete the pre-and post-intervention measurements. The waitlist group will receive the intervention immediately after the post-intervention measurements, approximately 8 weeks later than the experimental group.

Instruments

Table 4.1 presents an overview of the measurements used at each assessment point for the skills-training programs.

Table 4.1 Overview of the variables' instruments and sources

Outcome	Variable name	Instrument	Time of measurement	Variable type	Source
Program targets	Coping skills	CERQ-short	T1, T2	Outcome	Students
	Social skills	SIG-A	T1, T2	Outcome	Students, parents
Direct program outcomes	Performance anxiety	PFAI, TAI	T1, T2	Outcome	Students, parents
	Social anxiety	RCADS, subscale social phobia	T1, T2	Outcome	Students, parents
Mental health outcomes	Stress levels	CSQ-CA	T1, T2	Outcome	Students, parents
	Internalizing and externalizing behavior	Y-OQ	T1, T2	Outcome	Students
Physiological stress response	Well-being	WHO-5	T1, T2	Outcome	Students
	Self-esteem	RSES	T1, T2	Outcome	Students
	Stress	Heart rate, heart rate variability, skin conductance	T1, T2	Outcome & moderator	Students
	Current stress and mood	VAMS	T1, T2	Outcome & moderator	Students
Demographics	Demographics	Developed for this study	T1	Moderator	Students, parents, trainers
Student characteristics	Social support	SSL-I	T1	Moderator	Students
	Perfectionism	CAPS-14	T1	Moderator	Students
Program characteristics	Stressful life events	Negative life events inventory	T2	Moderator	Students
	Perceived parental pressure	MIPS parental pressure subscale	T2	Moderator	Students
	Level of experience and competence of trainers	Developed for this study	T1	Moderator	Trainers
Parent characteristics	Program integrity	Developed for this study	T2	Moderator	Trainers
	Treatment alliance	TASC	T2	Moderator	Students
	Positive parenting behavior	VSOG subscale positive parenting	T1	Moderator	Parents

Outcome measures

Program targets, direct program outcomes and mental health outcomes will be assessed before the start of the skills-training program and immediately after the completion of the program.

Program targets

Skills to deal with performance anxiety will be measured with the Dutch version of the Cognitive Emotional Regulation Questionnaire – short form (CERQ-short) (Garnefski & Kraaij, 2006), completed by students. This instrument is a 18-item self-report measuring cognitive related coping (e.g., “I think I can learn something from the situation” or “I keep thinking about how terrible it is what I have experienced”). It consists of nine subscales: Self-blame, acceptance, rumination, positive refocusing, refocus on planning, positive reappraisal, putting into perspective, catastrophizing and other-blame. The authors made a distinction between maladaptive coping (self-blame, other-blame, rumination and catastrophizing) and adaptive coping (acceptance, refocus on planning, positive refocusing, positive reappraisal and putting into perspective) (Garnefski et al., 2001). The internal consistency of the subscales is between .68 and .81 (Garnefski & Kraaij, 2006).

Social skills will be measured with the Scale for Interpersonal Behavior of Adolescents (SIG-A) (Arrindel et al., 1984; Bijstra & Oostra, 2000), completed by students and parents. For parents, an adapted version will be used where “I” is replaced with “my child”. The self-report version for students consists of 47 situations that are evaluated on two dimensions (i.e., how much anxiety students experience during these situations and how often they experience these specific situations). In this study we only use the performance dimension (i.e., frequency) to assess social skills. For example, the item “Starting a conversation with someone you haven’t met before” is scored on a scale from “never” to “always” for the performance dimension. The instrument consists of four subscales that refer to specific social situations: 1) display negative feelings (14 items, e.g., “If someone interrupts you, saying you find that annoying”) 2) express personal limitations (13 items, e.g., “Asking for an explanation about something that you didn’t understand”), 3) initiate assertiveness (9 items, e.g., “Starting a conversation with someone you haven’t met before”) and 4) display positive feelings (8 items, e.g., “Agreeing when someone makes a compliment about your appearance”). This instrument has sufficient psychometric properties with a Cronbach’s alpha above .80 for all subscales (Bijstra & Oostra, 2000).

Direct program outcomes

Performance anxiety will be measured by two instruments measuring different domains, i.e., fear of failure and test anxiety, completed by students and parents. For parents, adapted versions are used where “I” is replaced by “my child”. The short form of the Performance Failure Appraisal Inventory (PFAI) (Conroy et al., 2002) will be used, translated into Dutch. The PFAI is a 5-item self-report instrument measuring fear of failure (e.g., “When I am failing, I am afraid that I might not have enough talent”) with good reliability (internal consistency between .72 and .82) (Conroy et al., 2002; Conroy & Coatsworth, 2004). The Dutch short version of the widely used Spielberger Test Anxiety Inventory (TAI) (Spielberger, 1980; van der Ploeg, 1983) will be used to assess anxiety in school testing situations. This instrument consists of 20 items (e.g., “I feel confident and relaxed while taking tests”) and has demonstrated adequate internal consistency (between .92 and .96) (Spielberger et al., 1978).

Social anxiety will be measured with the social phobia scale of the Dutch version of the Revised Child Anxiety and Depression Scale (RCADS) (Chorpita et al., 2000), completed by students and parents. For parents, an adapted version will be used where “I” is replaced with “my child”. This instrument consists of 9 items (e.g., “I worry what other people think of me”) and has good internal consistency (between .78 and .81) (Chorpita et al., 2000; Ferdinand et al., 2006).

Mental health outcomes

Stress levels of students will be measured with the Chronic Stress Questionnaire for Children and Adolescents (CSQ-CA) (de Bruin et al., 2018) and will be completed by students and parents (adapted version). The CSQ-CA is a 19-item self-report questionnaire (e.g., “I often get upset about things that are not important”) that demonstrated good psychometric properties with an internal consistency of .87 (de Bruin et al., 2018). In addition, physiological measurements are performed to assess basal stress levels in a subsample of students. Heart rate, heart rate variability and skin conductance are measured via a wearable (“Shimmer3 GSR+,” n.d.) during a 5-minute resting period where students watch a relaxing aquatic video (Piferi et al., 2000). Prior to the physiological assessment, students will complete Visual Analogue Mood Scales (VAMS) (Stern et al., 1997) about their current mood and stress level.

Internalizing and externalizing problem behavior will be assessed with the Youth Outcome Questionnaire (Y-OQ-30.1) (Dunn et al., 2005), translated into Dutch and completed by

students. This instrument consists of 30 items (e.g., “My emotions are strong and change quickly”) and measures change in psychological symptoms and social functioning. It includes six subscales: somatic complaints (3 items), social isolation (2 items), aggression (3 items), conduct problems (6 items), hyperactivity/distractibility (3 items) and depression/anxiety (6 items). Internalizing problem behavior will be assessed with the subscale depression/anxiety and externalizing problem behavior with the subscales aggression and conduct problems. The internal consistency of the total scale is .92 and between .55 and .85 for the different subscales (Dunn et al., 2005).

Well-being of students will be assessed with the Dutch version of the WHO-Five Well-Being Index (WHO, 1998), which consists of 5 items (e.g., “My daily life has been filled with things that interest me”). This instrument has good internal consistency for an adolescent sample (between .82 and .85) (Allgaier et al., 2012; de Wit et al., 2007).

Self-esteem is reported by students by completing the Dutch version of the Rosenberg Self-Esteem Scale (RSES) (Franck et al., 2008; Rosenberg, 1965). The instrument consists of 10 items (i.e., “I take a positive attitude toward myself”) and has sufficient internal consistency (between .77 and .88) for high school students (Rosenberg, 1965).

Moderators

Student, parent and trainer characteristics, including age, gender, ethnicity and education level will be collected at baseline. Parents will also report family characteristics and information about work and education level (as indicator of SES), and trainers will report information about their level of experience, perceived competence and educational background. Finally, students and parents will report their expectations for the skills-training program (at baseline) and will evaluate the program (post-intervention measurement).

Positive parenting behavior will be measured with the Dutch Abbreviated Scale of Parenting Behavior (VSOG) (van Leeuwen et al., 2011), completed by parents. This instrument is a 25-item self-report for parents with five subscales. In this study only the subscale positive parenting behavior will be used, which consists of 8 items (e.g., “I make time for my child, when he/she wants to tell me something”). The subscale has a Cronbach’s alpha of .83 for mothers and .87 for fathers (van Leeuwen et al., 2011).

Social support will be measured with the Social Support List – Interactions (SSL-I) (van Eijk et al., 1994), adapted for use in adolescents. It measures the extent of received social support by social interactions in an individual's social network. The instrument consists of 12 items (e.g., Does it ever happen to you that people: “are interested in you” or “ask you for help or advice”?) and three subscales (i.e., everyday social support, social support in problem situations and esteem support) and has acceptable internal consistency for all subscales (.70 or above) (Kempen & van Eijk, 1995; van Eijk et al., 1994).

Perfectionism will be measured with the Child and Adolescent Perfectionism Scale (CAPS-14) (O'Connor et al., 2009), translated into Dutch. This instrument is a 14-item self-report measuring perfectionism and consists of three subscales: self-oriented perfectionism-striving (3 items, e.g., “I try to be the best at everything I do”), socially prescribed perfectionism (7 items, e.g., “Other people always expect me to be perfect”) and self-oriented perfectionism-critical (4 items, e.g., “I get mad at myself when I make a mistake”). The internal consistency of the subscales is between .72 and .86 (O'Connor et al., 2009).

Stressful life events will be measured with the Negative Life Events Inventory (Wills et al., 2001; Wills et al., 1996), translated into Dutch. This instrument is a 20-item checklist of negative life events (e.g., “Somebody in my family had a serious illness”). Students are asked to indicate whether an event had occurred during the previous year and includes events that occurred to family members and directly to themselves. The internal consistency is between .67 and .71 (Wills et al., 2001; Wills et al., 1996). Students will complete this instrument after completion of the skills-training program (post-intervention measurement).

Perceived parental pressure will be measured with the subscale parental pressure of the Multidimensional Inventory of Perfectionism in Sport (MIPS) (Stoeber et al., 2006), translated into Dutch. The perceived parental pressure subscale consists of 8 items (e.g., “My parents set extremely high standards for me”). The internal consistency is good (above .92) (Stoeber et al., 2006; Stoeber & Rambow, 2007). Parental pressure has a high temporal stability (O'Rourke et al., 2011) and students will therefore complete this instrument at post-measurement.

Treatment alliance will be measured with the Therapy Alliance Scale for Children (TASC) (Shirk & Saiz, Christopher, 1992), translated into Dutch and altered for use in group skills-

training programs. This is a 12-item instrument measuring the bond-aspect of alliance (6 items, e.g., “I like my trainer”) and the tasks of the program (6 items, e.g., “I work with my trainer on solving my problems”). This instrument has good internal consistency (above .70) (DeVet et al., 2003; Ormhaug et al., 2015) and is completed by students after completion of the skills-training program (post-intervention measurement).

Program integrity will be measured with a questionnaire specifically developed for this study. After each session, trainers will be asked to evaluate the session by registering if they carried out the session as intended (e.g., is the content of the session sufficiently treated, are other components discussed, and what was their overall impression of the session).

Statistical analyses

To examine the effectiveness of the skills-training programs, the effects of all outcome measures will be investigated by conducting analyses of covariance (ANCOVAs). The dependent variables are the outcome measures at post-test (program targets, direct program outcomes and mental health outcomes), the independent variables are the conditions and the covariates are the pre-test (baseline) measurements of the outcome measures. The effect of potential categorical and continuous moderators on the effectiveness of the skills-training programs on the specific goals of the programs and mental health of students will be examined by adding the moderators to the ANCOVAs. Data will be imported from an online server software (i.e., Qualtrics) and will be securely stored at the server of Utrecht University where data back-ups will be performed regularly.

DISCUSSION

This study protocol introduces the design of two RCTs investigating the effectiveness of school-based skills-training programs targeting skills to deal with performance anxiety or social skills to promote the mental health of adolescents. Further empirical tests of the utility of the RTI model will be published separately. Previous studies demonstrated reduced stress levels, reduced internalizing and externalizing behavior, increased self-esteem and improved well-being in adolescents receiving skills-training interventions. To overcome the limitations of previous studies, including study design (e.g., non-randomization, small sample sizes and the absence of moderator analyses) and use of mostly universal interventions, we will investigate small-group skills-training programs

in a mixed-ethnicity community sample and use a RCT to exclude confounding (e.g., allocation and selection bias) as much as possible. We will use a multi-informant (i.e., students, parents and trainers) and multi-method (i.e., questionnaires and physiological measurements) approach. Furthermore, we will use a sufficiently large sample size to examine potential moderators of the effectiveness of the interventions (i.e., student, parent and program characteristics).

There are several challenges in this study, such as the recruitment of an ethnically diverse and representative sample of students and the prevention of dropout of students and parents. First, the self-selection of students to enroll in a skills-training program may constitute a challenge, as students may feel unable to make the correct decision or think they have problems in one domain, while these are caused by another underlying problem. We try to diminish this by involving parents and teachers to help students make the right choice. On the other hand, the self-selection of students may also be advantageous, because students are likely to be more motivated which may contribute to a more beneficial program outcome (Sin & Lyubomirsky, 2009). Second, it may be difficult to recruit sufficient numbers of mixed-ethnicity students and parents and maintain their involvement over the course of this study. Recruitment may be difficult because of language barriers and unfamiliarity and mistrust with research. It is therefore of great importance that the schools are actively involved in giving information to students and parents, because they rely and trust on their school. Since participation of students requires active informed consent from their parents, it is of utmost importance to reach all parents and provide them with clear information about study participation. In our efforts to reach students and their parents, we will use multiple sources (i.e., researchers and teachers or other school contacts) and multiple methods (i.e., information during classes, written information and phone calls) to provide them with information and to emphasize the relevance of the study. In order to make giving permission as easy as possible, participants can also give digital consent. Moreover, the questionnaires for students, parents and trainers are brief, clear and can be completed online, to avoid lost or non-returned questionnaires. These precautions are expected to increase the likelihood of participation and retention. In addition, with these precautions we aim to reduce the risk that socially disadvantaged groups, that are difficult to recruit and retain in health research (Bonevski et al., 2014), are underrepresented in our sample.

Third, a challenge in this study is to implement the skills-training programs at schools because of logistics (i.e., different locations and scheduling) and the participation and

involvement of multiple parties (i.e., researchers, schools, students, parents, youth care organizations that provide the skills-training programs, and municipalities involved). With regard to the latter, multiple schools and multiple organizations offering skills-training programs are involved in this study. To strengthen the collaboration between the schools and the youth care organizations, we will organize regular meetings with all parties involved and aim to match the schools with suitable youth care organizations. With regard to logistics, it is very important that enrollment in the skills-training programs and arrangements in terms of schedules and locations will be timely communicated with the schools and youth care organizations. The researchers will try to overcome potential implementation issues by being present at the schools at least once a week, by giving weekly updates to the youth care organizations, and by being available for consultation at any time during the referral process and skills-training programs.

Fourth, the participating schools do not belong to the same municipality geographically, which complicates the financial conditions for the skills-training programs. To overcome financial issues, we will talk to different municipalities to obtain funding for the skills-training programs. Finally, it is important to be aware that in the Netherlands, school and youth care systems are completely separate, both organizationally as well as financially, which makes cooperation complicated. We try to overcome this challenge by giving regular updates and organize meetings with all parties involved, to promote a fruitful collaboration.

Overall, in order to overcome the practical challenges in this study, we aim to be as flexible as possible (e.g., being available for consultation at all times) towards the different parties involved. Of foremost importance is investing time in clear and timely communication with all parties in order to collaborate as effectively as possible. We try to involve the parties as much as possible by organizing regular meetings and actively involving them in the decisions in the research. Furthermore, we try to work according to a standardized research protocol as much as possible, to avoid miscommunications and ensure a positive and productive collaboration.

The current protocol describes a study that will investigate the effectiveness of school-based skills-training programs targeting skills to deal with performance anxiety or social skills promoting mental health in adolescents. It is of crucial importance that the school environment can provide students with interventions to help them cope with stress-inducing factors and to prevent the development of mental health problems, school dropout and dysfunction later in life.



CHAPTER 5

Promoting Adolescent Mental Health: Recommendations for Successful Implementation and Evaluation of School-Based Intervention Programs

This chapter is adapted from:

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (under review). Promoting adolescent mental health: Recommendations for successful implementation and evaluation of school-based intervention programs.

Author contributions:

AL conceived and participated in the design of the study, coordinated and conducted the data collection, and drafted the manuscript. HC conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. SV participated in data collection and interpretation, and critically revised the manuscript. NS, AM, and MW participated in data interpretation and critically revised the manuscript. JA conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. All authors read and approved the final manuscript.

ABSTRACT

The present study describes the challenges encountered and lessons learned when carrying out randomized controlled trials to investigate the effectiveness of targeted school-based skills-training programs promoting adolescent mental health. The aim of the present study is to improve future research by informing others who plan to implement and evaluate such programs in schools. Our personal experiences, as well as the experiences of involved parties (i.e., school liaisons and trainers), are included to provide a comprehensive view on the implementation process. Some of the challenges encountered apply to all effectiveness studies, such as the recruitment and retention of participants for intervention and research, others are more 'intervention at school' specific, such as scheduling the programs and assessments. Our experiences, as well as those of involved parties, show that it is possible to effectively implement and evaluate targeted intervention programs promoting adolescent mental health in secondary schools, even during a worldwide health pandemic, but that it requires investing sufficient time in keeping close and regular contact as well as clear communication between the involved parties. Moreover, as no school is the same, school-specific protocols are recommended to benefit from the unique opportunities at each site, while assuring adherence to a common standardized approach. Finally, to overcome challenges encountered during implementation and evaluation of such programs, high levels of flexibility are needed in adjusting scheduled meetings for intervention and research, whilst keeping track of the entire process for each school and individual participant.

Keywords: Adolescence, Mental Health, Implementation, Randomized Controlled Trial, School-Based Intervention Programs.

INTRODUCTION

Worldwide, mental health problems affect 10-20% of children and adolescents (Kieling et al., 2011). Yet, while effective mental health interventions for youth are available (Weisz et al., 2006), the majority of affected adolescents do not receive treatment (Merikangas et al., 2011). As adolescents spend a substantial part of their time at school (Hofferth, 2009), the school environment seems particularly suitable to reach and support adolescents with emerging mental health problems. In the last decades, school-based intervention programs have become increasingly popular and meta-analytic reviews have demonstrated that school-based intervention programs – particularly targeted programs aimed at adolescents in need – have the potential to improve adolescent mental health, including physiological and psychological stress, social and emotional skills, internalizing problems, and behavior problems (Durlak et al., 2011; Feiss et al., 2019; van Loon et al., 2020, 2022; Werner-Seidler et al., 2017).

Although targeted school-based intervention programs promoting mental health seem a promising way to support adolescents, successful implementation and evaluation of such programs are considered challenging (Gee et al., 2021). Some of these challenges apply to effectiveness studies in general, such as creating and maintaining productive and positive collaborations with involved parties and participant recruitment and retention. Other challenges are more ‘intervention at school’ specific, such as scheduling the intervention and the accompanied effectiveness study. Overall, these challenges can threaten the robustness of study findings and thereby hamper our knowledge on what works and for whom.

While randomized controlled trials (RCTs) are considered the ‘gold standard’ for effectiveness studies, as randomization reduces bias (Hariton & Locascio, 2018), a recent meta-analysis demonstrated that only half of included studies examining the effectiveness of school-based intervention programs conducted (cluster) RCTs (van Loon et al., 2020). Practical reasons (e.g., cooperation with involved parties, randomization process) might demotivate researchers to use a RCT design to evaluate the effectiveness of school-based intervention programs. Furthermore, few studies pay attention to the implementation process of intervention programs (Perepletchikova et al., 2007), even though successful implementation may be essential for program effectiveness (Lane et al., 2004).

Therefore, the present study describes the implementation process of two RCTs to investigate the effectiveness of two targeted school-based skills-training programs promoting adolescent mental health. The challenges encountered during the implementation and evaluation of these programs are presented, as well as lessons learned. To advance the current literature, we obtained information from involved parties (i.e., schools and youth care organizations) in addition to the (customary) perspective of the research team. We believe our experiences, together with the experiences of involved parties, may be useful and relevant for others planning to study the effectiveness of school-based intervention programs, to ultimately improve the evidence base for supporting adolescents with emerging mental health needs in the school environment. Moreover, this study may motivate others to conduct a RCT, which may subsequently pave the way for future RCTs (Asscher et al., 2007), advancing the quality of knowledge on program effectiveness. Overall, our study aims to provide a comprehensive view on implementation challenges and lessons learned based on experiences of multiple parties.

Background of the project

As part of a larger project aimed at strengthening the link between secondary education and youth mental health care, we implemented two school-based skills-training programs in nine secondary schools in the Netherlands and conducted randomized controlled trials to examine their effectiveness (see van Loon et al., 2019 for the study protocol). The project was performed in the context of a Response to Intervention (RtI) model (Kearney & Graczyk, 2014), focusing on identifying vulnerable adolescents and providing them with suitable (preventive) interventions. Stress was chosen as an overarching topic, as stress has been associated with various mental health problems (Snyder et al., 2017). Moreover, the schools involved in the project expressed a need for supporting their students to adaptively cope with school and social stress, which was frequently observed. As such, adolescents in the first, second, and third year (equivalent to USA 7th, 8th, and 9th grade students) of the participating secondary schools first received an educational program about stress (i.e., Tier 1: Universal intervention). After these three lessons, which were delivered to the whole class, adolescents were asked if they would like to participate in one of the skills-training programs offered in the research context (i.e., Tier 2: Targeted intervention), targeting either school or social stress by addressing skills to deal with performance anxiety or social skills, respectively (van Loon et al., 2019; 2022). Adolescents self-selected into one of the programs, and after obtaining active informed consent from both adolescents and parents, they were

randomly assigned to an intervention (i.e., experimental) or waitlist control group. The programs were evaluated in a mixed-ethnic identity sample of adolescents attending different educational levels (i.e., from prevocational to preuniversity education). The programs were offered by three external youth care organizations and consisted of seven weekly sessions of 45 minutes. This project was conducted in the school years 2018-2019, 2019-2020, and 2020-2021. The effectiveness results of the programs are reported elsewhere (van Loon et al., 2022).

Encountered challenges and lessons learned

For the evaluation of the implementation process of the RTCs, experiences from school liaisons and trainers were added to the experiences of the research team. To this end, school liaisons/contact persons and trainers/contact persons were approached to answer questions about the implementation process (see Appendix A5.1), either by phone ($N = 18$; 72%) or by completing a questionnaire ($N = 7$; 28%). Nine (out of ten) school liaisons and 16 (out of 19) trainers agreed to participate. Of these 25 participants, 18 were female (72%, $n = 9$ school liaisons and $n = 9$ trainers). Seven participating schools and all youth care organizations were represented. Experiences by school liaisons and trainers were grouped to identify overarching themes indicating strengths and challenges regarding the implementation process, as well as possible solutions for the encountered challenges.

Maintaining cooperation and participation of involved parties: Challenges

Creating and maintaining positive relationships with external facilitators of the intervention programs and school staff, as well as between them, is important for successful program implementation (Gee et al., 2021). However, establishing productive and positive collaborations with involved parties can be complicated, especially with many parties, as each party has its own priorities and interests. In our case, diversity in terms of school population, student number, and school policies, necessitated taking sufficient time to attend to each schools' characteristics. Yet, because of the large number of participating schools and youth care organizations, investing enough time in establishing relationships was a challenge. Another challenge we encountered was the unfamiliarity of involved parties, particularly schools, with (randomized controlled) research. Some contact persons did not fully grasp the goals and requirements of a controlled research design (e.g., were not convinced of the necessity of having an experimental and control group) and randomization process (e.g., believed that

adolescents with more pressing problems should get the program first). Unfortunately, due to a combination of factors, one school dropped out of the project.

Maintaining cooperation and participation of involved parties: Lessons learned

To establish cooperative collaborations while taking the diversity among schools into account, we realized that investing in a customized approach for each school was required. Each school selected a youth care organization they believed was the best match for their student population and entered into a partnership. We collaborated with the matched schools and youth care organizations to develop school-specific protocols for informing school staff, adolescents, and parents about the programs and project logistics (e.g., when to send information, when and where to schedule program sessions and assessments). This way, we aimed to attune as much as possible to the regular methods for working with adolescents at the specific school within the boundaries of our standardized approach for this project. In the end, only minor aspects differed between schools, ensuring internal and external validity of the project (Wagner et al. 2004). The partnership and co-creation in the development of school-specific protocols also strengthened the collaboration between schools and youth care organizations. For example, some school liaisons mentioned that because of this project, they knew better how to find their way to youth mental health care and contacted the organization for other issues (e.g., individual help, other programs).

To create support for adhering to the design of our project, we invested time in explaining and discussing the controlled research design and the significance of the randomization process. We experienced that making plans together and discussing important topics stimulated the support and active contribution of the involved parties to all the steps of the process. Nevertheless, at one school this did not work sufficiently, given that the school stopped participation. Apparently we were unable to reach mutual agreement on various aspects of the implementation process (possibly reinforced by the COVID-19 pandemic).

As noted by the school liaisons, approachability and availability of the researchers (i.e., at least once a week the primary researcher was on site) worked well to maintain close contact, create unofficial contact moments, and to be accessible when problems occurred (e.g., detect problems and act immediately). Moreover, according to the interviewees, clear communication and keeping short lines of communication by the researchers, by informing school staff and youth care organizations about every step of the process

(i.e., keeping them up-to-date) and providing them with the appropriate information on time, was important for creating and maintaining positive and fruitful collaborations. We encountered that by being helpful, available, flexible, and communicative, the required time investment for schools (and youth care organizations) was minimized, which is important, as many secondary school teachers present high levels of burnout symptoms (García-Carmona et al., 2019). Overall, our experiences emphasize that it is important to invest sufficient time in establishing positive relationships with involved parties to improve support and participation in the project, by keeping tight management and up-to-date administration about the process at each specific school.

Reaching the target group: Challenges

Effective recruitment is essential for successful program implementation, as recruitment is the first opportunity to contact and engage participants (Bruzzese et al., 2009). Furthermore, to properly investigate the effectiveness of an intervention program, it is necessary to include a sufficient number of participants to ensure there is enough power to detect potential statistical differences (Umscheid et al., 2011). Yet, reaching and recruiting participants is difficult to achieve. We encountered several challenges of reaching and recruiting adolescents (and parents) to enroll in the programs and participate in research. First, a challenge was a proper distribution of information and making sure that the provided information was clearly understood by adolescents and parents. Both researchers and school liaisons experienced that parents did not always receive or read the provided information, and therefore missed crucial information. According to the interviewees, the provided information was not always clearly understood by adolescents. That is, adolescents thought the programs were similar to the educative lessons (i.e., Tier 1) or had not understood the focus of the programs. Furthermore, as indicated by the interviewees, language issues, as well as the relatively long and complex information form (required part of consent procedure) might have hindered parents (and adolescents) to clearly understand the provided information.

Second, we encountered that involving parents as informants in the research (i.e., data collection) was a major challenge, and due to low response rates, we decided to remove this component. Although parent involvement is desirable, as this provides additional perspectives besides that of the adolescent, it is often difficult to achieve (Gee et al., 2021).

Third, motivating adolescents to participate was challenging, as reflected by low recruitment rates in some schools. Low levels of recruitment might be related to stigma of (mental health) programs (Gee et al., 2021) or mistrust or unfamiliarity regarding research in some populations (e.g., families with lower socioeconomic status; Bonevski et al., 2014). Study participation was conditional upon provided informed consent by adolescents and parents. Yet, for the collection of signed consent forms we were dependent on the willingness of adolescents and parents to return the forms, but above all on the dedication and determination of school staff to collect them. Some schools were more successful than others, as these school liaisons, mentors, or teachers were more dedicated to the project.

Reaching the target group: Lessons learned

In our study, to reach and motivate adolescents (and parents) to enroll in the programs and participate in research, we used multiple strategies. First, to increase the chance that adolescents received and understood the information, they received information in different ways and from multiple distributors. Adolescents received information on paper from researchers or school personnel and they received a classical presentation from their mentor and/or one of the researchers or trainers, including a short movie of the trainers explaining the content of the programs. Parents also received information in multiple ways. We designed a project website (targeting parents in particular), with information about the programs provided in text and in a video. Moreover, we organized general information evenings at school, gave adolescents written information (to take home), and emailed parents (via the school). Additionally, in some schools, parents were contacted by telephone to explain the value, aims, and purpose of the study (if necessary, family members were asked to translate the information to the parent), which increased recruitment rates. To prevent misunderstandings due to language issues, we tried to make the information form as simple as possible, including making the documents short and brief and adding pictograms next to the written text.

Second, by framing the programs as skills-training programs focusing on school stress and enhancing social skills, we tried to minimize stigmatization and make the programs as relevant, approachable, and low-threshold as possible. This way, we aimed to increase the motivation of adolescents to participate (and parents to consent).

Third, to enhance recruitment and the collection of signed consent forms, we organized meetings with mentors and teachers to ask their help in motivating and enthusing

adolescents to participate and to emphasize the importance of their involvement. Interviewees underscored that it is important to enhance the involvement of mentors and teachers in the project, as they can help to motivate adolescents to participate. Furthermore, to make giving permission as easy as possible, adolescents and parents could give informed consent digitally as well as on paper. In most schools, we received more digital than paper forms, which suggest that giving digital consent is preferred by adolescents and parents.

Retaining participants: Challenges

Once participants are recruited, the next challenge is making sure they actually attend the intervention and data collection sessions, because along the way, some participants might lose interest, become less motivated, or even drop out. Retention of participants is important, as high attrition can negatively affect the intervention as well as the quality of an effectiveness study (e.g., by creating nonrepresentative groups or reducing statistical power; Prinz et al., 2001). In our case, attendance regarding intervention and research required constant attention. With regard to the programs, interviewees indicated that not all adolescents were (intrinsically) motivated to attend (all) the sessions, possibly because some information was not properly understood by adolescents or parents. For example, some adolescents had different expectations, had registered because they believed participation was obligatory, or were registered by parents without adolescents fully supporting that decision. Regarding the research, absence of adolescents during the assessments, due to illness, other obligations, or lack of motivation, posed a challenge. Furthermore, interviewees considered the questionnaires too long and difficult, especially for younger adolescents or adolescents with lower educational levels, possibly lowering motivation to continue participation.

Retaining participants: Lessons learned

In our study, to prevent dropout regarding intervention and research, several strategies were used. With regard to the programs, before adolescents started the first session, we explained the relevance of the programs and answered questions of adolescents (i.e., during the preintervention measurement). During program implementation, trainers indicated that they tried to make the sessions as attractive as possible (e.g., variety of exercises, interactive format), and motivated adolescents throughout the sessions. Furthermore, the primary researcher kept a log to monitor program attendance, and if adolescents were not present, they were contacted and alerted by school staff or researchers, which increased program attendance. Regarding the assessments,

adolescents were invited in small groups, with at least one researcher present, so they could receive support and help on an individual level. Moreover, adolescents filled out the questionnaire online (i.e., on a phone, tablet, or laptop) and during school hours (i.e., not in their own free time). In addition, our experiences emphasize that at least one week (i.e., dependent on the number of participants) needs to be scheduled for the assessments per school, and that enough researchers are available to come (back) to that school during this period. This way, adolescents who were absent during the planned assessment could be reached at another moment later that week, preventing dropout.

Logistic and planning issues

For effective implementation and evaluation of targeted school-based intervention programs, accommodation with constraints imposed by the school environment, such as timetables, holidays or school events (e.g., exam weeks, outings), is important (Gee et al., 2021). However, accommodating logistical issues can be challenging. First, in our case, planning the program sessions and assessments was complicated due to the different schedules of adolescents (i.e., adolescents from different classes participated), the availability of sufficiently private spaces in school, and the timing of the program sessions (i.e., during or after school). Second, timely communication about planning and logistic issues is also key. In our project, trainers indicated that they sometimes received the schedule of the program sessions late or were unaware in which room they had to give the session, which could hinder the program sessions. It also occurred that adolescents missed a program session because of cancelation of lessons that day (and did not want to wait for the session) or because the session was planned parallel to a lesson they did not want to miss. Third, a challenge was the high staff turnover among the students-assistants, who were involved in the data collection. Some student-assistants became less motivated over time as their interest in the project seemed to decrease or had to quit because they graduated and got a job.

Overcoming logistic and planning issues: Lessons learned

First, to minimize problems regarding logistics and planning, we drafted the logistic procedure in collaboration with the involved parties weeks before the start of the recruitment phase. Second, we strived to inform adolescents (via an electronic learning environment for schools) and trainers well in time about the location and schedule of the program sessions. Involved parties were kept up-to-date about the actual status of the schedule at least once a week, in person or via phone, during the course of the

whole project. Moreover, if there were any obstacles (e.g., absence of a trainer, change in schedule), the concerning parties were notified immediately and a new date was planned and communicated. Third, to prevent understaffing and to be able to provide flexibility during the data collection, we hired a large team of student-assistants to support with the data collection assessments.

COVID-19 pandemic: Challenges

An unexpected challenge to the implementation and evaluation of the skills-training programs in schools was the worldwide outbreak of COVID-19. Due to government measures, secondary schools in the Netherlands were suddenly closed to prevent the spreading of the virus (i.e., March 2020). The majority of schools in our project were in the middle of the recruitment or implementation phase and had to be cancelled. We decided to (re)start the project six months later (i.e., from September 2020), necessitating rescheduling of the programs and assessments again, which demanded a lot of the adolescents, schools, youth care organizations, and researchers. Moreover, participants who already completed the preintervention assessment, needed to complete the questionnaire again to obtain accurate preintervention data. Unfortunately, restarting the programs resulted in dropout from the intervention (not the research). Half of the participants for which the program was postponed did not attend any session of the performance anxiety program (48%) and a quarter of participants did not attend any session of the social skills program (23%). It is possible that participants dropped out because they were not motivated anymore, participants felt they did not need the support anymore, or participants did not want to miss more classes.

COVID-19 pandemic: Lessons learned

The high dropout after postponement of the intervention programs emphasizes the necessity of registering and offering the program in a timely matter. That is, programs should be offered as soon as possible after participants sign up. The longer the time between registration and the start of the program, the greater the chance that participants do not want to attend the program anymore (e.g., they forget what they signed up for, do not have the time). Furthermore, as lesson learned from the COVID-19 pandemic, both program providers and researchers should have online or hybrid options for intervention programs and data collection, respectively, readily available. This enables them to flexibly respond to lockdowns with school-closings and, for program providers, to still provide timely help to those who reported willingness to participate. The ability to flexibly shift from off- to online and back may be necessary to make studies more

resilient in the face of sudden environmental challenges, such as the COVID-19 pandemic. An alternative online option for school-based intervention programs and research may prevent cancellation and participant dropout. Yet, although online programs can have a positive effect on adolescent mental health, moderate to high rates of non-completers have been found (Clarke et al., 2015). Hence, further research examining the effectiveness and adherence of online programs is warranted.

DISCUSSION

In the present study, we describe the implementation process of two school-based skills-training programs and accompanying RCTs in a diverse (i.e., mixed ethnic identity and educational level) sample of adolescents. Although some of the challenges we experienced were not unique to our study, such as creating and maintaining positive relationships with involved parties and logistical issues (Gee et al., 2021), the present study adds to the literature by providing experiences of participating school personnel and trainers, next to experiences of the research team. To this end, schools and youth care organizations were interviewed to give insight into their perspectives, enriching the evaluation of this project by providing a comprehensive overview of implementation challenges and lessons learned.

Based on our experiences, we have several recommendations for those planning to implement and evaluate targeted school-based intervention programs promoting adolescent mental health (Box 5.1). Our experiences, as well as those of involved parties, underscore that it is possible to effectively implement and evaluate skills-training programs in schools, but that it requires investing time, maintaining close contact and clear communication with and between involved parties (e.g., adolescents, school personnel, parents, trainers), and a research team characterized by flexibility and a problem-solving attitude. This means that researchers need to be 'on-call' to detect potential problems during the whole process, which requires tight management and up-to-date administration of the situation at each specific school and individual participant. In case of any obstacle, researchers should immediately contact the concerning parties and propose adequate solutions. Overall, flexibility and close contact are the key ingredients of successful program implementation and effectiveness research. In addition, as no school is the same, and every school presents unique opportunities as well as challenges (Wagner et al., 2004), it is important to provide tailored plans regarding

implementation and evaluation, adjusting to the needs of each individual school and its unique population.

One limitation of the present study is that we did not interview adolescents, parents, or contact persons of the school that withdrew from participation, which could have yielded additional and novel perspectives. Nevertheless, our findings provide extensive insights regarding the implementation and evaluation of school-based intervention programs as experienced by researchers, schools, and youth care organizations (i.e., external facilitators of the programs). In order to improve further research, more knowledge is needed from adolescents and parents who are offered (and participate in) such programs and accompanying research.

CONCLUSION

The present study describes the challenges we encountered during the implementation and evaluation of two school-based skills-training programs. We are convinced that the challenges we experienced also apply to other effectiveness studies of intervention programs within schools, which makes our experiences relevant to others who plan to implement and evaluate such programs. Successful implementation and evaluation of school-based intervention programs requires clear communication, close and regular contact, flexibility, and the development of school-specific protocols, tailored to the needs of each school and their unique population. We would like to stress the importance of paying attention to the implementation process of intervention programs in effectiveness research. Although successful implementation may be crucial for program effectiveness, few studies present explicit and comprehensive information about this. Despite the challenges, it is important that school-based intervention programs are effectively implemented to improve adolescents' mental health. Schools are an ideal environment to reach large groups of adolescents and offer preventive care, particularly for adolescents who are reluctant to search for care outside the school. Moreover, tackling (and thus limiting) challenges of program implementation is essential for effectiveness research to learn what works and for whom (i.e., improving care and support for adolescents), as well as for the sustainability of such programs.

Box 5.1: Recommendations for successful implementation and evaluation of targeted school-based intervention programs promoting adolescent mental health.

- The key for a productive and positive collaboration with involved parties is investing time in positive and clear communication, close contact, organize regular meetings (i.e., at least once a week), and keeping everyone up-to-date.
- In order to effectively implement and evaluate intervention programs, it is important that all involved parties are supportive of the project and are willing to actively contribute to all the steps of the process.
- Participating parties should agree with and stand behind every (major) decision, as this increases motivation to cooperate and finish the project.
- As no school is the same, it is recommended to develop school-specific protocols to benefit from the unique opportunities at each site, whilst assuring adherence to a common standardized approach.
- Motivate and enthuse school personnel (e.g., mentors, teachers) to be actively involved in the project, as they can help with participant recruitment and retention.
- Use multiple distributors (e.g., researchers, school staff) and methods (e.g., website, calling) to convey the information to adolescents (and parents).
- The information that adolescents (and parents) receive should be accessible, clear, and understandable, so that they can make a thoughtful decision about participation in intervention and research.
- Give adolescents and parents the opportunity to give digital informed consent, as giving digital consent is without intermediate steps or persons, increasing the chance of registration.
- It is important that the intervention programs and assessments are scheduled to benefit the adolescents (i.e., that it fits well within their schedules), that it is offered at the adolescents' own school location, and that the schedule is communicated well on-time to adolescents and trainers.
- It is crucial that adolescents understand why participation is important and why attending one of the programs is valuable for them, as this increases motivation and program attendance.
- To prevent high attrition rates, no-shows, or dropout, it is important that the program is appealing to participants (e.g., valuable, attractive) and that trainers connect with the participants and create a safe environment, so that participants want to come back.
- It is important that researchers are extremely flexible and readily available to overcome obstacles during implementation and evaluation as quickly as possible.
- It is necessary to keep track of all the steps of the implementation and evaluation process (i.e., tight management and excellent administration) at each school and for each individual participant.

Appendix A5.1 Questions asked to school liaisons and trainers (i.e., youth care organizations).

Number	Question
#1a	What do you think of the intervention programs?
#1b	What do you think of the research?
#2a	How did (up to now) the implementation of the intervention programs go at your school?
#2b	How did (up to now) the implementation of the research go?
#3	What challenges have you encountered (during the intervention programs and research)?
#4a	How did the recruitment of adolescents go (at your school)?
#4b	What were your hopes and expectations in this area, and how did the recruitment match this?
#5	What would help in recruiting adolescents?
#6	How can we prevent dropout? During the intervention programs and participation in research?
#7	In your experience, what did you think of working with the youth care organizations / schools and researchers to get this project off the ground? What worked well and what did not?
#8	How did you ensure that everyone involved in the project remained involved (e.g., students, teachers, school leaders)?
#9	What were the reactions of colleagues to this project?
#10	What were the adolescents' reactions to this project? Were there any differences in responses (e.g., based on gender, educational level)?
#11a	How can the project continue (in your school)? What is needed for this?
#11b	Are specific COVID-19 adjustments required?
#12	Is there anything else you would like to share with the research team (e.g., tips, tricks)?

Note. Questions were slightly different for interviewees of schools or youth care organizations (e.g., “at your school” was added for interviews with school liaisons).



CHAPTER 6

The Effectiveness of School-Based Skills-Training Programs Promoting Adolescent Mental Health: A Randomized Controlled Study

This chapter is adapted from:

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Miers, A. C., Saab, N., Westenberg, P. M., & Asscher, J. J., (under review). The effectiveness of school-based skills-training programs promoting adolescent mental health: A randomized controlled study.

Author contributions:

AL conceived and participated in the design of the study, coordinated and conducted the data collection, performed data analysis, and drafted the manuscript. HC conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. SV participated in data collection and interpretation, and critically revised the manuscript. AM, NS, and MW participated in data interpretation and critically revised the manuscript. JA conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. All authors read and approved the final manuscript.

ABSTRACT

Given that high levels of stress during adolescence are associated with negative consequences, it is important that adolescents with psychological needs are supported at an early stage, for instance with interventions at school. However, knowledge about the potential of school-based programs targeting vulnerable, at-risk adolescents, aimed at reducing school or social stress, is lacking. The current study, therefore, aimed to investigate the effectiveness of two targeted school-based skills-training programs promoting adolescent mental health, addressing either skills to deal with performance anxiety or social skills. Two randomized controlled trials were performed with participants who self-selected to one of the programs. The sample comprised of $N = 361$ adolescents ($M_{\text{age}} = 13.99$ years, $SD = 0.83$) from various educational levels and ethnic identity backgrounds. The performance anxiety program included $N = 196$ participants ($N = 95$ in the experimental group), while the social skills program included $N = 165$ participants ($N = 86$ in the experimental group). Results showed that the performance anxiety program had a small effect on reducing adolescents' test anxiety. Furthermore, for adolescents who attended more than half of the sessions, the program had small effects on reducing test anxiety and fear of failure. The program did not improve adolescents' coping skills or mental health. The social skills program was not effective in improving social skills, social anxiety, and mental health. Overall, a relative short, targeted performance anxiety program was beneficial in reducing adolescents' performance anxiety. It may be worthwhile to offer and implement such programs in secondary schools.

Keywords: Adolescents; School-Based Interventions; Effectiveness; Stress; Mental Health.

INTRODUCTION

Adolescence is a period of physical, psychological, and social developments (Christie & Viner, 2005), including puberty, the transition to secondary school, peer identification, and seeking independence. Moreover, adolescence is a period of elevated stress-sensitivity and increased risk of developing mental health problems (Andersen & Teicher, 2008; Romeo, 2013). High levels of stress throughout this developmental phase have been associated with various negative outcomes, including internalizing and externalizing problems (Snyder et al., 2017), burnout (Walburg, 2014), reduced well-being (Chappel et al., 2014), reduced academic performance (Arsenio & Loria, 2014), and school drop-out (Dupéré et al., 2015). To prevent adverse outcomes, it is important to support adolescents with psychological needs (i.e., vulnerable, at-risk adolescents) at an early stage.

Interventions aimed at stress reduction may be more appealing to adolescents with psychological needs than mental health interventions (e.g., targeting anxiety or depression). Given that adolescents are exposed to various stressors (e.g., related to school, family, and peers; Núñez-Regueiro & Núñez-Regueiro, 2021), and most adolescents experience stressors related to school or social situations at any given moment, interventions focusing on stress reduction may be perceived by adolescents as a low-threshold and encouraging way to address their psychological needs. The school environment is particularly suitable for such interventions, as adolescents spend a large amount of their time at school (Hofferth, 2009), and the school context is important for adolescents' emotional, social, and cognitive development (Roeser et al., 2000). Providing adolescents with appropriate tools to regulate their emotions and adequately cope with stress-inducing factors might prevent the development of mental health problems and promote adolescents' well-being. The current study investigated the effectiveness of two school-based skills-training programs promoting adolescent mental health, by targeting either school or social stress.

A recent systematic review demonstrated that the most salient domains of negative stressors among adolescents are related to the family (e.g., issues with parents), the school (e.g., school pressure), the self (e.g., health issues), and peers (e.g., romantic issues; Núñez-Regueiro & Núñez-Regueiro, 2021). School-related stressors are often experienced by adolescents, and include school pressure (e.g., taking exams, workload), school performance (e.g., keeping up with school work), and academic difficulties (e.g., failure in exams, poor grades; Anniko et al., 2019; Núñez-Regueiro & Núñez-Regueiro,

2021; Vogelaar et al., 2022). For instance, in the Netherlands, one in three secondary students experience stress and pressure from school (Kleinjan et al., 2020; Stevens et al., 2018). Furthermore, in various European countries, particularly higher income countries, increases in school stress have been demonstrated over the last two decades (Cosma et al., 2020, 2021; Stevens et al., 2018). As a recent study demonstrated positive associations between performance anxiety and school-based distress (Fernández-Sogorb et al., 2021), improving skills to deal with performance anxiety may be a promising target to reduce school-related stress and prevent mental health problems in adolescents.

Previous literature demonstrated the potential of school-based interventions targeting test anxiety, that is, a situation-specific form of (performance) anxiety evoked by evaluative or testing situations (von der Embse et al., 2017). Systematic reviews and recent studies showed that school-based interventions consisting of biofeedback and cognitive and/or behavioral frameworks had small to large effects on reducing adolescents' test anxiety (O'Driscoll & McAleese, 2021; Putwain & von der Embse, 2021; Soares & Woods, 2020; von der Embse et al., 2013). In addition, school-based test anxiety interventions also improved mental health outcomes of adolescents, including reduced physiological stress (Bradley et al., 2010) and internalizing problems (O'Driscoll & McAleese, 2021; Weems et al., 2014), and resulted in an increase in self-esteem (Yahav & Cohen, 2008) and self-compassion (O'Driscoll & McAleese, 2021). Nevertheless, knowledge on the effectiveness of school-based interventions targeting test anxiety remains limited for a number of reasons. First, systematic reviews indicated that not all interventions were effective in reducing test anxiety (Soares & Woods, 2020; von der Embse et al., 2013), suggesting differences in effectiveness (e.g., between interventions, samples, or studies) that are not yet understood. Second, methodological issues limit the robustness of previous studies' results. More specifically, only half of the studies used a randomized controlled design, which provides the strongest evidence for causal relations between intervention and outcome. Third, half of the studies focused on classroom or universal interventions rather than targeted interventions (i.e., aimed at high-risk selective samples), leaving the effectiveness for at-risk students and targeted interventions partly unknown. Fourth, previous studies mainly focused on interventions to reduce test anxiety, while research on interventions targeting the broader performance anxiety in adolescents is scarce and mainly focuses on specific populations, such as music students (Burin & Osório, 2016), athletes (Cadieux et al., 2021), or young children (Blanco et al., 2015). Although results from these studies are encouraging, they cannot be generalized to the larger group of adolescents. Overall, even though available research in adolescents yields

promising results regarding the potential of school-based interventions to reduce test and performance anxiety, more robust research on the effectiveness of targeted school-based interventions addressing skills to deal with performance anxiety in adolescents is necessary.

Besides school-related stressors, stressors related to social situations are also common and intense among adolescents, including issues with parents (e.g., conflicts, arguments, misunderstandings), romantic relationships, and peer pressure (Anniko et al., 2019; Núñez-Regueiro & Núñez-Regueiro, 2021). For instance, various studies suggest that a substantial proportion of adolescents in European countries experience limited family and peer support (28% and 40%, respectively; Inchley et al., 2020; Stevens et al., 2018), and that one in ten Dutch adolescents experience stress related to social problems (e.g., problems or disagreements at home, quarrels with others; Kleinjan et al., 2020). As dysfunctional relationships and factors that disrupt the relationship or interaction with others, such as isolation, rejection, or disagreements can evoke stress (Ditzen & Heinrichs, 2014; Juth & Dickerson, 2013), improving social skills might reduce social stress and promote mental health in adolescents. More specifically, learning or improving skills to initiate and maintain positive social relationships (e.g., assertiveness, communication skills) may protect against mental health problems among adolescents (Eskin, 2003). Indeed, previous research demonstrated that assertive behavior (e.g., expressing one's own opinion, displaying positive feelings) was negatively associated with adolescent mental health (e.g., internalizing problems, self-esteem; Sarkova et al., 2013) and that assertiveness training reduced levels of stress and improved mental health in adolescents (Parray & Kumar, 2017).

A meta-analysis and various studies have demonstrated the potential of school-based programs to improve social and emotional skills, as well as mental health outcomes (e.g., emotional distress, internalizing problems, self-concept) and behavioral problems (Durlak et al., 2011; Gaspar et al., 2018; Schonert-Reichl & Lawlor, 2010). Yet, only universal interventions (i.e., aimed at the entire student body) were examined (Durlak et al., 2011; Gaspar et al., 2018; Schonert-Reichl & Lawlor, 2010). Research focusing on school-based targeted interventions addressing social skills are scarce. Likely, targeted programs are more beneficial for vulnerable, at-risk adolescents (i.e., adolescents with psychological needs), as previous research showed that targeted interventions (i.e., aimed at high-risk selected samples) were more effective than universal interventions (Feiss et al., 2019; van

Loon et al., 2020; Werner-Seidler et al., 2017). Overall, more research on the effectiveness of targeted school-based interventions addressing social skills in adolescents is needed.

Taken together, although previous research suggests that universal school-based intervention programs have the potential to reduce test anxiety and improve social skills, as well as improve mental health outcomes, knowledge about the potential of targeted school-based skills-training programs addressing either skills to deal with performance anxiety or social skills is lacking. Therefore, the current study aimed to examine the effectiveness of two targeted school-based skills-training programs promoting adolescent mental health by targeting either school or social stress, where participants self-selected to either the performance anxiety program or the social skills program (van Loon et al., 2019). With two randomized controlled trials, we examined the effectiveness of 1) the performance anxiety program in improving skills to deal with performance anxiety (i.e., coping skills), reducing performance anxiety (i.e., fear of failure and test anxiety), and improving mental health (i.e., reduced stress, internalizing, and externalizing problems, and increased well-being and self-esteem); and 2) the social skills program in improving social skills, reducing social anxiety, and improving mental health (i.e., reduced stress, internalizing, and externalizing problems, and increased well-being and self-esteem).

METHODS

Design and procedure

This study was performed in the context of a larger project to identify vulnerable, at-risk adolescents and provide them with appropriate help, following a Response to Intervention model (RtI) (Kearney & Graczyk, 2014). First, classes of students received psychoeducation about stress (i.e., Stress Lessons) and were asked about their knowledge about stress and experienced stress levels (i.e., Tier 1 of the RtI model: universal intervention for all students). Next, after these three educative lessons, students were offered to learn more about dealing with school or social stress by attending a skills-training program at their school. Students self-selected to either the performance anxiety program or the social skills program (i.e., Tier 2 of the RtI model: targeted intervention for a selected sample of students). Students who self-enrolled in one of the skills-training programs were asked to participate in the present study.

Two randomized controlled trials were conducted for both skills-training programs. Students (and parents) received written information about the skills-training programs that were offered and received an information letter about the corresponding study (on paper and via email). Effort was put into promoting the skills-training programs to students (and parents), including motivating mentors and school staff, giving presentations (about the programs and study) during classes, sending a promotion video (by trainers of the programs), and telephoning parents. Students and parents provided active informed consent for the students' participation in the study. Participants were randomly allocated by the first author (stratified for educational level, using a computerized randomization in a 1:1 ratio) into the experimental (for which the training started immediately) or the waitlist control group. Before the start of the skills-training programs (T1) and immediately after completion of the intervention programs (T2), program targets (i.e., skills to deal with performance anxiety or social skills), direct program outcomes (i.e., performance or social anxiety), and mental health outcomes (i.e., stress, internalizing and externalizing problems, self-esteem, and well-being) were assessed in both groups. Participants filled in the questionnaires individually in small groups (i.e., not during classes), under supervision of one or multiple researchers. Filling out the questionnaires took approximately 45 minutes. The current study is registered in the Netherlands Trial Register (number NL7548) and the Ethical Committee Psychology of Leiden University approved the design of the study (CEP19-1210/577; for study protocol, see van Loon et al., 2019).

Participants

This project was performed at nine secondary schools located in one of the four largest cities in the Netherlands. As it is essential that various groups are represented in study samples, especially socially disadvantaged groups (e.g., groups of lower socioeconomic status) (Bonevski et al., 2014), the programs were evaluated in a heterogeneous sample of adolescents, with different ethnic identity backgrounds and educational levels (i.e., from practical to preuniversity education level).

In total, 379 participants registered for the skills-training programs (see Figure 6.1 for the flow chart of the study). More than half of the participants registered for the performance anxiety program (55.7%; $N = 211$, with $n = 104$ in the experimental group), while the other participants registered for the social skills program (44.3%; $N = 168$, with $n = 87$ in the experimental group). Some participants were excluded from the sample because they were not targeted as intended ($N = 68$) (Figure 6.1). From the total sample, 18 participants

(4.7%, with $n = 15$ in performance anxiety program and $n = 3$ in the social skills program) were lost to follow-up (i.e., dropped out of the study at T2). For the performance anxiety program, dropouts were more often participants from the lowest educational level at T1 ($\chi^2 = 6.831, p = .029$). For the social skills program, dropouts had higher levels of well-being at T1 ($t = -5.905, p = .002$). There were no other differences at T1 between participants and dropouts regarding demographics (i.e., age, number of siblings, gender, educational level, school year, financial problems, country of birth, ethnic identity, and living situation) and study variables. Dropouts were excluded from the analyses (see Figure 6.1). The final sample comprised $N = 361$ adolescents between 12 and 17 years old ($M_{age} = 13.99$ years, $SD = 0.83$, 51.6% female). Table 6.1 presents further details about demographics of the samples.

Figure 6.1 Flow chart of both school-based skills-training programs

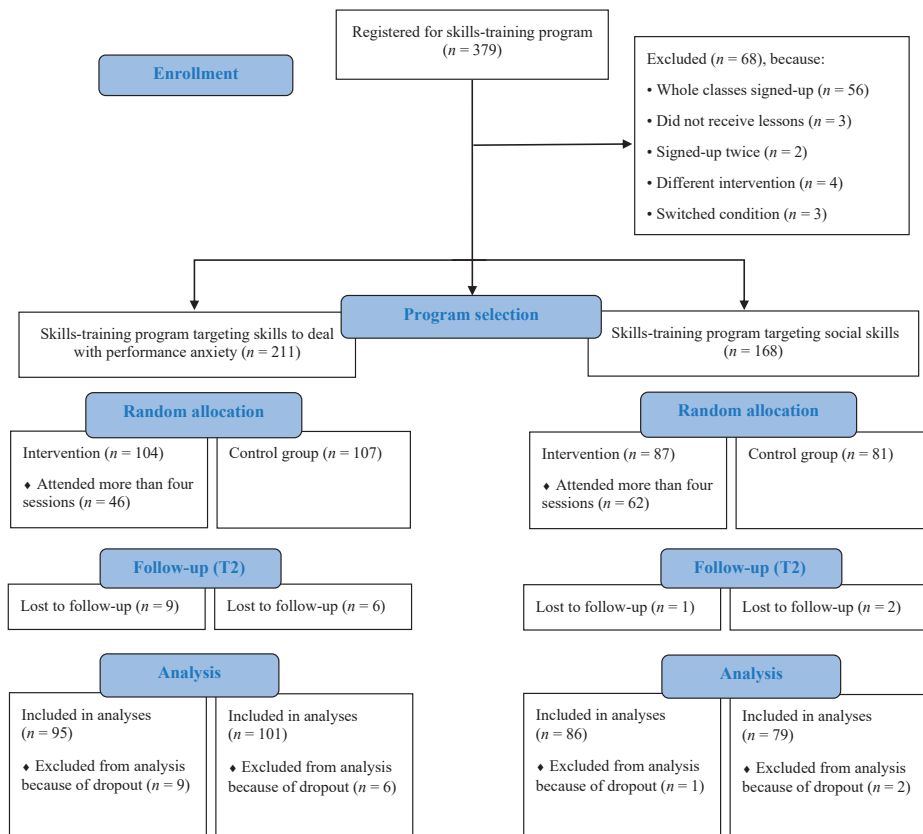


Table 6.1 Demographics at baseline (T1) and differences at T1 between the experimental and control group for both school-based skills-training programs

Variables	Performance anxiety program				Social skills program			
	Experimental group (N = 95)	Control group (N = 101)	Differences at T1		Experimental group (N = 86)	Control group (N = 79)	Differences at T1	
	M (SD)	M (SD)	t (p)	X ² (p)	M (SD)	M (SD)	t (p)	X ² (p)
Age	14.14 (0.75)	14.11 (0.82)	0.262 (.794)		13.86 (0.89)	13.81 (0.84)	0.382 (.703)	
Number of siblings	1.74 (1.24)	1.94 (1.30)	-1.120 (.264)		1.95 (1.48)	1.94 (1.31)	0.077 (.939)	
	N (%)	N (%)			N (%)	N (%)		
Female	58 (61.1)	45 (44.6)	5.344 (.015)		41 (47.7)	42 (53.2)	0.496 (.292)	
Educational level			0.119 (.950)				0.022 (1.000)	
Practical-prevocational education	31 (32.6)	34 (33.7)			38 (44.2)	35 (44.3)		
Prevocational/senior general education	26 (27.4)	29 (28.7)			20 (23.3)	19 (24.1)		
Senior general-preuniversity education	38 (40.0)	38 (37.6)			28 (32.6)	25 (31.6)		
School year			1.929 (.593)				3.668 (.303)	
First year	12 (12.6)	17 (16.8)			18 (20.9)	24 (30.4)		
Second year	62 (65.3)	62 (61.4)			52 (60.5)	41 (51.9)		
Third year	14 (14.7)	11 (10.9)			9 (10.5)	11 (13.9)		
Fourth year	7 (7.4)	11 (10.9)			7 (8.1)	3 (3.8)		
Financial problems	5 (5.3)	6 (5.9)	0.042 (.542)		5 (5.8)	3 (3.8)	0.363 (.408)	
Country of birth: the Netherlands	78 (82.1)	87 (86.1)	0.598 (.282)		78 (90.7)	70 (88.6)	0.195 (.426)	
Ethnic identity			1.124 (.601)				1.809 (.411)	
Western	50 (52.6)	59 (58.4)			46 (53.5)	36 (45.6)		
Western-non-Western	12 (12.6)	14 (13.9)			13 (15.1)	18 (22.8)		
Non-Western	33 (34.7)	28 (27.7)			27 (31.4)	25 (31.6)		
Living situation: living with both parents	67 (70.5)	63 (62.4)	1.456 (.146)		59 (68.6)	55 (69.6)	0.020 (.511)	

Note. Program 1 = skills-training program targeting skills to deal with performance anxiety; program 2 = skills-training program targeting social skills.

The first cohort of data collection started and finished in the school year 2018/2019 at three schools ($N = 89$ participants, see Appendix, Table A6.1). The second cohort started in the school year 2019/2020 at nine (six additional) schools. Two schools finished the skills-training programs before the COVID-19 pandemic and school closings ($N = 55$ participants). Due to the COVID-19 pandemic and the abrupt closing of the schools (from March 16, 2020), the skills-training programs that had started in February 2020 at five schools were cancelled after 2-4 sessions. At four of these schools, the programs restarted in September 2020 when the schools reopened. Furthermore, two schools had not yet started with the skills-training programs in February 2020. Programs at these schools were postponed to September 2020. Unfortunately, having to restart or postpone the programs in these six schools resulted in drop-out from the intervention (not the assessments): half of the participants at these schools did not attend any session of the performance anxiety program ($N = 30$ of 62 participants) and a quarter did not attend any session of the social skills program ($N = 11$ of 48 participants).

School-based skills-training programs

The skills-training programs were provided at the schools by trained professionals from three youth care organizations. Each skills-training program consisted of seven 45-minute small-group sessions during consecutive weeks. The groups consisted of approximately eight students (range of 3-16 participants), with one or two professional trainers per group.

Performance anxiety program

The performance anxiety program consisted of psychoeducation (e.g., different forms of performance anxiety, consequences of stress), cognitive coping strategies (e.g., negative thought restructuring, managing emotions), dealing with (school) pressure (e.g., keeping focus, planning skills), and relaxation techniques (e.g., breathing exercise). With regard to program integrity, on average, 90% of the program assignments were correctly implemented (i.e., assignments were executed consistent with the protocol, self-reported by the trainers). In the remainder, program assignments could not be completed within the time frame.

Social skills program

The program targeting social skills consisted of social skill building (e.g., identifying personal qualities, giving own opinions, standing up for yourself, setting boundaries) and cognitive coping strategies (e.g., managing emotions). Regarding program integrity, on average, 89% of the program assignments were correctly implemented. Again, the other assignments could not be completed due to time constraints.

Control group

The waitlist control group did not receive any training during the implementation of the intervention program in the experimental group. The control group received the skills-training program after completion of the postintervention measurement (T2), approximately eight weeks later than the experimental group.

Instruments

Demographics

Characteristics of adolescents were collected at baseline (T1), including gender, age, number of siblings, country of birth, ethnic identity, educational level (and school year), living situation, and financial problems. We assessed *ethnic identity* by asking which identity the participants felt most connected to (I see myself as: “Dutch, Indonesian, Turkish, Moroccan, Surinamese, Antillean, or other”) and distinguished three groups: Western (e.g., Dutch), mix Western-non-Western (e.g., Dutch-Turkish) or non-Western (e.g., Moroccan). *Educational level* of participants was assessed by the class they were in (e.g., practical education, preuniversity education). Three groups were distinguished: practical-prevocational education students (i.e., lowest educational level), prevocational/senior general education students, and senior general-preuniversity education students (i.e., highest educational level). *Living situation* was distinguished by adolescents who lived with both their parents (in the same house) versus adolescents who reported something else. *Financial problems* were assessed by asking participants about financial problems in their family.

Program targets

Skills to deal with performance anxiety were assessed with the Dutch version of the Cognitive Emotional Regulation Questionnaire, short form (CERQ-short) (Garnefski & Kraaij, 2006). Participants completed an 18-item self-report questionnaire measuring cognitive related coping, measured on a 5-point Likert scale ranging from 1 (*never*) to

5 (*always*). The questionnaire consists of nine subscales, divided into maladaptive and adaptive coping (Garnefski et al., 2001). The maladaptive coping scale consists of the subscales self-blame, other-blame, rumination, and catastrophizing (e.g., “I keep thinking about how terrible it is what I have experienced”). The adaptive coping scale consists of the subscales acceptance, refocus on planning, positive refocusing, positive reappraisal, and putting into perspective (e.g., “I think I can learn something from the situation”). A higher score reflects more maladaptive coping ($\alpha = .81$ at T1 and $\alpha = .84$ at T2; 8 items) or adaptive coping ($\alpha = .82$ at T1 and $\alpha = .88$ at T2; 10 items).

Social skills were assessed with the Scale for Interpersonal Behavior of Adolescents (SIG-A) (Arrindel et al., 1984; Bijstra & Oostra, 2000). Participants completed a questionnaire of 47 situations, evaluating how often they experienced these specific situations (i.e., frequency), based on a scale ranging from 1 (*never*) to 5 (*always*). The questionnaire consists of four subscales that refer to specific social situations: 1) display negative feelings (14 items, e.g., “If someone interrupts you, saying you find that annoying”), 2) express personal limitations (13 items, e.g., “Asking for an explanation about something that you did not understand”), 3) initiate assertiveness (9 items, e.g., “Starting a conversation with someone you have not met before”), and 4) display positive feelings (8 items, e.g., “Agreeing when someone makes a compliment about your appearance”). A higher score reflects more display of negative feelings ($\alpha = .83$ at T1 and $\alpha = .87$ at T2), expression of personal limitations ($\alpha = .84$ at T1 and $\alpha = .88$ at T2), assertiveness ($\alpha = .84$ at T1 and $\alpha = .87$ at T2), and display of positive feelings ($\alpha = .81$ at T1 and $\alpha = .85$ at T2).

Direct program outcomes

Performance anxiety was assessed with two questionnaires, measuring fear of failure and test anxiety (i.e., anxiety in school testing situations). The Dutch short form of the Performance Failure Appraisal Inventory (PFAI) (Conroy et al., 2002) and the Dutch short version of the Spielberger Test Anxiety Inventory (TAI) (Spielberger, 1980; van der Ploeg, 1984) were used, respectively. The PFAI is a 5-item self-report questionnaire (e.g., “When I am failing, I am afraid that I might not have enough talent”), measured on a 5-point scale ranging from -2 (*do not believe at all*) to 2 (*believe 100% of the time*). The TAI is a 20-item self-report questionnaire (e.g., “During tests I feel very tense”), measured on a 4-point scale ranging from 1 (*almost never*) to 4 (*almost always*). Higher (positive) scores reflect more fear of failure (PFAI, $\alpha = .84$ at T1 and $\alpha = .89$ at T2) or test anxiety ($\alpha = .93$ at T1 and $\alpha = .88$ at T2).

Social anxiety was assessed with the social phobia scale of the Revised Child Anxiety and Depression Scale (RCADS) (Chorpita et al., 2000), Dutch version. Participants completed a 9-item self-report questionnaire (e.g., “I worry what other people think of me”), measured on a 4-point scale ranging from 0 (*never*) to 3 (*always*). A higher score reflects more social anxiety ($\alpha = .89$ at T1 and $\alpha = .90$ at T2).

Mental health outcomes

Stress levels of participants was assessed with the Chronic Stress Questionnaire for Children and Adolescents (CSQ-CA) (de Bruin et al., 2018). Participants completed a 17-item self-report questionnaire (e.g., “I often get upset about things that are not important”), measured on a 4-point scale ranging from 1 (*not true for me at all*) to 4 (*completely true for me*). A higher score reflects more stress ($\alpha = .83$ at T1 and T2).

Internalizing and externalizing problems were assessed with the Dutch version of the Youth Outcome Questionnaire (Y-OQ-30.1) (Dunn et al., 2005). The self-report questionnaire consists of 30 items, measuring psychological symptoms and social functioning on a 5-point Likert scale ranging from 0 (*never*) to 5 (*always*). It consists of six subscales: Somatic complaints, social isolation, aggression, conduct problems, hyperactivity/distractibility, and depression/anxiety. Internalizing problems were assessed with the subscale depression/anxiety (six items, e.g., “I am sad or unhappy”). Externalizing problems were assessed with the subscales aggression and conduct problems (nine items, e.g., “I fight with adults”). Higher scores reflect more internalizing problems ($\alpha = .83$ at T1 and $\alpha = .85$ at T2) or externalizing problems ($\alpha = .88$ at T1 and $\alpha = .90$ at T2).

Self-esteem was measured with the Dutch version of the Rosenberg Self-Esteem Scale (RSES) (Franck et al., 2008; Rosenberg, 1965). Participants completed a 10-item self-report questionnaire (e.g., “At times I think I am no good at all”), based on a 4-point scale ranging from 1 (*strongly agree*) to 4 (*strongly disagree*). A higher score reflects more self-esteem ($\alpha = .87$ at T1 and $\alpha = .86$ at T2).

Well-being was measured with the WHO-Five Well-Being Index (WHO, 1998), Dutch version. Participants were asked to think about the past two weeks and report how they felt. The self-report questionnaire consists of five statements (e.g., “My daily life has been filled with things that interest me”), based on a 6-point scale ranging from 0 (*at no time*) to 5 (*all of the time*). The score was multiplied by four to create the final score (i.e., 0-100), with higher scores reflecting more positive well-being ($\alpha = .85$ at T1 and $\alpha = .89$ at T2).

Statistical analyses

Statistical analyses were performed using SPSS version 25. Descriptive analyses were performed for all study variables. We followed an intention-to-treat approach, and included all participants in the analyses (including participants who did not start the intervention or attended only a few sessions) to reduce motivation as a potential confounding effect and to examine the effectiveness of the assigned program (Montori & Guyatt, 2001). To check whether the randomization was successful, differences between the experimental and control groups at T1 (e.g., demographics, mental health outcomes) were investigated by conducting independent t-tests and chi-square tests.

To test the effectiveness of both school-based skills-training programs, multivariate analyses of covariance (MANCOVA's) were performed for the three outcome domains (i.e., program targets, direct program outcomes, and mental health outcomes). The posttest outcome measures (i.e., at T2) were included as dependent variables and condition (i.e., experimental and control group) was included as a fixed factor. The pretest outcome measures (i.e., at T1) and potential differences between the experimental and control group at T1 were included as covariates in the analyses. MANCOVA's that were (trend-) significant were followed by ANCOVA's, to investigate whether there was a statistically significant difference between the groups in terms of each dependent variable. Cohen's *d*'s were calculated using an online effect size calculator (Wilson, n.d.), based on standardized means and errors. A positive Cohen's *d* reflects improvements favoring the experimental group compared to the control group. Small effect sizes were considered $d = 0.20$, moderate effect sizes $d = 0.50$ and large effect sizes $d = 0.80$ (Cohen, 1988).

As the COVID-19 pandemic affected this project, we performed some additional (sensitivity) analyses to determine its impact on the results of this study. First, we investigated whether cohort influenced the results. Almost half of the participants enrolled in the skills-training programs before the COVID-19 pandemic (Cohort 1; $N = 144$). The other participants enrolled during the pandemic (Cohort 2; $N = 217$). Of Cohort 2 participants, most (Cohort 2a; $N = 181$) registered before postponement of the programs (before March 2020), while some (Cohort 2b; $N = 36$) registered at a later opportunity, shortly before the postponed programs were to start. We performed a MANCOVA (as mentioned in the previous paragraph), with cohort as a covariate (i.e., cohort 1, 2a and 2b), adding the interaction of condition versus cohort (i.e., condition*cohort). Second, we repeated the MANCOVA's in the subsamples of adolescents who attended more than four sessions (i.e., participants who attended more than 57% of the program; 46

participants (48.4%) in the performance anxiety program and 62 participants (71.3%) in the social skills program). Before the analyses, we examined differences at T1 between participants who attended more than four sessions and the control group. Materials, datasets, and analysis codes for this study are available from the corresponding author on reasonable request.

RESULTS

Differences at T1 between experimental and control group

There were no significant differences at T1 between the experimental and control group for both skills-training programs, except for gender in the performance anxiety program. There were more females in the experimental group (see Table 6.1). Hence, further analyses were performed with gender as a covariate (for the performance anxiety program only). Apart from this, the randomization was successful for both skills-training programs (see Tables 6.1-6.3).

Program target outcomes

Tables 6.2 and 6.3 present the MANCOVA results of the performance anxiety program and social skills program, respectively. Results demonstrated that for the performance anxiety program, there were no significant effects for coping skills (i.e., maladaptive and adaptive coping). The social skills program yielded no significant effects for social skills (i.e., display of negative feelings, express personal limitations, initiate assertiveness, and display of positive feelings).

Direct program outcomes

Results demonstrated that for the performance anxiety program only, there was a trend-significant effect of condition ($F(2, 190) = 2.733, p = .068, \eta_p^2 = .028$; Table 6.2). ANCOVA results demonstrated a small but significant positive effect for test anxiety ($F(1, 192) = 4.935, p = .027, d = 0.32$), indicating that participants in the intervention group showed a significant reduction in test anxiety compared to participants in the control group. A trend-significant positive effect was found for fear of failure ($F(1, 192) = 1.962, p = .056, d = 0.28$), indicating that participants in the intervention group showed a trend-significant reduction in fear of failure compared to participants in the control group. For the social skills program, there was no significant effect on social anxiety (Table 6.3).

Table 6.2 Descriptive statistics and MANCOVA results for the skills-training program targeting skills to deal with performance anxiety

Variables	Experimental group (N = 95)				Control group (N = 101)				Cohen's <i>d</i> ^a
	Pretest (T1)	Posttest (T2)	Pretest (T1)	Posttest (T2)	Differences at T1	Differences at T2	MANCOVA condition		
	M (SD)	M (SD)	M (SD)	M (SD)	F (p)	F (p)	F (p)		
<i>Program target outcomes</i>									
Maladaptive coping	17.63 (6.43)	17.79 (6.27)	18.62 (6.09)	19.45 (6.65)	-1.109 (.269)	-0.478 (.633)	1.103 (.334)	0.19	
Adaptive coping	27.74 (8.11)	27.24 (8.60)	28.28 (7.70)	28.82 (8.64)				-0.20	
<i>Direct program outcomes</i>									
Test anxiety	40.93 (11.7)	38.85 (10.60)	42.37 (13.04)	42.26 (12.69)	-0.810 (.419)			0.32	
Fear of failure	-0.80 (0.94)	-0.86 (0.97)	-0.88 (0.89)	-0.75 (0.92)	0.620 (.536)			0.28	
<i>Mental health outcomes</i>									
Stress	40.80 (7.89)	40.14 (8.38)	40.04 (8.41)	41.02 (7.84)	0.650 (.516)		0.843 (.521)	0.29	
Internalizing problems	6.01 (4.74)	6.07 (4.80)	6.63 (5.06)	7.05 (5.36)	-0.881 (.379)			0.17	
Externalizing problems	4.27 (4.18)	5.21 (5.92)	5.59 (5.69)	6.63 (6.53)	-1.846 (.067)			0.05	
Self-esteem	29.35 (5.17)	28.83 (4.96)	29.16 (6.06)	27.97 (6.18)	0.233 (.816)			0.19	
Well-being	56.80 (22.34)	57.39 (25.26)	57.44 (23.66)	55.68 (24.40)	-0.194 (.846)			0.16	

Note. Analyses were performed with gender as covariate.

^a Cohen's *d*'s were calculated based on standardized means and errors.

^b Follow-up ANCOVA's were performed.

^c N = 100 for the control group, because one participant did not complete the questionnaires.

Table 6.3 Descriptive statistics and MANCOVA results for skills-training program targeting social skills

Variables	Experimental group (N = 86)		Control group (N = 79)		Differences at T1	MANCOVA condition	Cohen's <i>d</i> ^a
	Pretest (T1)	Posttest (T2)	Pretest (T1)	Posttest (T2)				Differences at T1
	M (SD)	M (SD)	M (SD)	M (SD)	F (p)	F (p)	
<i>Program target outcomes</i>							
Display of negative feelings	40.45 (9.02)	41.37 (10.29)	41.10 (9.88)	41.95 (12.46)	-0.440 (.660)	0.221 (.927)	-0.01
Express personal limitations	42.65 (8.41)	41.65 (10.28)	42.58 (9.13)	42.25 (11.03)	0.050 (.960)		-0.08
Initiate assertiveness	27.21 (6.86)	26.29 (7.48)	26.35 (7.67)	26.29 (9.01)	0.756 (.451)		-0.13
Display of positive feelings	24.78 (6.58)	23.87 (7.24)	24.81 (6.79)	24.08 (7.77)	-0.030 (.976)		-0.03
<i>Direct program outcomes</i>							
Social anxiety	7.97 (6.19)	7.52 (5.96)	8.42 (6.81)	8.53 (6.53)	-0.447 (.655)	1.230 (.269)	0.17
<i>Mental health outcomes^b</i>							
Stress	39.05 (7.73)	38.78 (7.50)	40.10 (8.64)	40.04 (8.63)	-0.822 (.412)	0.340 (.888)	0.09
Internalizing problems	5.55 (4.83)	6.05 (5.50)	6.21 (5.20)	6.74 (5.49)	-0.831 (.407)		0.06
Externalizing problems	5.62 (5.94)	6.01 (7.46)	7.43 (8.01)	7.00 (6.90)	-1.638 (.103)		-0.02
Self-esteem	28.66 (6.16)	28.66 (5.94)	28.52 (6.38)	28.21 (6.28)	0.141 (.888)		0.09
Well-being	63.39 (23.69)	61.65 (24.41)	62.23 (21.15)	57.30 (29.02)	0.326 (.745)		0.16

^a Cohen's *d*'s were calculated based on standardized means and errors.^b N = 85 for the experimental group and N = 77 for the control group, because two participants did not complete the questionnaires.

Mental health outcomes

For both the performance anxiety program and the social skills program, no significant effects were found for mental health outcomes (i.e., stress, internalizing and externalizing problems, self-esteem, and well-being) (Tables 6.2 and 6.3).

Sensitivity analyses

For both skills-training programs, there were no significant condition*cohort effects for any of the outcomes, suggesting that program effectiveness was not affected by COVID-19-related postponement of the programs. Next, for both programs, the MANCOVA's were repeated with the subgroup of the experimental group consisting of participants who attended at least four program sessions compared to the control group. Apart from higher levels of fear of failure ($t = 2.750, p = .007$) and stress ($t = 2.210, p = .029$) in the experimental subgroup relative to the control group of the performance anxiety program, these experimental subgroups did not differ from the control groups on any of the T1 assessments (i.e., for both programs). The MANCOVA's yielded similar results for the social skills program, whereas the aforementioned significant results for the performance anxiety program were slightly stronger. That is, a significant effect was found for the performance anxiety program ($F(2, 142) = 3.824, p = .024, \eta_p^2 = .051$) and ANCOVA results demonstrated that the program effectively reduced test anxiety ($F(1, 144) = 5.073, p = .026, d = 0.41$) and fear of failure ($F(1, 144) = 4.405, p = .038, d = 0.38$). This indicates that participants who attended more than four sessions of the performance anxiety program showed significant reductions in test anxiety and fear of failure compared to participants in the control group. All other results remained unchanged.

DISCUSSION

Given that high levels of stress during adolescence are associated with negative mental health consequences and adolescents are exposed to various stressors related to school and social situations (Núñez-Regueiro & Núñez-Regueiro, 2021), interventions at school focusing on stress reduction (i.e., school or social stress) may be an appropriate way to address adolescents' psychological needs. Therefore, the current study aimed to examine the effectiveness of two targeted school-based skills-training programs promoting mental health, addressing either skills to deal with performance anxiety or social skills. Results demonstrated that the performance anxiety program had a small effect on reducing adolescents' test anxiety. Furthermore, when adolescents attended more than four sessions (i.e., more than 57% program attendance), the program had a

small effect on reducing levels of test anxiety and fear of failure. The performance anxiety program did not improve adolescents' coping skills (i.e., adaptive and maladaptive coping) nor mental health outcomes (i.e., stress, internalizing and externalizing problems, well-being, and self-esteem). The social skills program was not effective in improving any of the outcomes, including social skills (i.e., display of negative feelings, express personal limitations, initiate assertiveness, and display of positive feelings), social anxiety, and mental health.

The finding that the performance anxiety program had a small effect on reducing test anxiety is in line with previous research in adolescents (O'Driscoll & McAleese, 2021; Putwain & von der Embse, 2021; Soares & Woods, 2020; von der Embse et al., 2013), highlighting the potential of school-based skills-training programs to support adolescents who express a need for support in this area. Furthermore, our results demonstrated positive effects on test anxiety and fear of failure for adolescents that attended more than four sessions. As attending more than half of the sessions increased program effectiveness, additional efforts should be made to motivate students to attend and engage in such programs. A previous study demonstrated that motivational interviewing (e.g., explicit attention to participants hopes, experience with previous mental health treatment, external difficulties, and internal barriers) before the start of cognitive behavioral therapy enhanced treatment engagement in adolescents (Dean et al., 2016). More motivation may increase program attendance and engagement, which is likely to enhance program effectiveness, and should thus be encouraged. Although the effects were small, the performance anxiety program consisted of only seven sessions, demonstrating that even a relatively short performance anxiety program can yield positive results in reducing adolescents' performance anxiety. Overall, it appears that school-based intervention programs addressing skills to deal with performance anxiety are beneficial for adolescents with psychological needs (i.e., self-selected sample). This is promising, as school-based stress among adolescents increased over the last two decades (Cosma et al., 2020, 2021; Stevens et al., 2018) and high levels of test anxiety are associated with negative consequences, such as lower educational performance and self-esteem (von der Embse et al., 2017). Hence, governments and schools should be aware that school-based performance anxiety programs can reduce adolescents' test anxiety and fear of failure, and should offer such programs to students that suffer from school-related stress.

Alternatively, given the higher levels of stress and fear of failure for adolescents who attended more than four sessions of the performance anxiety program relative to participants in the control group, the somewhat stronger effects in the sensitivity analysis may point towards more effectiveness for adolescents with more or stronger needs. Although we did not find significant moderator effects, a recent study indicated that higher levels of baseline problems were associated with greater treatment effectiveness in adolescents (Stjerneklar et al., 2019). This may indicate that adolescents with higher initial problems have more to gain from intervention programs, which advocates the use of screening methods (e.g., self-selection) at recruitment. Further research is necessary to draw clear conclusions about the effects of initial problem severity on program effectiveness.

Interestingly, we found that the performance anxiety program improved performance anxiety without improving adolescents' coping skills. This suggests that improving coping skills was not the working mechanism by which adolescents' performance anxiety was reduced. It could be that other mechanisms were involved in reducing performance anxiety, such as increased understanding (from psycho-educative elements) or ability to relax (from relaxation techniques). Previous research, for example, demonstrated that relaxation exercises reduced test anxiety in children and adolescents (Gregor, 2005; Larson et al., 2010). Another explanation for not finding improvements in coping skills could be that participants needed more time to internalize the newly learned coping skills, and only after some additional time would report significant changes (i.e., after experiencing some challenging situations). In that case, immediate postintervention effects would be smaller or less probable than effects in the long-term (i.e., at follow-up). Therefore, future studies should also include follow-up measurements, to identify sleeper effects (i.e., improved longer term outcomes). Finally, it is also possible that our questionnaire did not fully capture skills to deal with performance anxiety, as the questionnaire was related to coping skills in general rather than specifically related to performance anxiety. Future effectiveness research should include a questionnaire that is more specific to coping with performance anxiety. For instance, questions could be developed that take into account the context of performance or test anxiety situations (e.g., dealing with exam failure, giving a presentation).

With regard to mental health outcomes, the current study showed that the performance anxiety program did not improve adolescents' mental health (i.e., stress, internalizing and externalizing problems, self-esteem, and well-being), contradicting previous research

in adolescents (Bradley et al., 2010; O'Driscoll & McAleese, 2021; Weems et al., 2014; Yahav & Cohen, 2008). In the current study, mental health problems were secondary or distal program outcomes, for which smaller effects could be expected immediately postintervention. Further, it could be that more sessions are necessary to observe significant mental health changes among adolescents. In fact, test anxiety interventions with demonstrated mental health changes also targeted general anxiety (O'Driscoll & McAleese, 2021; Weems et al., 2014) or had more and longer sessions (Bradley et al., 2010; Yahav & Cohen, 2008). Nevertheless, although we did not observe significant positive effects on coping skills or mental health outcomes, there were no negative program effects. This suggests that the targeted school-based performance anxiety program is promising as a preventive intervention for adolescents to reduce performance anxiety immediately after completion of the program.

The current study demonstrated that the targeted school-based social skills program was not effective in improving social skills, nor reducing social anxiety or improving mental health outcomes. This seems to contradict previous results, that observed positive effects for school-based social skills programs (Durlak et al., 2011; Gaspar et al., 2018; Schonert-Reichl & Lawlor, 2010). However, these programs were all universal and were mostly more intensive interventions, with ten sessions (Schonert-Reichl & Lawlor, 2010), 22 sessions (Gaspar et al., 2018), and a mean number of 40.8 sessions (Durlak et al., 2011). It could therefore be that we did not observe significant program effects because the intervention was too short or did not contain enough exercises. Indeed, a previous meta-analysis demonstrated that an optimal social skills intervention for nonclinical children and adolescents should contain three to six psychoeducation components and 11 to 20 skill-building exercises (de Mooij et al., 2020), which is more than the number of exercises in the current social skills program. Future research should take this into account and develop school-based interventions with an optimal number of sessions and components.

Alternative explanations for the absence of effectiveness of the social skills program are the heterogeneous group of participants, the broad scope of the program, and the limited transfer of skills to daily life. First, as noticed by some of the trainers, it is possible that the problems of the participants before the start of the program were too heterogeneous (e.g., social anxiety, impulsive or aggressive behavior), which might have disrupted the dynamics of the group and complicated the teaching process. Second, the social skills program consisted of teaching different social skills (e.g., assertiveness,

emotion regulation, self-esteem). Possibly, this broad rather than in-depth focus did not allow for significant improvements. Third, in order to generate positive changes, it may be necessary to practice and apply the learned social skills in everyday life, as previous research demonstrated that prevention programs with homework assignments yielded larger effects than programs without (Stice et al., 2009). Although adolescents were encouraged to practice their skills in daily life, there were no official homework assignments in the current study, which may have impeded transfer of skills in daily life. Given that few studies examined the effectiveness of targeted school-based social skills programs, further intervention studies are needed to draw conclusions about the effectiveness of such programs and effective elements in particular.

Limitations

The current study has some limitations. First, as we used a waitlist control group, long-term follow-up measurements were not possible. This is a limitation, as a previous meta-analysis investigating the effectiveness of school-based stress-reduction interventions demonstrated larger effects for follow-up compared to postintervention assessments (van Loon et al., 2020). It could be that improvements in (mental health) outcomes only manifest at a later stage in the adolescents' life (i.e., sleeper effect), not immediately after the intervention. Future intervention research should therefore also include follow-up assessments, to examine long-term effects.

Second, the usual challenges of program implementation (e.g., participant recruitment and attainment, collaboration with stakeholders, practical issues) were aggravated by the COVID-19 pandemic. As the schools had to close (suddenly), the skills-training programs at six schools were postponed and restarted, and most participants had to complete the T1 assessments again. Consequently, a subgroup of participants had to fill in the questionnaires more often than (the original) two times to control for time effects and some had to restart the intervention program at least six months later than planned. Postponement of the programs may have resulted in a lower program attendance (particularly for the performance anxiety program), for instance because adolescents felt they did not need the extra support anymore (e.g., because they were in a higher grade or were not experiencing problems), they did not want to miss any classes (i.e., the programs were mostly scheduled during school hours), or because of lack of motivation in general. In sum, implementation challenges due to the COVID-19 pandemic (e.g., multiple assessments, low program attendance), might have influenced program effectiveness. Nevertheless, program enrollment before or after the COVID-19 pandemic

did not yield different program effects, suggesting that the COVID-19 pandemic-induced challenges had little impact on program effectiveness.

CONCLUSION

In conclusion, the current study examined two targeted school-based skills-training programs promoting mental health by addressing school or social stress, yielding positive effects for the performance anxiety program but no positive effects for the social skills program. The performance anxiety program was effective in reducing adolescents' performance anxiety, indicating that a relative short performance anxiety program can be beneficial for adolescents. The social skills program was not effective in improving social skills, social anxiety, and mental health, probably because the program was too broad and/or not sufficiently intensive. As a recent meta-analysis showed that social skills interventions for nonclinical children and adolescents should contain an optimal number of (psychoeducation and skill-building) components and sessions (de Mooij et al., 2020), future research should take this into account when developing school-based skills-training programs targeting social skills. In both programs, participation was based on self-selection, demonstrating that adolescents (with psychological needs) were willing to sign up for a low threshold skills-training program at school. This is important, as the majority of adolescents with mental health problems do not receive treatment (Merikangas et al., 2011). Given the mildly positive results for the performance anxiety program, and the fact that school mental health services are associated with lower stigma (Stephan et al., 2007), it may be worthwhile to offer and implement school-based skills-training programs to reduce performance anxiety during the first years of secondary school. Nevertheless, follow-up research is needed to establish long-term effects, as well as the effective ingredients of such programs.

Appendix Table A6.1

	Before the COVID-19 pandemic (N = 144)			After the start of the COVID-19 pandemic (N = 217)			
	School year 2018/2019	School year 2019/2020	Time T1	School year 2020/2021 (restarted)	School year 2020/2021 (postponed)	Time T1	Registered in September 2020 (N = 36, 16.6%)
	N (% of total)	N (% of total)		N (% of total)	N (% of total)		N (% of school)
School 1	50 (34.7)		February 2019	40 (18.4)		September 2020	4 (10.0)
School 2	3 (2.1)		February / March 2019	6 (2.8)		September 2020	0 (0.0)
School 3	36 (25.0)		May 2019	Dropped out			
School 4		20 (13.9)	December 2019				
School 5		35 (24.3)	January 2020				
School 6				111 (51.2)		October 2020	2 (1.8)
School 7				19 (8.8)		October 2020	1 (5.3)
School 8					10 (4.6)	September 2020	7 (70.0)
School 9					31 (14.3)	October 2020	22 (71.0)

Overview of participating schools, final number of participants, and data collection cohorts



CHAPTER 7

Prepandemic Risk Factors of COVID-19-Related Concerns in Adolescents During the COVID-19 Pandemic

This chapter is adapted from:

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Miers, A., Saab, N., Westenberg, P. M., & Asscher, J. J. (2021). Prepandemic risk factors of COVID-19-related concerns in adolescents during the COVID-19 pandemic. *Journal of Research on Adolescence*, 31(3), 531-545.

Author contributions:

AL conceived and participated in the design of the study, coordinated and conducted the data collection, performed data analysis, and drafted the manuscript. HC conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. SV participated in data collection and interpretation, and critically revised the manuscript. AM, NS, and MW participated in data interpretation and critically revised the manuscript. JA conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. All authors read and approved the final manuscript.

ABSTRACT

To identify adolescents who may be at risk for adverse outcomes, we examined the extent of COVID-19-related concerns reported by adolescents and investigated which pre-pandemic risk and protective factors predicted these concerns during the COVID-19 pandemic. Dutch adolescents ($N = 188$; $M_{\text{age}} = 13.49$, $SD = .81$) were assessed before the pandemic and at eight and ten months into the pandemic. Results demonstrated that adolescents' most frequently reported COVID-19-related concerns were about social activities and getting delayed in school. Adolescents that have specific vulnerabilities before the pandemic (i.e., higher stress, maladaptive coping, or internalizing problems) experience more concerns during the pandemic, stressing the importance of guiding and supporting these adolescents in order to prevent adverse developmental outcomes.

Keywords: Adolescence, COVID-19, Stress, Mental Health, Longitudinal.

INTRODUCTION

Society at large is heavily affected by the coronavirus disease 2019 (COVID-19) crisis and the accompanying national government measures to prevent the spread of the virus. However, a hitherto somewhat understudied group in pandemic research are adolescents (Francisco et al., 2020), a group that may be particularly affected by the drastic changes on daily lives since the outbreak of COVID-19. Adolescence is a period of social development, in which the social environment is increasingly important, especially interactions with peers (Blakemore & Mills, 2014). During this developmental period, adolescents seek independence from their parents and the interaction with and influence of peers increases significantly (de Goede et al., 2009). Yet, with social distancing being enforced by the government, the opportunities and possibilities for (social) experiences outside the family home are reduced. In the Netherlands for instance, as of 15th March 2020 public spaces (e.g., schools, restaurants, cinemas, sport clubs) were closed and public gatherings were prohibited in order to minimize social interactions. As schools were closed and people were strongly advised to work from home, adolescents and their families (e.g., parents, siblings) were forced to spend most of their time at home, together. Moreover, instead of going to school, adolescents had to switch to online education. Although from 2nd June 2020, schools gradually re-opened (with, in secondary schools, a combination of physical and online education) and other measures were partially lifted (e.g., restaurants and cinemas were allowed to open, as well as sport clubs, yet with a maximized number of visitors to ensure social distancing), other measures were tightened or put into effect (e.g., limiting group sizes, wearing face masks). Moreover, as of 15th December 2020, a hard lockdown was in effect, with public spaces closed, as well as all non-essential shops. Furthermore, schools were closed again and students had to switch back to online education (i.e., schools were closed until the end of February 2021 and only partly reopened from March 2021).

The restrictions on adolescents' daily life and physical peer interactions in particular, the changing demands with regard to school, and the uncertainty about the pandemic and restrictions can cause concern in adolescents. Previous research conducted at the beginning of the COVID-19 pandemic (i.e., April-June 2020; in Canada, Australia, and Spain) demonstrated that adolescents between 13 and 18 years old were very concerned about the COVID-19 pandemic, specifically about school and not being able to see their friends, and to a lesser degree about a loved one becoming ill, finances, and becoming ill themselves (Ellis et al., 2020; Magson et al., 2020; Muñoz-Fernández & Rodríguez-

Meirinhos, 2021). Girls reported higher COVID-19 stress levels than boys (Ellis et al., 2020; Muñoz-Fernández & Rodríguez-Meirinhos, 2021). Other research indicated that German adolescents aged 11 to 17 years felt burdened and reported that homeschooling and learning was more difficult at the beginning of the COVID-19 pandemic (Ravens-Sieberer et al., 2021). Yet, while some adolescents might experience the COVID-19 pandemic and accompanied restrictions as very stressful and worrisome, others might adapt quickly to the situation and try to make the most of it (Brailovskaia & Margraf, 2020; Dvorsky et al., 2020). How adolescents experience and deal with the COVID-19 pandemic might have consequences for future challenges, such as school or mental health problems (Wade et al., 2020). It is therefore important to acquire knowledge on pre-pandemic factors that are associated with higher levels of COVID-19-related concerns, to identify adolescents who might need help.

Both negative (i.e., risk) as well as positive (i.e., protective) pre-pandemic factors may predict high levels of COVID-19-related concerns in adolescents. Since worrying is assumed to play a key role in the development of stress-related mental health problems (Anniko et al., 2019), adolescents with elevated symptoms of stress, anxiety, or depression might be especially prone to COVID-19-related concerns, as these adolescents tend to worry about situations of which the outcome is uncertain, unpredictable, and potentially negative. A prospective link of pre-pandemic stress with COVID-19-related burden has been identified in adults (Brailovskaia & Margraf, 2020). Furthermore, different coping skills can have negative or positive influences on COVID-19-related concerns. Coping behaviors are defined as responses to the demands and emotions caused by stressful events (Lazarus & Folkman, 1984). Research during the first COVID-19 lockdown demonstrated that negative coping strategies were associated with increases in perceived stress in young Dutch adolescents aged 10 to 13 years (Achterberg et al., 2021). Hence, adolescents that use more maladaptive coping, such as rumination and catastrophizing (e.g., negative ways to cope with stress), might report higher COVID-19-related concerns, while adolescents that use more adaptive coping, such as acceptance and positive refocusing (e.g., positive ways to cope with stress), might report lower COVID-19-related concerns. Positive well-being, associated with resilience and adaptive coping (Sagone & Caroli, 2014; Verzeletti et al., 2016), might contribute to fewer concerns about the COVID-19 pandemic. Indeed, a recent study in adults demonstrated that pre-pandemic positive mental health was associated with lower levels of COVID-19-related burden (Brailovskaia & Margraf, 2020). Finally, social support may prevent escalation of COVID-19-related concerns, as research in adolescents showed that social support

promoted resilience and well-being (Liu et al., 2021), and adolescents that experienced high levels of social connection reported less distress during the COVID-19 pandemic (Magson et al., 2020).

Most previous studies about the COVID-19 pandemic are based on cross-sectional study designs, lacking information about psychological functioning before the pandemic (Singh et al., 2020; Wade et al., 2020). Moreover, there is limited longitudinal knowledge about the effects of the pandemic in youth (Wade et al., 2020), as its impact may vary over time. To advance previous research, the present study investigated COVID-19-related concerns in adolescents at two stages during the pandemic (i.e., at approximately eight and ten months into the pandemic). The first aim was to describe the level of COVID-19-related concerns in adolescents during the COVID-19 pandemic, and to explore gender, age (i.e., school year), or education level differences in these concerns. Moreover, we examined whether COVID-19-related concerns changed during the course of the pandemic. The second aim was to investigate which individual pre-pandemic factors were predictive of COVID-19-related concerns during the COVID-19 pandemic, and to examine predictor differences in type of concerns. It was expected that perceived stress, internalizing problems (i.e., anxiety and depressive symptoms), and maladaptive coping would predict higher levels of COVID-19-related concerns, while adaptive coping, well-being, and social support would predict lower levels of COVID-19-related concerns during the COVID-19-pandemic. By first assessing the types and levels of concerns among adolescents, and to subsequently predict these by pre-pandemic factors, we sought to gain insight in this largely unexplored field. It is important to gain longitudinal knowledge about pre-pandemic factors that affect the experienced level of COVID-19-related concerns, as this may help to identify adolescents who might be at risk for later adverse outcomes, such as school or mental health problems (Wade et al., 2020). This may guide professionals (e.g., mental health professionals, school personnel) working with adolescents to provide them with appropriate support.

METHODS

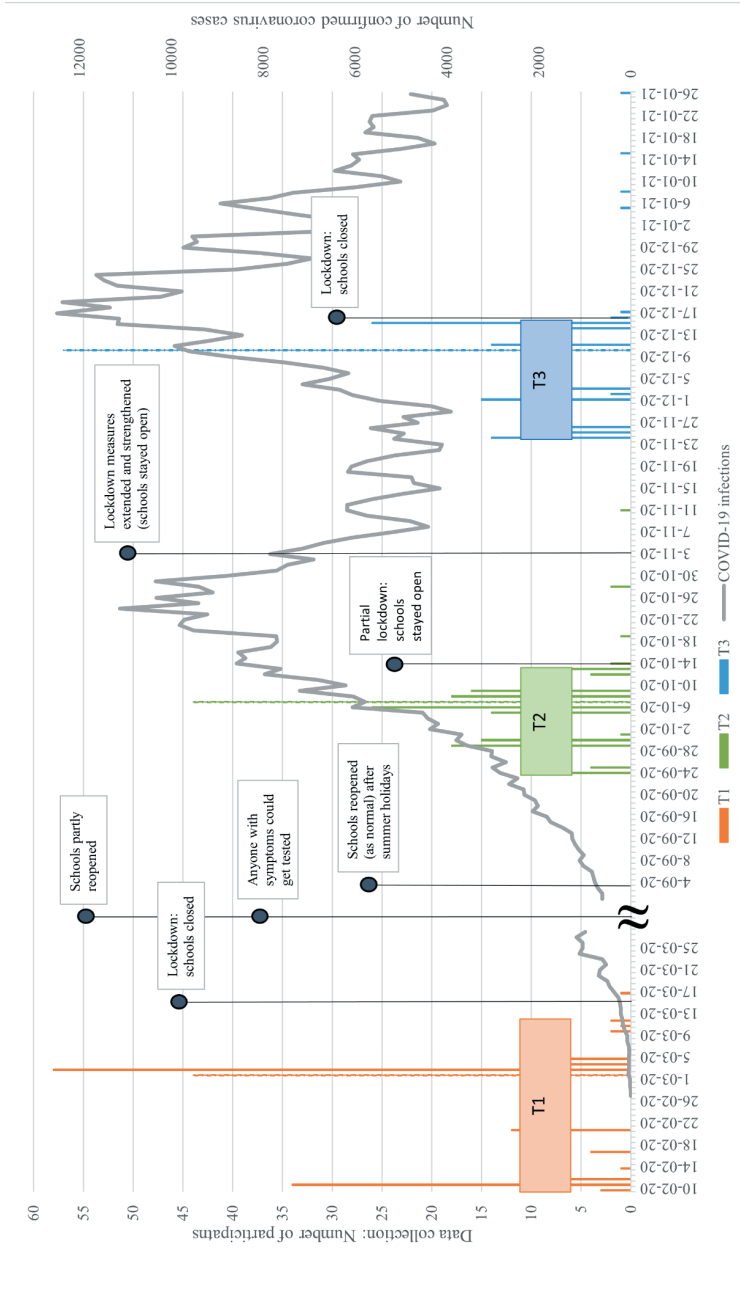
Study design, participants and procedure

The data were collected within the context of an ongoing evaluation study conducted in secondary schools in the Netherlands. As the COVID-19 outbreak occurred during the course of this study it provided an ideal opportunity to collect data about COVID-19 related concerns in adolescents. This evaluation study investigated the effectiveness of

school-based skills-training programs, in which secondary school students enrolled by self-selection (van Loon et al., 2019). The current sample is a subsample, consisting of all adolescents that were included in the effectiveness study in February 2020. Due to the outbreak of COVID-19 and the consequent school closing, the school-based skills-training programs for which they registered were ended after some initial sessions.

Pre-COVID-19 pandemic data were collected between 10 February and 17 March 2020, thus before the first COVID-19 lockdown, when students were at school and unaware of the long-lasting adversity that would come (T1). During the COVID-19-pandemic, data were collected at eight months after the first measurement (T2; on average after 31 weeks), when students were at school again and there were fewer restrictions. The third measurement took place two months after the second measurement (T3; on average after 9 weeks), when most students were at school and the situation deteriorated again, pending stricter restrictions. Figure 7.1 presents the windows of data assessment (i.e., at T1, T2, and T3), as well as the timing of COVID-19 restrictions (e.g., opening and closing of schools) and infection rates in the Netherlands.

The sample comprised of 188 adolescents (54% female; $M_{\text{age}} = 13.49$, $SD = .81$). The participants were first, second, and third year students (equivalent to USA 7th, 8th, and 9th grade) in secondary schools located in one of the four largest cities in the Netherlands. The majority of the participants were in their first year of secondary school (65%) during the first measurement (T1), and in the second grade during the second (T2) and third measurement (T3). Educational level varied from 1) pre-vocational education level (32%), 2) pre-vocational or senior general education level (27%), and 3) senior general education-pre-university education level (41%). The second group included classes with mixed educational levels (i.e., pre-vocational and senior general education level). The third group included multiple educational levels, including senior education level, pre-university education, and a combination of these two (i.e., a separate subgroup for senior general education level was not created, because this only represented 14% of the students). Further details about demographics are presented in Table 7.1.

Figure 7.1 Timing of COVID-19 pandemic in the Netherlands

Note. The histograms show the number of assessed participants per timepoint, for each window of data assessment (T1: orange, T2: green, T3: blue), of which dashed lines represent the median of the data collection window. The line shows the number of confirmed coronavirus cases (i.e., infections) per day in the Netherlands (adapted from the RIVM¹; <https://www.rivm.nl/coronavirus-covid-19/grafieken>). Please note: as from June 1 2020, anyone with coronavirus-symptoms could get tested (i.e., before that date corona testing capacity was restricted). Furthermore, specific government restrictions regarding school opening or closings are represented (adapted from the RIVM¹; <https://www.rivm.nl/gedragsonderzoek/tijdlijn-maatregelen-covid>). From March 16, schools were closed. From June 2, schools partly reopened and from September, schools reopened as normal (after summer holidays). On October 14, a partial lockdown was put into effect and from November 3, these measures were extended and strengthened (but schools stayed open). From December 16, the schools were closed again.

¹RIVM: National Institute for Public Health and the Environment.

Table 7.1 Demographics at baseline (T1)

	<i>N</i>	<i>M (SD)</i>
Age	188	13.49 (0.81)
Number of siblings	188	1.76 (1.28)
	<i>N</i>	<i>%</i>
Female	102	54.3
Education level		
Pre-vocational education	61	32.4
Pre-vocational/senior general education	50	26.6
Senior general-pre-university education	77	41.0
School year ^a		
First year	123	65.4
Second and third year	65	34.6
Financial problems	10	5.3
Country of birth: The Netherlands	175	93.1
Ethnic identity		
Western	114	60.6
Western-non Western	33	17.6
Non Western	41	21.8
Living situation: Living with both parents	124	66.0

^aEquivalent to USA 7th, 8th, and 9th grade (respectively first, second, and third year)

At T2, $N = 10$ participants were lost to follow up and at T3, an additional $N = 8$ participants were lost to follow-up (total of $N = 18$ at T3). Independent t-tests and chi-square tests were conducted to examine differences at T1 between participants and dropouts at T2 and T3. There were no statistically significant differences in demographics and pre-pandemic factors (i.e., stress, internalizing problems, coping skills, and social support) at T1 between participants and dropouts at T2 or at T3, with the exception of well-being. Dropouts at T3 reported lower levels of well-being at T1 than participants ($t(185) = -2.140, p = .034$).

Since a subset of adolescents participated in one of the skills-training programs between T2 and T3 (51%; $N = 96$ participants were assigned to the experimental group, of which only 34 participants attended more than four sessions), we examined whether attending the skills-training programs correlated with any of the investigated variables. Attending the skills-training programs (i.e., number of sessions, $N = 53$ participants attended more than one session) did not correlate with demographics (i.e., gender, age, and educational level), pre-pandemic factors, and COVID-19-related concerns at T2 and T3. Hence, we did not include attending the skills-training programs as a control variable in the analyses.

Assessments were predominantly at school, but at T1 and T3 a small number of students (T1: $N = 1$, 1%; T3: $N = 7$, 4%) were assessed online and during the lockdown (i.e., because the schools had to close suddenly). At T2, a small number of participants were assessed after the start of the partial lockdown from October 14 ($N = 6$, 3%) (see Figure 1). We performed independent t-tests to examine whether these participants (i.e., outliers at T2 and T3) differed from the other participants in COVID-19-related concerns. Comparison of participants revealed no statistically significant differences, suggesting that outliers did not affect the results. Active parental and student informed consent was required for the students' participation in the study. The study was approved by the Psychology Ethical Committee of Leiden University.

Instruments

COVID-19-related concerns. Seven items were used to assess concerns about the COVID-19 pandemic and the restrictions, including the possibility of getting sick, as well as concerns related to friends and school (see Table 7.2). *COVID-19-related concerns* were measured at T2 and T3 on a 5-point scale from 1 (*never*) to 5 (*very often*). A principal component factor analysis demonstrated two distinct factors, one related to worrying about social activities (3 items; $\alpha = .77$ at T2; $\alpha = .76$ at T3) and the other consisting of worrying about getting sick (2 items; $\alpha = .71$ at T2; $\alpha = .71$ at T3). Items were averaged to create a score for the two subscales, with higher scores indicating more concerns. The two other items (worrying about school; worrying about financial problems) did not adequately fit into either factor, and were analyzed as a single item. A total scale score (i.e., total COVID-19-related concerns) was created by averaging the seven items (7 items; $\alpha = .76$ at T2; $\alpha = .78$ at T3).

Stress. The Chronic Stress Questionnaire for Children and Adolescents (CSQ-CA) was used to measure perceived stress (de Bruin et al., 2018). Participants were asked to respond to 17 items (e.g., "I often get upset about things that are not important") on a 4-point scale ranging from 1 (*not true for me at all*) to 4 (*completely true for me*). Higher scores reflect more stress ($\alpha = .79$ at T1).

Internalizing problems. The Dutch version of the Youth Outcome Questionnaire (Y-OQ-30.1) (Dunn et al., 2005) was used to assess internalizing problems (i.e., anxiety and depression symptoms). A subscale was used, consisting of 6 items (e.g., "I am sad or unhappy") on a 5-point Likert scale from 0 (*never*) to 4 (*always*). Higher scores reflect more internalizing problems ($\alpha = .76$ at T1).

Coping skills. The Dutch version of the Cognitive Emotional Regulation Questionnaire – short form (CERQ-short) was used to measure maladaptive and adaptive coping skills (Garnefski & Kraaij, 2006). This instrument is based upon self-report, measuring 18 items on a 5-point Likert scale from 1 (*never*) to 5 (*always*). The maladaptive coping scale consists of the subscales self-blame, other-blame, rumination and catastrophizing, and comprises of 8 items (e.g., “I keep thinking about how terrible it is what I have experienced”). The adaptive coping consists of the subscales acceptance, refocus on planning, positive refocusing, positive reappraisal and putting into perspective, and comprises of 10 items (e.g., “I think I can learn something from the situation”). Higher scores reflect more maladaptive coping ($\alpha = .78$ at T1) or adaptive coping ($\alpha = .79$ at T1).

Well-being. The Dutch version of the WHO-Five Well-Being Index was used to measure well-being (WHO, 1998), consisting of 5 statements (e.g., “My daily life has been filled with things that interest me”). Participants were asked to think about the past two weeks and report how they felt on a 6-point scale ranging from 0 (*at no time*) to 5 (*all of the time*). A total score was multiplied by four to create the final score, with higher scores indicating positive well-being ($\alpha = .85$ at T1).

Social support. The Social Support List – Interactions (SSL-I) was used to measure the extent of social support adolescents received by the social interactions in their network (van Eijk et al., 1994). Participants were asked to report how often a situation ever happened to them (e.g., Does it ever happen to you that people: “are interested in you?” or “ask you for help or advice?”) on a 5-point scale from 1 (*seldom or never*) to 4 (*very often*). A total score was created of the 12 items, with higher scores reflecting more social support ($\alpha = .92$ at T1).

Statistical analyses

Statistical analyses were conducted using SPSS version 25. To meet the first aim, descriptive analyses were performed for the COVID-19-related concerns, at both T2 and T3. Paired-sample t-tests were performed to investigate differences in COVID-19-related concerns between T2 and T3. In addition, gender, age (i.e., school year), and educational level (T1) differences were investigated by conducting independent t-tests and ANOVAs. Significant ANOVAs were followed by a post-hoc test. For the second aim, crude associations (correlations) between individual factors at T1 and COVID-19-related concerns at T2 and T3 were calculated for descriptive reasons. To examine which individual pre-pandemic factors predicted COVID-19 related concerns,

three-step hierarchical regression analyses were performed for the different outcome variables, both at T2 and T3. The first step included educational level (T1) as a control variable, as educational level correlated with (subscales of) COVID-19-related concerns at T2. In addition, concerns at T2 were added as a covariate in the regression analyses for outcomes at T3. The second step included risk factors and consisted of stress, internalizing problems, and maladaptive coping (T1). The final third step included protective factors and consisted of adaptive coping, well-being, and social support (T1).

RESULTS

COVID-19-related concerns in adolescents

Table 7.2 presents the mean scores of COVID-19-related concerns reported by adolescents. The most frequently reported COVID-19-related concern at T2 and T3 was related to doing fewer fun things (e.g. cinema, shopping), followed by worrying about getting delayed in school, seeing friends less, and worrying that someone in the family gets sick (see Table 7.2). Descriptive analyses (Table 7.3) demonstrated that more than half of the adolescents experienced medium to high levels of COVID-19-related concerns about doing fewer fun things (range “3” to “5”: 60.7%, $N = 108$ at T2 and 67.1%, $N = 114$ at T3), getting delayed in school (range “3” to “5”: 55.6%, $N = 99$ at T2, 64.2%, $N = 109$ at T3), seeing friends less (range “3” to “5”: 53.3%, $N = 95$ at T2 and 57.6%, $N = 98$ at T3), and someone in the family getting sick (range “3” to “5”: 57.9%, $N = 103$ at T2 and 57.6%, $N = 98$ at T3). Concerns about financial problems were reported the least (range “3” to “5”: 16.9%, $N = 30$ at T2 and 25.3%, $N = 43$ at T3). Differences in levels of concern from T2 to T3 were not statistically significant for any of the items and scales, except for concerns about financial problems (see Table 7.2).

Tables A7.1-7.3 (Appendix) present gender, age (i.e., school year), and educational level (T1) differences in COVID-19-related concerns (i.e., total scale and subscales). There were no statistically significant differences between males and females or age (i.e., school year) in COVID-19-related concerns at both T2 and T3 (see Appendix, Table A7.1 and A7.2). There was a statistically significant educational level difference in concerns about getting sick at T2, with adolescents with the highest educational level (i.e., HAVO-VWO) reporting a higher level of concerns relative to adolescents with the lowest educational level (i.e., VMBO). No statistically significant differences were observed at T3 (see Appendix, Table A7.3).

Table 7.2 Mean scores for COVID-19-related concerns

	T2 (N = 178) M (SD)	T3 (N = 170) M (SD)	Paired samples t-test (N = 170) t (p-value)
How often do you worry about the following things? (1 = never; 5 = very often)			
1. That I get sick from the coronavirus.	1.95 (0.97)	2.02 (0.10)	-0.784 (.434)
2. That someone from my family or relatives get sick from the coronavirus.	2.64 (1.26)	2.62 (1.24)	0.235 (.814)
3. That I'm behind or delayed in school due to the coronavirus.	2.66 (1.29)	2.79 (1.19)	-1.112 (.268)
4. That I see my friends less because of the coronavirus.	2.64 (1.30)	2.72 (1.24)	-0.367 (.714)
5. That I can do less fun things (e.g., cinema, shopping) because of the coronavirus.	2.89 (1.34)	3.04 (1.30)	-0.988 (.325)
6. That I can no longer go to my (sports)club because of the coronavirus	2.49 (1.39)	2.42 (1.39)	0.836 (.404)
7. Financial problems for me and/or my family or relatives because of the consequences of the coronavirus.	1.60 (1.00)	1.84 (1.11)	-2.827 (.005)
Subscale: Concerns – social activities.	2.67 (1.11)	2.73 (1.07)	-0.163 (.871)
Subscale: Concerns – getting sick.	2.29 (0.99)	2.32 (0.99)	-0.289 (.773)
Total scale: Concerns.	2.41 (0.79)	2.49 (0.80)	-1.083 (.280)

Table 7.3 Percentages and frequency of responses to COVID-19-related concerns

How often do you worry about the following things?	Never % (N)	Seldom % (N)	Sometimes % (N)	Often % (N)	Very often % (N)
That I get sick from the coronavirus.	42.1 (75)	27.5 (49)	24.2 (43)	5.6 (10)	0.6 (1)
	39.4 (67)	26.5 (45)	27.6 (47)	5.3 (9)	1.2 (2)
That someone from my family or relatives get sick from the coronavirus.	26.4 (47)	15.7 (28)	33.1 (59)	16.9 (30)	7.9 (14)
	27.6 (47)	14.7 (25)	30.0 (51)	22.9 (39)	4.7 (8)
That I'm behind or delayed in school due to the coronavirus.	26.4 (47)	18.0 (32)	27.0 (48)	20.2 (36)	8.4 (15)
	20.0 (34)	15.9 (27)	35.9 (61)	21.2 (36)	7.1 (12)
That I see my friends less because of the coronavirus.	27.0 (48)	19.7 (35)	23.0 (41)	23.0 (41)	7.3 (13)
	21.8 (37)	20.6 (35)	28.8 (49)	21.2 (36)	7.6 (13)
That I can do less fun things (e.g., cinema, shopping) because of the coronavirus.	21.9 (39)	17.4 (31)	22.5 (40)	25.8 (46)	12.4 (22)
	17.6 (30)	15.3 (26)	26.5 (45)	27.1 (46)	13.5 (23)
That I can no longer go to my (sports)club because of the coronavirus.	34.8 (62)	19.7 (35)	18.0 (32)	16.9 (30)	10.7 (19)
	37.6 (64)	17.1 (29)	21.8 (37)	12.4 (21)	11.2 (19)
Financial problems for me and/or my family or relatives because of the consequences of the coronavirus.	66.3 (118)	16.9 (30)	9.0 (16)	6.2 (11)	1.7 (3)
	54.7 (93)	20.0 (34)	15.9 (27)	5.9 (10)	3.5 (6)

Note: Highest percentages per item are bolded.

Predictors of COVID-19-related concerns

Correlations between the investigated variables are presented in Tables 7.4 and 7.5. Tables 7.6 and 7.7 present the hierarchical regression analyses with COVID-19-related concerns (i.e. total scale) and different type of concerns (i.e., social activities, getting sick, school, and financial problems) as outcome, at T2 and T3 respectively. The third step (i.e., adding protective factors) did not improve any of the models. Per outcome, the results of the final step generating a statistically significant improvement of the model are discussed.

At T2, for COVID-19-related concerns (i.e. total scale), the second step improved the model (explaining an additional 7.0% of the variance), which accounted for a total of 10.2% of variance ($F = 4.879, p < .01$). Pre-pandemic stress was a statistically significant predictor of total COVID-19-related concerns. For COVID-19-related concerns about social activities, none of the steps were statistically significant, indicating that none of the pre-pandemic factors were associated with concerns related to social activities. For COVID-19-related concerns about getting sick, the second step improved the model (explaining an additional 7.6% of the variance), which accounted for a total of 12.8% of the variance ($F = 6.325, p < .001$). Pre-pandemic maladaptive coping was a statistically significant predictor of concerns related to getting sick. For COVID-19-related concerns about school, the second step improved the model (explaining an additional 9.7% of the variance), which accounted for a total of 12.2% of the variance ($F = 5.953, p < .001$). Pre-pandemic stress was a statistically significant predictor of concerns related to school. For COVID-19-related concerns about financial problems, the second step improved the model (explaining an additional 9.8% of variance), which accounted for a total of 9.9% of the total variance ($F = 4.698, p < .01$). Levels of pre-pandemic internalizing problems was a statistically significant predictor of concerns related to financial problems (see Table 7.6).

At T3, for COVID-19-related concerns (i.e., total scale), the second step improved the model (explaining an additional 7.1% of the variance), which accounted for a total of 35.0% of variance ($F = 17.540, p < .001$). Pre-pandemic stress was a statistically significant predictor of total concerns. For COVID-19-related concerns about social activities, adding the pre-pandemic risk-factors did not improve the model, indicating that none of the factors predicted concerns related to social activities. For COVID-19-related concerns about getting sick, the second improved the model (explaining an additional 7.5% of the variance), which accounted for a total of 25.0% of variance ($F = 10.888, p < .001$). Pre-pandemic stress was a statistically significant predictor of concerns related to getting

sick, as was maladaptive coping at $p = .052$. For COVID-19-related concerns about school, the second step improved the model (explaining an additional 12.1% of the variance), which accounted for a total of 23.7% of the variance ($F = 10.111, p < .001$). Pre-pandemic stress was a statistically significant predictor of concerns related to school. For COVID-19-related concerns about financial problems, the second step improved the model (explaining an additional 5.2% of variance), which accounted for a total of 25.3% of the variance ($F = 11.036, p < .001$). Again, pre-pandemic stress was a statistically significant predictor of concerns related to financial problems (see Table 7.7).

In sum, pre-pandemic stress predicted total COVID-19-related concerns and concerns about school at both T2 and T3, and predicted concerns about getting sick and financial problems at T3. Pre-pandemic maladaptive coping predicted concerns about getting sick at both T2 and T3 and pre-pandemic internalizing problems predicted concerns about financial problems at T2. None of the pre-pandemic factors were associated with concerns about social activities (at both T2 and T3). Protective factors did not predict total COVID-19-related concerns nor specific concerns (i.e., social activities, getting sick, school, and financial problems) at T2 and T3.

Table 7.4 Correlations between individual factors (T1) and COVID-19-related concerns (T2)

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Concerns (T2) ^a	-												
2. Concerns – social activities (T2)	.847***	-											
3. Concerns – getting sick (T2)	.738***	.385***	-										
4. Concerns – school (T2)	.641***	.358***	.412***	-									
5. Concerns – financial problems (T2)	.400***	.110	.271***	.232**	-								
6. Stress (T1)	.250***	.135	.185*	.319***	.149*	-							
7. Internalizing problems (T1)	.134	-.040	.192*	.148*	.294***	.556***	-						
8. Maladaptive coping (T1)	.199**	.084	.237**	.124	.187*	.382***	.391***	-					
9. Adaptive coping (T1)	.034	.002	.110	.010	-.052	-.153*	-.247**	.319***	-				
10. Well-being (T1)	-.131	-.013	-.142	-.164*	-.183*	-.435***	-.517***	-.139	.344***	-			
11. Social support (T1)	.008	.169*	-.119	-.103	-.148*	-.198**	-.398***	.026	.323***	.410***	-		
12. Age (T1)	.037	.014	.089	.093	-.141	.072	-.005	-.019	.159*	-.020	-.010	-	
13. Gender (T1) ^b	.043	-.001	.004	.137	.053	.107	.159*	-.006	-.106	-.128	.127	-.018	-
14. Educational level (T1) ^c	.177*	.090	.228**	.158*	.021	.046	-.130	.030	.204**	-.002	-.025	.225**	-.084

Note. *** $p < .001$; ** $p < .01$; * $p < .05$; ^aTotal scale (i.e., 7 items aggregated together); ^b1 = male, 2 = female; ^c1 = pre-vocational education level, 2 = pre-vocational/senior general education level, 3 = senior general-pre-university education level.

Table 7.5 Correlations between individual factors (T1) and COVID-19-related Concerns (T3 and T2)

	1	2	3	4	5
1. Concerns (T3) ^a	-				
2. Concerns – social activities (T3)	.849***	-			
3. Concerns – getting sick (T3)	.740***	.382***	-		
4. Concerns – school (T3)	.703***	.446***	.482***	-	
5. Concerns – financial problems (T3)	.513***	.226**	.330***	.322***	-
6. Concerns (T2) ^a	.520***	.491***	.347***	.329***	.231**
7. Concerns – social activities (T2)	.409***	.493***	.172*	.200**	.117
8. Concerns – getting sick (T2)	.420***	.335***	.423***	.281***	.094
9. Concerns – school (T2)	.325***	.226**	.238**	.329***	.207**
10. Concerns – financial problems (T2)	.267***	.121	.209**	.171*	.442***
11. Stress (T1)	.379***	.230**	.294***	.414***	.280***
12. Internalizing problems (T1)	.187*	.049	.115	.325***	.249**
13. Maladaptive coping (T1)	.281***	.168*	.285***	.221**	.186*
14. Adaptive coping (T1)	.002	.011	.065	-.041	-.095
15. Well-being (T1)	-.239**	-.134	-.151*	-.305***	-.222**
16. Social support (T1)	-.079	.057	-.126	-.173*	-.155*
17. Age (T1)	-.007	-.061	.070	.005	.011
18. Gender (T1) ^b	.037	.030	-.067	.131	.078
19. Educational level (T1) ^c	.094	.074	.113	.033	.025

Note: Correlations between the pre-pandemic factors (T1) and correlations between COVID-19-related concerns (T2) and pre-pandemic factors (T1) are already presented in Table 4 (variables 6-19).

***.001; ** $p < .01$; * $p < .05$; ^aTotal scale (i.e., 7 items aggregated together); ^b1 = male, 2 = female; ^c1 = pre-vocational education level, 2 = pre-vocational/senior general education level, 3 = senior general-pre-university education level.

Table 7.6 Hierarchical regression analyses with types of COVID-19-related concerns as outcome at T2 ($N = 177$)

Variable	Concerns ^a			Social activities			Getting sick			School			Financial problems		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Educational level (T1)	.178*	.164*	.167*	.090	.051	.079	.228**	.245**	.220**	.158*	.138	.121	.021	.066	.062
Stress (T1)		.192*	.178	.199*	.176	.176	.021	.028	.028	.316**	.315**			-.060	-.072
Internalizing problems (T1)		.005	.020	-.171	-.116	-.116	.153	.136	.136	-.008	-.030			.302**	.265*
Maladaptive coping (T1)		.120	.110	.071	.077	.077	.164*	.132	.132	.000	-.017			.092	.108
Adaptive coping (T1)			-.002		-.086	-.086		.103	.103	.064					-.011
Well-being (T1)			-.069		-.051	-.051		-.048	-.048	-.054					-.046
Social support (T1)			.091		.209*	.209*		-.062	-.062	-.039					-.026
ΔR^2	.032*	.070**	.007	.008	.036	.034	.052**	.076**	.010	.025*	.097***	.005	.000	.098***	.003
R^2	.032	.102	.109	.008	.044	.078	.052	.128	.138	.122	.127	.127	.000	.099	.101
Adjusted R^2	.026	.081	.072	.002	.022	.040	.047	.108	.102	.019	.101	.091	-.005	.078	.064

Note. β = standardized coefficient beta; *** $p < .001$, ** $p < .01$; * $p < .05$; ^aTotal scale (i.e., 7 items aggregated together).

Step 1: educational level (covariate); Step 2: stress, internalizing problems, and maladaptive coping; level 3: adaptive coping, well-being, and social support.

Table 7.7

Variable	Concerns			Social activities			Getting sick			School			Financial problems		
	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3
Concerns (T2)	.528***	.449***	.445***	.496***	.463***	.459***	.416***	.366***	.356***	.343***	.231**	.223**	.447***	.410***	.404***
Educational level (T1)	.000	-.011	-.027	.028	.010	-.002	.014	-.016	-.031	-.018	.010	-.015	.022	.016	.013
Stress (T1)		.250**	.229**	.159	.140		.247**	.237**		.247**	.229*		.200*	.200*	.179*
Internalizing problems (T1)		-.054	-.111	-.064	-.091		-.145	-.215*		.145	.107		.029	.029	-.024
Maladaptive coping (T1)		.103	.115	.075	.073		.150†	.178*		.035	.019		.031	.031	.066
Adaptive coping (T1)			.021		.028			.004			.077				-.041
Well-being (T1)			-.111		-.104			-.042			-.142				-.059
Social support (T1)			-.028		.017			-.103			-.006				-.026
ΔR ²	.279***	.071**	.010	.250***	.028	.006	.176***	.075**	.011	.116***	.121***	.014	.201***	.052*	.006
R ²	.279	.350	.360	.250	.278	.284	.176	.250	.261	.116	.237	.251	.201	.253	.259
Adjusted R ²	.270	.330	.328	.241	.256	.249	.166	.227	.224	.105	.213	.213	.191	.230	.222

Hierarchical regression analyses with types of COVID-19-related concerns as outcome at T3 (N = 169)

Note. β = standardized coefficient beta; **, .001, **p < .01; *p < .05; †p = .052. †Total scale (i.e., 7 items aggregated together).

Step 1: Concerns at T2 and educational level (covariates); Step 2: stress, internalizing problems, and maladaptive coping; level 3: adaptive coping, well-being, and social support.

DISCUSSION

The present study aimed to describe COVID-19-related concerns in adolescents, and gender, age, and educational level differences in reported concerns. Furthermore, we aimed to investigate which individual pre-pandemic risk and protective factors predicted COVID-19-related concerns at eight and ten months into the pandemic. Results demonstrated that more than half of the adolescents experienced medium to high levels of COVID-19-related concerns at both stages during the pandemic. Adolescents most frequently expressed concerns about restricted possibilities to do fun things, but also reported concerns about getting delayed in school, seeing friends less, and someone in the family getting sick. Adolescents were least concerned about financial problems, followed by getting sick themselves. The level of COVID-19-related concerns remained stable from eight to ten months into the pandemic, with the exception of concerns about financial problems, which increased over time. Eight months into the pandemic, adolescents with the highest educational level reported more concerns about getting sick (i.e., self or family) than adolescents with the lowest educational level. There were no other educational level differences nor any gender or age differences in expressed concerns. Pre-pandemic predictors of COVID-19-related concerns differed somewhat depending on type of concern. Eight months into the pandemic, total COVID-19-related concerns and concerns about school were predicted by pre-pandemic stress, while concerns about getting sick was predicted by pre-pandemic maladaptive coping and concerns about financial problems was predicted by pre-pandemic internalizing problems. Ten months into the pandemic, total COVID-19-related concerns, as well as concerns about getting sick, school, and financial problems were predicted by pre-pandemic stress. In addition, concerns about getting sick was predicted (at $p = .052$) by pre-pandemic maladaptive coping.

More than half of the adolescents reported medium to high levels of COVID-19-related concerns at both stages during the pandemic, with an overall (non-significant statistical) trend for higher levels of concern over the course of the pandemic. The results of the present study suggest that adolescents may experience continued and possibly increased COVID-19-related concerns during the course of the pandemic. It is plausible that this is related to the long-lasting and persistent government measures and restrictions, the unpredictability of the (course of the) pandemic, and the increased uncertainty about the future. Further research at multiple timepoints is necessary to gain more knowledge about the changes over the course of the pandemic. Nevertheless,

seasonal effects should be taken into account, as recent research demonstrated that youth reported more depressive symptoms during the winter months (Lukmanji et al., 2020), which can distort results.

Overall, adolescents most frequently expressed concerns about social activities and getting delayed in school at both stages during the COVID-19 pandemic. In contrast, adolescents expressed least concerns about financial problems and getting sick themselves. These findings are in line with previous research in adolescents at the beginning of the COVID-19 pandemic (Ellis et al., 2020; Magson et al., 2020; Muñoz-Fernández & Rodríguez-Meirinhos, 2021; Ravens-Sieberer et al., 2021). This combination of findings suggests that concerns about social activities and school persist throughout the pandemic, possibly due to the long-lasting and persistent government measures and restrictions. Governments should be aware of the negative consequences of the restrictions (e.g., social distancing), and may want to stimulate alternative online social activities for this age group, as digital connectedness might attenuate the negative effects of social deprivation in adolescents (Orben et al., 2020). Furthermore, concerns about financial problems, the least reported concern in the current study, increased during the COVID-19 pandemic. It is plausible that some adolescents and their families experience more negative financial consequences as the pandemic continues, because of economic consequences of the long-lasting, strict, and persistent government measures (e.g., closing of restaurants, non-essential shops). Families with financial struggles should receive attention and support, as the negative economic consequences will presumably deteriorate throughout the pandemic, and may persist in the long-term. Remarkably, adolescents reported that they were not very concerned about getting sick themselves. This may be explained by the lower level of risk appraisal that characterizes adolescence. For instance, as levels of risk-taking behavior, impulsivity, seeking out novel experiences, and sensation seeking are highest during adolescence (i.e., around 14-16 years; Collado et al., 2014; Harden & Tucker-Drob, 2011), it could be that adolescents feel less susceptible to infection by COVID-19, and thus reported few concerns about getting sick. Moreover, it is possible that as adolescents generally have mild symptoms after COVID-19 infection and generally have a good prognosis (Mantovani et al., 2021), they worry less about getting sick themselves.

The results demonstrated that eight months into the pandemic, adolescents with a higher educational level experienced more COVID-19-related concerns related to getting sick than adolescents with a lower educational level, whereas no educational

differences were found ten months into the pandemic. Given their initial lower level of concern about getting sick, adolescents with lower educational levels may have needed more time to grasp the impact of the pandemic on their own and families' health, and therefore reported fewer concerns about getting sick at the first measurement during the pandemic. Alternatively, as T2 was in a period of relatively few government restrictions (i.e., restrictions were somewhat lifted, see Figure 7.1), adolescents with higher educational levels might have anticipated the upcoming lockdown and accompanying stricter restrictions, reflecting more concerns at the first measurement, while adolescents with lower educational levels did not.

The results demonstrate that adolescents with specific vulnerabilities (i.e., higher stress, maladaptive coping, or internalizing problems) before the pandemic experience higher levels of concerns during the COVID-19 pandemic. The finding that pre-pandemic stress is an important and persistent predictor of total and specific COVID-19-related concerns (i.e., getting sick, school, and financial problems) suggests that stress is an important general and broad risk factor for concerns during the COVID-19 pandemic. This is in line with a previous study in adults which observed that pre-pandemic stress predicted higher levels of COVID-19-related burden at the beginning of the pandemic (Brailovskaia & Margraf, 2020). As stress about school is one of the most reported types of stress among adolescents, including stress related to tests, grades, homework, and the future (de Anda et al., 2000), it is likely that adolescents with higher pre-pandemic stress are more concerned about getting delayed in school during the COVID-19 pandemic (at both assessment points). Moreover, as the lives of adolescents changed drastically during the COVID-19 pandemic, particularly adolescents' school life, it is plausible that adolescents who are already stressed before the pandemic, also have more COVID-19-related concerns about school. Interestingly, pre-pandemic stress also predicted higher concerns related to getting sick and financial problems, but only at ten months into the pandemic. Possibly, the negative effects of pre-pandemic stress on these concerns became apparent only later in the pandemic because of the continued restrictions and uncertainty about the future, the unpredictability, the possible increased feelings of hopelessness, and the prospect of another (stricter) lockdown. Overall, adolescents with higher levels of pre-pandemic stress appear a vulnerable group in terms of COVID-19-related concerns, placing them at-risk for adverse developmental outcomes at a later stage, such as school and mental health problems (Wade et al., 2020). This specific group of adolescents requires extra attention and support throughout and after the pandemic, to help them cope with the changed (social) situation.

Remarkably, maladaptive coping before the pandemic predicted higher levels of COVID-19-related concerns about getting sick (i.e., getting sick themselves or a relative getting sick), not about other types of concerns. Possibly, adolescents who use more negative ways to cope with stressful situations may view the risk of themselves or a relative becoming seriously ill as the most unpredictable and uncontrollable, as it appears random who gets infected and sick or not. Moreover, this type of concern might be seen by some, potentially including adolescents with maladaptive coping, as most serious, as many people became ill or died from the virus.

Pre-pandemic internalizing problems (i.e., anxiety and depression symptoms) were predictive of COVID-19-related concerns about financial problems, but only at eight months into the pandemic. It could be that adolescents with high levels of internalizing problems are especially prone to concerns about financial problems, as these concerns are specific, forceful, and family oriented, possibly reflecting more problems than only financial ones (e.g., parental conflicts, single-parent families). Previous research demonstrated that high perceived familial financial stress was related to internalizing problems in young adolescents (Liu & Merritt, 2018). Therefore, it could also be that because of existing family financial problems, adolescents develop internalizing problems, which aggravated during the COVID-19 pandemic due to the restrictions and accompanied economic consequences. Hence, adolescents with internalizing problems reported more concerns about financial problems. These findings indicate that adolescents and families that experience high financial stress need attention and support, as internalizing problems in adolescents and financial problems are related, which may become more pressing as the pandemic continues (e.g., because of prolonged closing of restaurants, shops).

Interestingly, all pre-pandemic predictors of COVID-19-related concerns were risk factors, including stress, maladaptive coping, and internalizing problems. Protective factors before the pandemic did not seem to affect the extent of COVID-19-related concerns. This contrasts previous research, which demonstrated that positive mental health predicted lower levels of COVID-19-related burden in adults (Brailovskaia & Margraf, 2020). However, this is in line with the notion that bad is stronger than good, suggesting that it is evolutionary adaptive to respond more strongly to bad events than good ones, which makes it more likely to survive threats (Baumeister et al., 2001). In addition, as the COVID-19 pandemic is a unique situation, linked to negative associations such as hopelessness, uncertainty, unpredictability, and mental health problems, it is plausible

that only risk factors significantly predicted COVID-19-related concerns. Nevertheless, some adolescents might benefit from the societal changes caused by the lockdown and government restrictions (Dvorsky et al., 2020). Indeed, previous research showed that young adolescents reported slightly decreased problem behavior and in general low stress at the beginning of the COVID-19 pandemic, as well as more free time and time with their family, probably serving as protective factors (Achterberg et al., 2021). This indicates that not all adolescents experience negative effects of the pandemic. Future research should therefore not only focus on the negative effects of the pandemic, but also on potential positive or adaptive effects.

Limitations

The first limitation of the current study is that only seven items regarding COVID-19-related concerns were used, reflecting some but not all important areas of possible concerns. Even though the two subscales we used had adequate internal consistency, they consisted of only a few items. Furthermore, two additional items were analyzed separately. In addition, although the items to assess COVID-19-related concerns can be distinguished from items assessing the pre-pandemic factors by their explicit link with the coronavirus (see Table 7.3), we cannot rule out the possibility that part of the variance is attributable to overlap between measurement methods (i.e., common method variance). The findings of this study should therefore be interpreted with caution. However, we provided a first insight in the extent of COVID-19-related concerns adolescents experienced at eight and ten months into the COVID-19 pandemic.

Second, the adolescents in this study were enrolled in an evaluation study investigating the effectiveness of two school-based skills-training programs (i.e., short prevention programs offered in schools to adolescents who expressed interest in participating in the program). Although this selection may have affected the representativeness of the sample to the (Dutch) adolescent population, our sample was comparable to the Dutch population of 10-15 year olds in terms of minority background (CBS, 2021a) and educational level (CBS, 2021b). In addition, pre-pandemic scores on stress and well-being were generally comparable to levels of stress and well-being in community samples of adolescents (de Bruin et al., 2018; McMahon et al., 2017). Furthermore, as only few adolescents attended one or more program sessions and attending sessions did not correlate with COVID-19-related concerns, we believe our findings are generalizable to a broad group of (Dutch) adolescents.

Finally, interpreting the findings in relation to government restrictions is complicated, as the measurements were not assessed prior to or after specific government measures, and restrictions were subject to frequent changes. For instance, the first measurement during the pandemic (i.e., T2) was after the summer holidays, not immediately after the first lockdown. In addition, since there was limited time between the assessments during the COVID-19 pandemic (i.e., 9 weeks), it is possible that the assessments do not represent distinct COVID-19 phases. However, as shown in Figure 7.1, the situation in the Netherlands was worse in December than in October in terms of restrictions (i.e., more and stricter restrictions) and infection rates (i.e., more infections), indicating that the two data assessments can be seen as distinct COVID-19 phases.

Implications

The current study showed that adolescents reported most concerns about social activities and school during the COVID-19 pandemic, with an overall trend for higher levels of concerns over the course of the pandemic. Following this trend, it is plausible that in the post-pandemic situation, adolescents are still concerned about their social network and academic delay. In order to help adolescents catch up, it is important to organize social activities such as school outings and gatherings. Moreover, adolescents should be encouraged to ask for guidance and support from their social network (i.e., peers, teachers, parents). Further, to prevent school delays and adverse (school) outcomes, governments should fund schools to detect at-risk adolescents and develop a personalized support plan. It is crucial that adolescents feel supported and know where to go for help and guidance.

Additionally, since specific vulnerabilities before the pandemic resulted in more concerns during the COVID-19 pandemic, it is important to screen and monitor adolescents with heightened levels of distress (i.e., stress, maladaptive coping, internalizing problems), as these adolescents may be at-risk for later adverse developmental outcomes. Vulnerable adolescents may benefit from (early) intervention programs to alleviate stress or internalizing symptoms. Therefore, access to mental health services should be facilitated. For instance, schools might be particularly suitable for intervention programs, as previous research demonstrated that school-based intervention programs have the potential to reduce psychosocial stress, anxiety, and depression, in particular for at-risk adolescents (Feiss et al., 2019; van Loon et al., 2020). Furthermore, online mental health interventions also show potential in promoting adolescents' mental health, which is

promising considering the possible long-term changes in adolescents' social lives as a consequence of the COVID-19 pandemic.

CONCLUSION

Adolescents with high levels of concern during the COVID-19 pandemic may be at risk for later adverse developmental outcomes, such as school and mental health problems. In order to identify and help these adolescents, the current study aimed to investigate the extent of COVID-19-related concerns in adolescents at eight and ten months into the COVID-19 pandemic. Moreover, we examined its relation with pre-pandemic risk and protective factors. Adolescents most frequently reported concerns about social activities and getting delayed in school, at two stages during the pandemic. An important finding was that adolescents who have specific vulnerabilities before the pandemic (i.e., higher stress, maladaptive coping, or internalizing problems), experience more concerns during the pandemic, placing them at risk for potential long-term negative effects of the pandemic. These vulnerable adolescents need guidance and support as soon as possible, in order to prevent later adverse developmental outcomes.

Appendix Table A7.1 Gender (T1) differences in COVID-19-related concerns at T2 and T3

	T2		t-value (p)	T3		t-value (p)
	Males (N = 81) M (SD)	Females (N = 97) M (SD)		Males (N = 77) M (SD)	Females (N = 93) M (SD)	
Concerns	2.37 (0.78)	2.44 (0.80)	-0.573 (.568)	2.46 (0.82)	2.52 (0.79)	-0.475 (.636)
Concerns – social activities	2.67 (1.15)	2.67 (1.08)	0.008 (.994)	2.69 (1.09)	2.76 (1.07)	-0.384 (.702)
Concerns – getting sick	2.29 (1.00)	2.30 (0.99)	-0.059 (.953)	2.40 (1.04)	2.26 (0.95)	0.868 (.387)
Concerns – school	2.47 (1.30)	2.82 (1.27)	-1.840 (.067)	2.62 (1.19)	2.94 (1.18)	-1.710 (.089)
Concerns – financial problems	1.54 (0.94)	1.65 (1.05)	-0.706 (.481)	1.74 (1.06)	1.91 (1.16)	-1.013 (.313)

Table A7.2 Age (i.e., school year; T1) differences in COVID-19-related concerns at T2 and T3

	T2		t-value (p)	T3		t-value (p)
	Year 1 (N = 117) M (SD)	Year 2-3 (N = 61) M (SD)		Year 1 (N = 112) M (SD)	Year 2-3 (N = 58) M (SD)	
Concerns	2.39 (0.82)	2.46 (0.72)	-0.559 (.577)	2.42 (0.80)	2.63 (0.80)	-1.604 (.111)
Concerns – social activities	2.66 (1.09)	2.70 (1.15)	-0.219 (.827)	2.68 (1.08)	2.82 (1.06)	-0.774 (.440)
Concerns – getting sick	2.22 (1.05)	2.43 (0.84)	-1.459 (.147)	2.23 (0.98)	2.50 (1.00)	-1.679 (.095)
Concerns – school	2.61 (1.36)	2.77 (1.15)	-0.846 (.399)	2.72 (1.22)	2.93 (1.12)	-1.079 (.282)
Concerns – financial problems	1.68 (1.07)	1.46 (0.83)	1.489 (.139)	1.73 (1.11)	2.03 (1.11)	-1.688 (.093)

Table A7.3 Educational level (T1) differences in COVID-19-related concerns at T2 and T3

	T2				T3			
	Prevocational/ senior general		Senior general-preuniversity		Prevocational/ senior general		Senior general-preuniversity	
	M (SD)	M (SD)	M (SD)	F-value (p)	M (SD)	M (SD)	M (SD)	F-value (p)
Concerns	2.24 (0.85)	2.39 (0.81)	2.56 (0.70)	2.848 (.061)	2.39 (0.90)	2.49 (0.77)	2.57 (0.74)	0.753 (.473)
Concerns – social activities	2.57 (1.07)	2.61 (1.14)	2.80 (1.12)	0.793 (.454)	2.60 (1.15)	2.78 (1.10)	2.79 (1.00)	0.567 (.568)
Concerns – getting sick	1.96 (0.99)	2.39 (1.10)	2.49 (0.85)	5.443 (.006) ^a	2.18 (0.99)	2.32 (1.08)	2.44 (0.93)	1.075 (.344)
Concerns – school	2.42 (1.38)	2.59 (1.24)	2.89 (1.24)	2.302 (.103)	2.78 (1.28)	2.70 (1.21)	2.86 (1.12)	0.241 (.786)
Concerns – financial problems	1.61 (1.08)	1.50 (0.98)	1.65 (0.95)	0.340 (.712)	1.83 (1.27)	1.75 (1.08)	1.89 (1.01)	0.211 (.810)

^aWelch's F and significant post-hoc test between prevocational education level and senior general education-preuniversity.



CHAPTER 8

Negative Impact of the COVID-19 Pandemic on Adolescent Mental Health: Fact or Fiction?

A revised version of this chapter is accepted as:

van Loon, A.W.G., Creemers, H. E., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2022). Trajectories of adolescent perceived stress and symptoms of depression and anxiety during the COVID-19 pandemic. *Scientific reports*, *12*(1), 1-12.

Author contributions:

AL conceived and participated in the design of the study, coordinated and conducted the data collection, performed data analysis, and drafted the manuscript. HC conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. SV participated in data collection and interpretation, and critically revised the manuscript. NS, AM, and MW participated in data interpretation and critically revised the manuscript. JA conceived and participated in the design of the study, coordinated the study, and drafted the manuscript. All authors read and approved of the final manuscript.

ABSTRACT

Adolescents might be particularly affected by the drastic social changes as a consequence of the COVID-19 pandemic, given the increased stress-sensitivity and importance of the social environment in this developmental phase. Most research examining the impact of the pandemic on mental health has examined group means, while it is likely that adolescents differ in their responses. In order to examine heterogeneity during the pandemic, the current study aimed to identify whether subgroups of adolescents could be distinguished based on their stress and internalizing problems. In addition, we examined which prepandemic factors predicted these trajectories. Adolescents were assessed before the pandemic ($N = 188$, $M_{\text{age}} = 13.49$, $SD = 0.81$) and at three timepoints during the pandemic (i.e., eight, ten, and 15 months after the start of the pandemic in the Netherlands). Contrary to our expectations, we did not observe differential subgroups of adolescents for stress and internalizing problems during the COVID-19 pandemic. In addition, no significant changes in mental health problems were identified. Certain prepandemic factors (e.g., lower social support) predicted higher initial levels of stress and internalizing problems during the pandemic. To support adolescents with such prepandemic vulnerabilities, strategies could be developed, for instance to enhance adolescents' social support.

Keywords: Adolescence, COVID-19, Mental Health, Longitudinal, Trajectories.

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic and national measures to prevent the spread of the virus have profoundly disrupted the daily (social) lives of individuals. In the Netherlands for instance, from March to May 2020, the government enforced restrictions such as social distancing and closing of public spaces, including closing of schools (i.e., first lockdown). Between December 2020 and February 2021, public spaces were closed again, as well as non-essential shops (i.e., second lockdown). Further, in the time between the lockdowns and after, ongoing measures were in effect to limit social interactions (e.g., working from home, limiting group sizes). Adolescence is a period of elevated stress-sensitivity and a period where the social environment is of increasing importance, especially peer interaction (Blakemore & Mills, 2014; Christie & Viner, 2005; Romeo, 2013). As such, adolescents might be particularly affected by the drastic (social) changes as a consequence of the COVID-19 pandemic, in particular the fewer opportunities for physical peer interaction, the changing demands regarding school, and the uncertainty about the (course of) the pandemic. In previous studies adolescents indeed reported concerns about the COVID-19 pandemic (i.e., up to ten months into the pandemic), specifically related to social activities and school (Ellis et al., 2020; Magson et al., 2020; van Loon et al., 2021). In addition, recently published longitudinal studies conducted at the beginning of the COVID-19 pandemic observed increased distress, depressive, and anxiety symptoms in adolescents from before to during the pandemic (Hussong et al., 2021; Magson et al., 2020; Munasinghe et al., 2020; Rogers et al., 2021), suggesting that the pandemic has a negative impact on the mental health of adolescents.

Although previous longitudinal studies provide insight into the development of mental health problems during the first months of the COVID-19 pandemic, they focus on the average pathway for adolescents (i.e., group means), and do not allow for identifying subgroups of individuals based on mental health change over time. It is likely that not all adolescents experience COVID-19-related mental health changes to the same extent, or in the same direction (Dvorsky et al., 2020). For instance, some adolescents might benefit from the enforced measures. Indeed, a recent study observed that almost a quarter of adolescents became more satisfied with their life at the beginning of the COVID-19 pandemic (Tang et al., 2021), likely because of perceived benefits from staying at home (e.g., more time for family and personal activities). Furthermore, studies investigating moderators of mental health change from before to during the pandemic, such as gender and living condition, demonstrated that different subgroups of adolescents exist in

terms of how they respond to the COVID-19 pandemic (Barendse et al., 2021; Magson et al., 2020). Examining heterogeneity of mental health change during the COVID-19 pandemic can add to our understanding of how adolescents experience and deal with the pandemic. Insight in these changes can provide knowledge about the implications of the national measures (e.g., social distancing, closing of public spaces), which might prepare governments for future developments regarding the pandemic or possible other crises. Moreover, by identifying subgroups of adolescents that show differential trajectories of mental health change during the pandemic, appropriate support could be arranged for vulnerable adolescents (i.e., adolescents that demonstrate adverse mental health courses), by providing individualized and tailored care. In the present study, we aimed to identify whether subgroups of adolescents could be distinguished based on their stress and internalizing problems trajectories during the COVID-19 pandemic. As previous research showed increased mental health problems in adolescents during the COVID-19 pandemic (Hussong et al., 2021; Magson et al., 2020; Munasinghe et al., 2020; Rogers et al., 2021), and given that chronic stress and depression are associated with continued mental health problems in adolescents (Jonsson et al., 2011; Snyder et al., 2017), stress and internalizing problems were investigated as indicators of mental health.

In adults, different trajectories for perceived stress, depression, and anxiety symptoms during the first months of the COVID-19 pandemic have been identified. In these studies, the most common and largest group of adults (i.e., between 60% and 88%) experienced low levels of stress and internalizing problems throughout the pandemic (Ahrens et al., 2021; Batterham et al., 2021; Frank et al., 2020; Saunders et al., 2020). Additionally, smaller subgroups (i.e., between 3 and 17%) with deviating patterns were also observed (Ahrens et al., 2021; Batterham et al., 2021; Saunders et al., 2020). For instance, one subgroup of adults was identified that demonstrated initial moderate/severe anxiety or depression symptoms that increased during the pandemic (Saunders et al., 2020), while another subgroup of adults showed initial severe depression symptoms that declined over the course of the pandemic (Batterham et al., 2021). Overall, adult studies identified distinct trajectories of mental health problems during the first months of the COVID-19 pandemic, of which the largest group demonstrated a stable pattern, and small groups of adults experienced improvements or deteriorations in mental health during the pandemic. These findings highlight the importance of exploring differential trajectories, as not all individuals respond to the pandemic in the same way. Given the findings in adult samples (Ahrens et al., 2021; Batterham et al., 2021; Frank et al., 2020; Saunders et al., 2020) and moderator studies in adolescents that observed different subgroups in response

to the COVID-19 pandemic (Barendse et al., 2021; Magson et al., 2020), we expected heterogeneity in changes in stress and internalizing problems among adolescents during the pandemic.

Information about potential prepandemic predictors of adolescent mental health change, including stress and internalizing problems, demographics, and psychosocial variables, can help identify which adolescents are most at risk of having an adverse mental health course during the COVID-19 pandemic (e.g., a stable high level or an increase in symptoms), and thus require help and support. Adolescents with higher levels of stress and internalizing problems before the pandemic might be more susceptible to negative consequences of the pandemic, as these adolescents tend to worry about uncertain and unpredictable situations. Indeed, previous research in adolescents demonstrated that having mental health problems before the pandemic predicted higher levels of anxiety and depressive symptoms during the pandemic (Hafstad et al., 2021). Moreover, previous findings of the current study's sample indicated that adolescents with specific prepandemic vulnerabilities (i.e., higher stress, maladaptive coping, and internalizing problems) experienced more COVID-19-related concerns during the pandemic (van Loon et al., 2021).

Regarding demographics, the COVID-19 pandemic might have different effects for diverse age groups, as cross-sectional studies reported higher internalizing problems in older adolescents compared to younger adolescents at the beginning of the pandemic (Duan et al., 2020; Zhou et al., 2020). Yet, another study concluded that younger adolescents seem to be more negatively affected by the pandemic (Ravens-Sieberer et al., 2021), and other recent research did not observe that age moderated change in internalizing problems from before to during the pandemic (Magson et al., 2020). Given these conflicting results, research examining age differences is necessary. Gender might also be a predictor of mental health changes in adolescents during the pandemic. Previous research demonstrated that increases in internalizing problems from before to during the pandemic were more pronounced in female adolescents (Hafstad et al., 2021; Magson et al., 2020). Likewise, ethnic identity and educational level might also predict changes in adolescent mental health. Biracial adolescents demonstrated the strongest increase in depression symptoms from before to during the pandemic (Barendse et al., 2021). Furthermore, adolescents with a migrant background or from families with low education levels reported more mental health problems during the COVID-19 pandemic compared to a representative sample of peers before the pandemic (Ravens-Sieberer et al., 2021). Another possible factor associated with the impact of COVID-19 pandemic

in adolescents is their living situation, as research demonstrated that living in a single-parent household predicted higher levels of internalizing problems from before to during the pandemic (Hafstad et al., 2021).

Psychosocial variables, including social support and self-esteem, are also important to consider as potential predictors of adolescent mental health change, as these variables relate to individuals' psychological and social lives (Thomas et al., 2020), which are affected by the current pandemic. Cross-sectional studies carried out at the beginning of the COVID-19 pandemic demonstrated that lower levels of social support were associated with higher internalizing problems and mental distress among adolescents and young adults (Qi et al., 2020; Rens et al., 2021), suggesting that social support might prevent increased mental health problems in adolescents during the pandemic. Furthermore, a previous study demonstrated that increased mental health problems from before to during the COVID-19 pandemic were attenuated in adolescents with higher general self-efficacy (Hussong et al., 2021). This finding suggests that self-esteem might be a protective factor against experiencing negative effects from the COVID-19 pandemic.

Studies with longitudinal designs and prepandemic measures are necessary to determine long-term effects and to comprehensively apprehend the multiple factors playing a role in this pandemic (Racine et al., 2020; Singh et al., 2020; Wade et al., 2020). Different trajectories of mental health change during the COVID-19 pandemic have not yet been examined in adolescents, and trajectories in adults were only studied during the first few months of the pandemic. The current study, therefore, aimed to investigate changes in adolescent mental health during the COVID-19 pandemic, up to more than a year into the pandemic (i.e., at eight, ten, and 15 months after the start of the pandemic in the Netherlands). The first aim was to explore which trajectories could be distinguished in the course of stress and internalizing problems during the pandemic. The second aim was to investigate which prepandemic factors (i.e., stress and internalizing problems, demographics, and psychosocial variables) predicted these trajectories of adolescent stress and internalizing problems. We expected that adolescents with higher prepandemic levels of stress and internalizing problems, female adolescents, adolescents with a migrant ethnic identity, adolescents with a lower educational level, adolescents that do not live with both of their parents, and adolescents with lower social support and self-esteem before the pandemic are more likely to experience adverse courses of stress and internalizing problems during the COVID-19 pandemic (e.g., high levels or increased mental health problems over time). Investigating trajectories of

mental health change helps identify subgroups of adolescents that respond differently to the pandemic, improving knowledge on potential negative or positive consequences, as well as identify subgroups that need support. Furthermore, identifying factors that might predict negative or positive trajectories of mental health change may guide professionals working with adolescents to offer more individualized and tailored care.

METHODS

Study design, participants, and procedure

Data were collected within the context of an ongoing school-based intervention effectiveness study (i.e., randomized controlled study) conducted in secondary schools located in one of the four largest cities in the Netherlands. The COVID-19 outbreak occurred during the course of this study, which provided an ideal opportunity to investigate the impact of the COVID-19 pandemic on adolescents' mental health. The effectiveness study examined two school-based skills-training programs in which adolescents enrolled by self-selection, addressing social skills or skills to deal with performance anxiety (van Loon et al., 2019). The small-group skills-training programs consisted of seven sessions of 45 minutes. As secondary schools were closed due to the outbreak of COVID-19, the skills-training programs that started in February 2020 were cancelled after some initial sessions (i.e., 2-4 sessions). The programs restarted in the next school year (i.e., at four schools, with the same students). Students enrolled in the effectiveness study in February 2020 ($N = 188$) constitute the sample of this study.

Figure 8.1 presents an overview of the windows of data assessment, as well as infection rates and government measures in the Netherlands. Pre-COVID-19 pandemic data were collected between 10 February and 17 March 2020, before the first COVID-19 lockdown in the Netherlands (T1). During the COVID-19 pandemic, data were collected eight months after the first measurement (T2; on average 31 weeks after T1), two months after the second measurement (T3; on average 9 weeks after T2), and five months after the third measurement (T4; on average 19 weeks after T3). In total, the assessments covered a period from before the COVID-19 pandemic, to 15 months into the pandemic (i.e., over a year later). The first measurement (T1) occurred before the COVID-19 pandemic restrictions were put into effect, and students were at school. The second measurement (T2) took place during a period of fewer restrictions, when students were at school again (i.e., after the first lockdown when schools were closed and after the summer holiday). The third measurement (T3) was during a period of stricter restrictions (i.e., after the

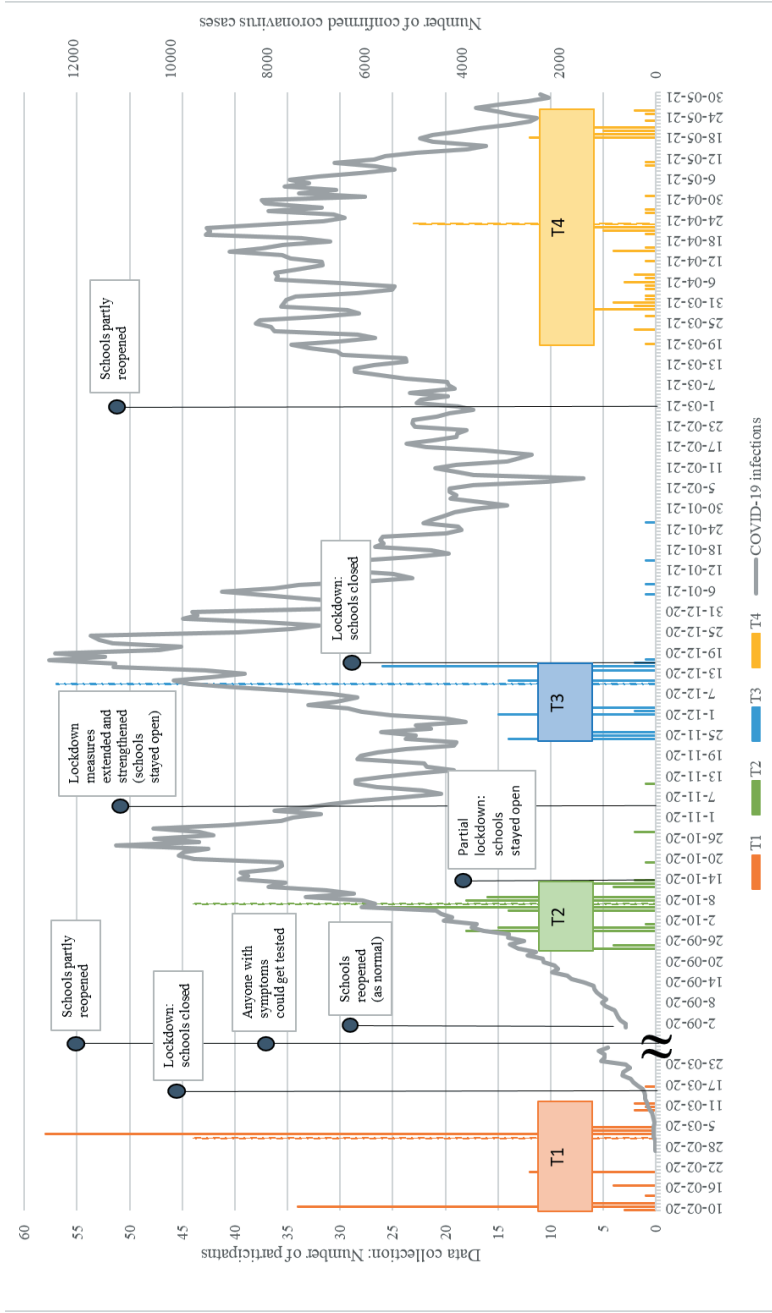
situation deteriorated again), but students were still at school. The fourth measurement (T4) took place during a period of fewer restrictions, but schools were only partly open and most students were receiving online education (Figure 8.1).

The sample consists of 188 adolescents (102 females; 54.3%) aged between 12.2 and 15.9 years, with a mean age of 13.49 years ($SD = 0.81$). Most participants were first year secondary school students (65.4%, equivalent to USA 7th grade) before the pandemic (T1), and were in their second year during the pandemic (at T2, T3, and T4). The rest of the participants were second or third year secondary school students (34.6%, equivalent to USA 8th and 9th grade) at T1. The sample consisted of prevocational students (i.e., lowest educational level; 32.4%), prevocational/senior general education students (26.6%), and senior general education-preuniversity education students (i.e., highest educational level; 41.0%). Most of the participants reported the Netherlands as country of birth (93.1%). Contrary to country of birth, the ethnic identity of participants was more mixed (Western, 60.6%, for instance: Dutch or Polish; Mix Western-non Western, 17.6%, for instance: Dutch-Turkish or Dutch-Surinamese; and Non Western, 21.8%, for instance: Moroccan or Turkish).

More than half of the participants (66.0%) reported that they lived with both their parents, while the other participants (34.0%) reported something else (e.g., living with only one parent, not living with either parent). Adolescents had an average of 1.76 siblings ($SD = 1.28$, ranging from 0 to 9 siblings). Ten participants reported that their family had financial problems (5.3%). The number of participants per data collection wave was 188 (T1), 178 (T2), 170 (T3), and 117 (T4). The retention rate from T1 to the other waves was respectively 94.7% (T1-T2), 90.4% (T1-T3), and 62.2% (T1-T4).

Independent t- and chi-square tests were performed to investigate differences at T1 between participants and dropouts at T2, T3, and T4. There were no statistical significant differences in mental health problems (i.e., stress, internalizing problems), demographics (i.e., gender, age, ethnic identity, educational level, and living situation), and psychosocial variables (i.e., social support and self-esteem) at T1 between the current sample and dropouts at T2 ($N = 10$), at T3 ($N = 18$) or at T4 ($N = 71$), except for educational level and country of birth. Dropouts at T4 were more likely to have a lower educational level ($\chi^2(2) = 41.147, p < .001$) and were more often born in another country than the Netherlands ($\chi^2(1) = 5.883, p = .020$). One school did not want to participate in the fourth measurement wave (T4), which might explain the differences in educational level, as this school educated adolescents at the lowest educational level only ($N = 21$).

Figure 8.1 Overview of the data collection windows, the number of confirmed coronavirus cases and the government restrictions in the Netherlands.



Note. The histograms present the number of assessed participants per timepoint, for each data collection window (T1: orange; T2: green; T3: blue; and T4: yellow). The dashed lines show the median of the data collection window. The line represents the number of confirmed coronavirus infections per day (adapted from the National Institute for Public Health and the Environment [RIVM] (RIVM, 2021a). From June 1, 2020, everyone with coronavirus-symptoms could get tested. Specific government restrictions regarding secondary schools are represented in text (adapted from the RIVM) (RIVM, 2021b).



As students were enrolled in school-based skills-training programs immediately after T1 (i.e., experimental group), between T2 and T3 (i.e., restarted programs; experimental group) and between T3 and T4 (i.e., control group), correlation analyses were performed to examine potential associations between number of attended sessions and mental health problems (i.e., for both stress and internalizing problems). Number of attended training sessions between T1 and T2 and between T2 and T3 were not associated with stress and internalizing problems (at T2 and T3, respectively). Number of attended training sessions between T3 and T4 was positively associated with stress and internalizing problems at T4 ($r = .342$ and $r = .307$, respectively). After combining the groups, number of attended training sessions between T1-T4 ($N = 112$ participants attended more than one session) was also positively related to stress and internalizing problems at T4 ($r = .410$ and $.374$, respectively). To control for this positive correlation, we added number of attended training sessions (between T1-T4) as predictor in the analyses. Almost half of the participants ($N = 76$) did not attend any training session.

Assessments at T1 and T2 were at school. At T3, most assessments were again at school, but a small number of students were assessed online, as schools had to close suddenly ($N = 7$, 4%). At T4, assessments were both online and at school. To motivate students to fill in the questionnaire again, students received a compensation of six euros after completion of the assessment (i.e., at T4 only). Unfortunately, because of the online assessment and partial lockdown, it was difficult to reach all students. Hence, the attrition rate was relatively high (37.8%) for the fourth measurement wave. Active parental and student informed consent was obtained for the students' participation in the study. The Psychology Ethical Committee of Leiden University approved the study (CEP19-1210/577). The study was performed in accordance with relevant guidelines and regulations (Declaration of Helsinki) for research involving human participants.

Instruments

Mental health outcomes

Stress. The Chronic Stress Questionnaire for Children and Adolescents (CSQ-CA) was used to assess perceived stress levels (de Bruin et al., 2018). Adolescents completed the questionnaire consisting of 17 items (e.g., "I often get upset about things that are not important") rated on a 4-point Likert scale from 1 (*not true for me at all*) to 4 (*completely true for me*). A higher score reflects more stress ($\alpha = .79$ at T1, $\alpha = .85$ at T2, $\alpha = .85$ at T3, and $\alpha = .84$ at T4).

Internalizing problems. The Dutch version of the Youth Outcome Questionnaire (Y-OQ-30.1) was used to measure anxiety and depression symptoms (i.e., internalizing problems) (Dunn et al., 2005). The subscale Depression/Anxiety, consisting of 6 items, was used (e.g., “I am sad or unhappy”). Adolescents reported their internalizing problems on a 5-point Likert scale from 0 (*never*) to 4 (*always*). A higher score reflects more internalizing problems ($\alpha = .76$ at T1, $\alpha = .85$ at T2, $\alpha = .87$ at T3, and $\alpha = .82$ at T4).

Predictors of mental health change

Demographics. Adolescent characteristics were collected at baseline (T1), which included gender, age, ethnic identity, educational level, and living situation. *Ethnic identity* was assessed by asking the participants with which identity they felt most connected to (I see myself as: “Dutch, Indonesian, Turk, Moroccan, Surinamese, Antillean, or other”). Three groups were distinguished: Western (e.g., Dutch), mix Western-non Western (e.g., Dutch-Moroccan) or Non Western (e.g., Turkish). *Living situation* was assessed by asking the participants about their living situation (Indicate what is right for you, with answer options such as “I live with both my parents, and my parents live together in one house”, “I live alone with my father”, “I don’t live with any of my parents”, or “other”). Two groups were distinguished: Adolescents who lived with both their parents in the same house and adolescents that reported something else.

Social support. The Social Support List – Interactions (SSL12-I) was used to measure the extent of social support received by social interactions in adolescents’ network (van Eijk et al., 1994). Adolescents reported how often a situation happened to them (e.g., Does it ever happen to you that people: “Are interested in you?” or “Ask you for help or advice?”) rated on a 4-point scale from 1 (*seldom or never*) to 4 (*very often*). The scale consists of 12 items, with a higher score reflecting more social support ($\alpha = .92$ at T1).

Self-esteem. The Dutch version of the Rosenberg Self-Esteem Scale (RSES) was used to assess self-esteem (Franck et al., 2008; Rosenberg, 1965). The instrument consists of 10 items (e.g., “At times I think I am no good at all”) rated on a 4-point Likert scale from 1 (*strongly agree*) to 4 (*strongly disagree*). A higher score reflects more self-esteem ($\alpha = .86$ at T1).

Statistical analyses

Descriptive and correlation analyses for included variables were performed using SPSS version 25. To examine trajectories concerning change in adolescent mental health (i.e.,

stress and internalizing problems) during the COVID-19 pandemic, a Growth Mixture Model (GMM) was conducted using *Mplus* version 8.6. GMM is useful for identifying homogenous subgroups within the larger heterogenous population, by estimating growth curves for each class and allowing individual variation around these growth curves (Jung & Wickrama, 2008). Stress and internalizing problems were analyzed separately.

First, Latent Growth Curve (LGC) modeling was used to examine the linear change in stress and internalizing problems from T2 to T4 (i.e., during the pandemic) for the whole group. The intervals between timepoints were adjusted to fit our timeline (i.e., two months between T2 and T3 and five months between T3 and T4). A Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) above .95, a Root Mean Square Error of Approximation (RMSEA) below .10, and a Standardized Root Mean Square Residual (SRMR) below .08 reflect a good model fit (Hu & Bentler, 1999). Second, Latent Class Growth Analyses (LCGA; results are available on request) were performed as precursors of the GMM analyses, given that LCGA models are less complex as only variance between classes (and not within classes) is allowed (Jung & Wickrama, 2008). Third, GMM analyses were conducted with an increasing number of classes, up until the new model (with an extra class) did not outperform the previous model, based on the Bayesian Information Criteria (BIC). Missing data were handled using a full-information maximum likelihood estimator with standard errors (MLR), that are robust to non-normality in the variables (Jung & Wickrama, 2008). Random starts and start iterations were increased to ensure successful convergence. The best-fitting model was chosen based on a low BIC, a high entropy (> .80) (Ram & Grimm, 2009), a significant improvement in model fit based on the Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR-LRT) and Bootstrapped Likelihood Ratio test (BLRT), the size of the subgroups (i.e., subgroups with a minimum of 5% of the total sample) (Andruff et al., 2009), theoretic justification, and interpretability of the observed trajectories (Jung & Wickrama, 2008).

To examine predictors of the trajectories, the prepandemic factors (i.e., stress and internalizing problems, age, gender, ethnic identity, educational level, living situation, social support, and self-esteem) were added to the model. A three-step method was used to predict class membership (van de Schoot et al., 2017), which takes into account the uncertainty or misclassification of class membership. If the entropy is high enough, the application of the three-step method is fairly reliable (van de Schoot et al., 2017). As described above, the model was estimated (step 1) and the most likely class membership (i.e., the probability of belonging to one of the trajectories) was determined (step 2)

without adding the predictors. The predictors were simultaneously added to the model (step 3) and using logistic regression, class membership was predicted.

RESULTS

Table 8.1 presents the correlations and descriptive statistics at T1, T2, T3, and T4 for all study variables.

Change in stress and internalizing problems

LGC analyses were performed to examine whether stress and internalizing problems changed during the COVID-19 pandemic (Table 8.2). The linear growth model for stress demonstrated a good fit, CFI = .996, TLI = .989, RMSEA = 0.070, SRMR = 0.018. The linear growth model for internalizing problems also demonstrated a good fit, CFI = 1.000, TLI = 1.000, RMSEA = 0.000, SRMR = 0.012. Overall, both stress and internalizing problems demonstrated a stable course during the pandemic for the whole group of adolescents (i.e., no significant slopes were observed; Table 8.2).

Determination of trajectories for stress

Table 8.3 presents the model fit statistics for the GMM models concerning stress (i.e., from one to two latent classes). The VLMR-LRT and BLRT were not significant for the two-class model, indicating that the two-class model did not fit the data better than the one-class solution. Although the two-class model had a high entropy, it included a subgroup smaller than 5% of the sample (i.e., it contained only one participant) and the BIC-value was higher than the one-class model. Therefore, the one-class GMM model was chosen as the final model. This class (i.e., whole sample) is characterized by an initial moderate score on stress that remained stable during the pandemic (see Appendix, Figure A8.1).

Determination of trajectories for internalizing problems

Table 8.4 represents the model fit statistics for all GMM models concerning internalizing problems (i.e., from one to four latent classes). For the GMM models with more than three classes, the variance of the slope was fixed at zero because of the negative definite in the covariance matrices.

Table 8.1 Correlations and descriptive statistics (means, standard deviations, ranges, and sample sizes) for study variables

	1	2	3	4	5	6	7	Mean	SD	Min-max	N
1. Age (T1)	-							13.49	0.81	12-16	188
2. Gender (T1) ^a	-.02	-						-	-	1-2	188
3. Educational level (T1) ^b	.19**	-.08	-					-	-	1-3	188
4. Ethnic identity (T1) ^c	-.09	.05	-.36***	-				-	-	1-3	188
5. Living situation (T1) ^d	-.05	.05	-.13	-.07	-			-	-	1-2	188
6. Self-esteem (T1)	.03	-.17*	.02	.02	-.11	-		2.85	0.59	1-4	188
7. Social support (T1)	-.01	.14	-.01	-.06	.07	.44***	-	2.86	0.67	1-4	187
T1											
8. Stress (T1)	.07	.13	.04	.02	.20**	-.37***	-.20**	2.42	0.43	1-4	188
9. Internalizing problems (T1)	-.01	.14	-.07	.00	.18*	-.68***	-.40***	1.12	0.77	0-4	187
T2											
8. Stress (T2)	.13	.18*	.04	-.08	.23**	-.33***	-.28***	2.37	0.49	1-4	178
9. Internalizing problems (T2)	.05	.15	.00	-.09	.18*	-.52***	-.41***	1.10	0.88	0-4	178
T3											
8. Stress (T3)	.06	.22**	-.01	-.01	.17*	-.29***	-.22**	2.39	0.50	1-4	170
9. Internalizing problems (T3)	.04	.21**	-.06	-.08	.19*	-.49***	-.34***	1.13	0.91	0-4	170
T4											
8. Stress (T4)	.10	.11	.12	-.01	.27**	-.22*	-.18	2.34	0.47	1-3	116
9. Internalizing problems (T4)	.04	.12	.03	-.01	.23*	-.41***	-.29**	1.06	0.79	0-3	116

Note. Significant correlations are bolded. For gender, educational level, ethnic identity, and living situations, Spearman correlations were conducted. *** $p < .001$; ** $p < .01$; * $p < .05$; ^a1 = male, 2 = female; ^b1 = prevocational educational level, 2 = prevocational / senior general educational level, 3 = senior general / preuniversity educational level; ^c1 = Western, 2 = mixed Western-non-Western, 3 = non-Western; ^d1 = living situation with both parents, 2 = other.

Table 8.2 The model fit information and descriptives for the LGC models for stress and internalizing problems (N = 178)

	AIC	Adjusted BIC	RMSEA	CFI	TLI	SRMR	Intercept M (SE), p	Slope M (SE), p	Intercept V (SE), p	Slope V (SE), p
Stress	432.363	432.483	0.070	.996	.989	0.018	2.378 (0.037), < .001	-0.001 (0.013), .941	0.193 (0.029), < .001	0.008 (0.008), .368
Internalizing problems	979.409	979.529	0.000	1.000	1.000	0.012	1.110 (0.065), < .001	0.002 (0.022), .917	0.618 (0.097), < .001	0.017 (0.029), .549

LGC = Latent Growth Curve; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual; V = variance.

Table 8.3 The model fit information for the GMM models for stress (N = 178)

Classes	AIC	Adjusted BIC	BIC	Class counts (%)	Entropy	VLMR-LRT	BLRT	Parameters
1	432.363	432.483	457.818	-	-	-	-	8
2	434.329	434.493	469.329	1: 1 (0.6); 2: 177 (99.4)	.995	.377	1.000	11

GMM = Growth Mixture Model; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; VLMR-LRT = Vuong-Lo-Mendell-Rubin Likelihood Ratio Test; BLRT = Bootstrap Likelihood Ratio Test.

Table 8.4 The model fit information for the GMM models for internalizing problems (N = 178)

Classes	AIC	Adjusted BIC	BIC	Class counts (%)	Entropy	VLMR-LRT	BLRT	Parameters
1	979.409	979.529	1004.864	-	-	-	-	8
2	963.042	963.206	998.041	1: 45 (25.3); 2: 133 (74.7)	.762	.174	< .001	11
3 ^a	952.050	952.229	990.231	1: 5 (2.8); 2: 53 (29.8); 3: 120 (67.4)	.854	.035	< .001	12
4 ^a	945.881	946.104	993.607	1: 5 (2.8); 2: 24 (13.5); 3: 47 (26.4); 4: 102 (57.3)	.763	.610	.040	15

GMM = Growth Mixture Model; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; VLMR-LRT = Vuong-Lo-Mendell-Rubin Likelihood Ratio Test; BLRT = Bootstrap Likelihood Ratio Test.

^aThe variance of the slope was fixed at zero for all classes.



The BLRT and VLMR-LRT were significant for the three-class model, and the BIC-value was the lowest, indicating that the three-class model fitted the data better than the two-class solution. However, as this model included a subgroup of only five participants, which is less than 5% of the total sample (Andruff et al., 2009), this model was rejected. The BLRT was significant for the two-class model, indicating that the two-class model fitted the data better than the one-class solution. With regard to this model, the largest class is characterized by adolescents with an initial low level of internalizing problems which increased during the COVID-19 pandemic. The smallest class is characterized by adolescents with an initial high level of internalizing problems that decreased during the pandemic. Yet, the VLMR-LRT was not significant and the entropy was below .80 for the two-class model, indicating that there was no clear evidence in favor of a multiple class solution. The one-class GMM model was therefore chosen as the final model. This class (i.e., whole sample) is characterized by an initial low score on internalizing problems that remained stable during the pandemic (Appendix, Figure A8.2).

Predictors of the course of stress and internalizing problems

As different trajectories of stress and internalizing problems during the COVID-19 pandemic could not be distinguished, we could not perform logistic regression analyses to predict group membership (i.e., the three-step method). Instead, to predict variation in stress and internalizing problems, we conducted regression analyses based on the whole-group LGC analyses (see Table 8.2). We only performed analyses to predict the intercepts, as the variance of the slope (of both stress and internalizing problems) was not significant (Table 8.2). The prepandemic predictors (i.e., stress and internalizing problems, demographics, and psychosocial variables) were simultaneously added to the model. Results demonstrated that several prepandemic factors (i.e., stress and internalizing problems, gender, and social support) were related to initial levels of stress and internalizing problems (i.e., intercept, see Table 8.5). More prepandemic stress and internalizing problems were related to higher initial levels of stress and internalizing problems, respectively, during the COVID-19 pandemic. Furthermore, female adolescents experienced higher initial levels of both stress and internalizing problems, and higher levels of social support were related to lower initial levels of both stress and internalizing problems. Since number of attended sessions (between T1-T4) positively correlated with both stress and internalizing problems at T4, we also performed the analyses with addition of this variable as a covariate. Adding number of attended training sessions did not alter the model fit statistics or the results of the predictor analyses, for both stress and internalizing problems.

Table 8.5 Results regression analyses of stress and internalizing problems for the whole group ($N = 177$)

	T1 ^a	Age	Gender	Educational level	Ethnic identity	Living situation	Self-esteem	Social support
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Stress								
Intercept	0.581***	0.097	0.183**	-0.033	-0.111	0.118	-0.013	-0.202**
Internalizing problems								
Intercept	0.676***	0.065	0.130*	0.027	-0.066	0.097	-0.003	-0.190**

*** $p < .001$; ** $p < .01$; * $p < .05$.

^a Stress at T1 was a predictor for the intercept of stress; internalizing problems at T1 was a predictor for the intercept of internalizing problems.

DISCUSSION

The current study aimed to investigate changes in adolescents' mental health during the COVID-19 pandemic. We explored whether trajectories could be distinguished based on changes in stress and internalizing problems. Contrary to our expectations, we did not observe subgroups of adolescents with diverse trajectories of stress and internalizing problems, from eight to 15 months after the start of the COVID-19 pandemic. In addition, no significant changes in stress and internalizing problems were identified during this period. On average, adolescents experienced stable moderate levels of stress and stable low levels of internalizing problems over the course of the pandemic. Since no differential trajectories nor variation in change over time (i.e., slopes) were identified, we investigated which prepandemic factors (i.e., stress and internalizing problems, demographics, and psychosocial variables) predicted individual intercepts. Higher prepandemic levels of stress and internalizing problems predicted higher initial levels of stress and internalizing problems, respectively, during the pandemic. In addition, female adolescents and adolescents with lower social support before the COVID-19 pandemic experienced higher initial levels of both stress and internalizing problems during the pandemic.

Our findings resemble previous results of mental health trajectories in adults, showing that the majority of adults reported stable mild levels of stress and internalizing problems during the first months of the COVID-19 pandemic (Ahrens et al., 2021; Batterham et al., 2021; Frank et al., 2020; Saunders et al., 2020). However, in contrast to these adult studies, smaller subgroups of adolescents with deviating patterns were not identified. Possibly, (small) subgroups of adolescents with improvements or deteriorations in mental health during the pandemic were not identified because adolescent mental health is less affected by the COVID-19 pandemic (measures) relative to adult mental health. Given that adolescence is a period of elevated stress-sensitivity (Romeo, 2013) and adolescents report increases in daily stress over time (Jose & Ratcliffe, 2004), COVID-19-related stress may not have that much (additional) effect on adolescents' general mental health. Moreover, adolescents might be more flexible or compliant compared to adults regarding the changes in daily life, as they generally have less responsibilities (e.g., supporting their family) and more experience with digital alternatives for (social) interaction. Possible developmental differences in mental health change during the COVID-19 pandemic require further examination in future research.

Methodological factors might also explain why no differential subgroups were identified. The low levels of observed variance in stress (between 0.18-0.25) and internalizing problems (between 0.59-0.83) over the course of the pandemic, suggest that potentially existing subgroups with deviating patterns are small. Consequently, a larger sample size would be needed to detect meaningful subgroups based on distinguishable trajectories. Moreover, our data demonstrated various and irregular patterns in individual mental health trajectories (see Appendix, Figures A8.1 and A8.2), suggesting that adolescents did respond differently over the course of the COVID-19 pandemic. However, these various and irregular patterns, combined with our sample size, may have made it difficult to distinguish deviating patterns experienced by subgroups of adolescents.

In any case, we did not observe changes in adolescents' mental health between eight and 15 months after the start of the COVID-19 pandemic, as we did not identify trajectories of change nor significant slopes of stress and internalizing problems. First, it could be that the pandemic counteracts the normative development of adolescents. Research in a large sample of adolescents demonstrated that depressive symptoms increase during early adolescence and peak in mid to late adolescence (i.e., at ages 15-17) (Adkins et al., 2009). Our findings indicate that stress and internalizing problems did not increase during the COVID-19 pandemic, possibly because of observed benefits of the pandemic (e.g., more free time, more time with family, or less (social) pressure), that may compensate for experienced adversities. Some recent studies during the first COVID-19 lockdown even pointed at improvements in mental health, that is, lower stress from social isolation was associated with reduced internalizing problems amongst children and adolescents (Cost et al., 2021) and with improved emotional health in female adolescents (Silk et al., 2022). Second, we followed our participants up until 15 months after the start of the COVID-19 pandemic, which might not be long enough to observe robust changes in mental health. Mental health changes as a consequence of the pandemic might take more time to appear, especially since the government measures were often subject to change (e.g., in duration or severity). Third, although the situation in the Netherlands differed at the three measurement waves in terms of restrictions and infection rates (see Figure 8.1), it could be that adolescents did not perceive any major differences between the three waves, and therefore demonstrated stable mental health trajectories during the pandemic.

Finally, it is also possible that the peak of the COVID-19 pandemic, in terms of increases in mental health problems, was primarily at the beginning of the pandemic. Previous research showed increased mental health problems in adolescents from before to

during the pandemic (Hussong et al., 2021; Magson et al., 2020; Munasinghe et al., 2020; Rogers et al., 2021) and demonstrated differential trajectories of mental health change in adults during the pandemic (Ahrens et al., 2021; Batterham et al., 2021; Frank et al., 2020; Saunders et al., 2020). Interestingly, these studies took place in the first months of the pandemic (i.e., between April and July 2020, mostly during the first lockdown). However, recent research at later stages into the pandemic (i.e., from July 2020), demonstrated little change or reductions in mental health problems from before to during the pandemic (Bouter et al., 2021; Breaux et al., 2021; Hawes et al., 2021). One study in adolescents showed an initial increase of internalizing problems from before the pandemic to spring 2020 (i.e., May-June), but these symptoms decreased from spring to summer 2020 (i.e., July-August) (Breaux et al., 2021). Another study in Dutch adolescents found a modest increase in stress and depressive problems during the pandemic (i.e., in April and January 2021) relative to prepandemic levels, but a decrease in anxiety problems (Bouter et al., 2021). Furthermore, one study in adolescents demonstrated that levels of depression and anxiety peaked in April / May 2020, but decreased through July 2020 (Hawes et al., 2021). Taken together, it seems that mental health problems of adolescents increased during the first months of the COVID-19 pandemic, but decreased or remained stable later into the pandemic, which resembles our results of stable mental health trajectories during the pandemic (i.e., from September 2020). Furthermore, as two of these studies took place in the United States (Breaux et al., 2021; Hawes et al., 2021), it does not appear that this finding is specific for adolescents from the Netherlands. In addition, it could be that adolescents habituated to the (drastic) changes of daily life (in the first months of the pandemic), and therefore showed stable trajectories over the course of this study.

Our findings demonstrated that adolescents facing specific prepandemic vulnerabilities were at increased risk of experiencing higher initial mental health problems during the COVID-19 pandemic. Adolescents with higher prepandemic levels of stress and internalizing problems experienced higher initial levels of stress and internalizing problems, respectively, during the pandemic. This is in line with previous research in adolescents that demonstrated that having prepandemic mental health problems were associated with higher anxiety and depressive symptoms during the pandemic (Hafstad et al., 2021). Female adolescents reported higher initial levels of mental health problems, probably because in general, females are more prone to experiencing internalizing problems (Philipp et al., 2018). Furthermore, higher social support appeared to function as a protective factor for experiencing mental health problems during the pandemic, as having lower social support increased the chance of reporting higher initial levels of

stress and internalizing problems. This is in line with previous research demonstrating that less social support was associated with higher internalizing problems (Qi et al., 2020). It could be that contact with peers or family members reduces mental health problems through shared empathy, talking, or venting. In sum, this study highlighted a number of prepandemic factors associated with experiencing higher initial mental health problems during the pandemic, including experiencing higher levels of stress and internalizing problems, and lower social support. With this knowledge, strategies could be developed to provide individualized and tailored care to support these vulnerable adolescents, for instance enhancing adolescents' social support.

Additionally, previous findings in this sample also highlighted that adolescents with specific prepandemic vulnerabilities (i.e., higher stress, maladaptive coping, or internalizing problems) were at increased risk of experiencing more problems (i.e., COVID-19-related concerns) during the pandemic (van Loon et al., 2021). Yet, in the present study we observed a stable course of stress and internalizing problems during the pandemic, while more than half of these adolescents reported medium to high COVID-19-related concerns during the pandemic (van Loon et al., 2021). It appears that some adolescents experience elevated stress levels during the pandemic, but mostly related to the pandemic (i.e., not general mental health problems). Specific focus on reducing COVID-19-related stressors could therefore help adolescents cope and deal with the current pandemic.

A limitation of the current study is the low retention rate at the fourth measurement wave (62.2%), which could have influenced or biased the results, given that not all participants provided data on all measurement points. Due to the lockdown that was put into effect from December 2020, secondary schools were closed and only partly reopened from March 2021 (RIVM, 2021b), complicating the data collection. Some students were not reached or did not want to fill in the questionnaire (despite being offered a compensation of six euros after completion), and one school did not want to participate in the fourth measurement wave. Additionally, interpreting the findings in relation to the COVID-19 pandemic and restrictions is complicated, since the measurement waves were not allocated to a specific government measure or lockdown and restrictions changed very frequently (e.g., in duration or severity). Nevertheless, the current study used a longitudinal design with one prepandemic measure and multiple measurements during the COVID-19 pandemic to identify different trajectories of mental health changes among

adolescents, which provides an unique overview of adolescents' mental health change over the course of the pandemic.

Another limitation of the study is the sample size, which was small considering that some observed subgroups contained only few adolescents. Although subgroups containing more than 1% of the total sample are considered to be acceptable (Jung & Wickrama, 2008), we did not select subgroups smaller than 5% of the total sample (Andruff et al., 2009). Yet, small subgroups are theoretically interesting, as these subgroups often represent adolescents with divergent trajectories compared to the overall sample. In order to examine (smaller) subgroups and increase reliability, future research should examine trajectories of mental health change during the pandemic with larger adolescent samples. In addition, in the current study, we examined internalizing problems (i.e., anxiety / depression) instead of anxiety and depressive symptoms separately. It is possible that this could have influenced the results, as previous research in adults observed distinct trajectories for anxiety and depression symptoms (Batterham et al., 2021; Saunders et al., 2020), and some studies demonstrated increased depressive symptoms, but stable or reduced anxiety symptoms from before to during the COVID-19 pandemic (Barendse et al., 2021; Hollenstein et al., 2021). Although our questionnaire demonstrated good reliability on all timepoints, it only contained six items, which might not be enough to fully capture both anxiety and depression symptomology. Future studies should investigate depressive and anxiety symptoms separately, and with more items.

Finally, adolescents in this study were enrolled in an evaluation study that examined the effectiveness of two short prevention programs (i.e., school-based skills-training programs offered to adolescents who wanted to participate). Number of attended sessions in the skills-training programs was positively associated with reported mental health problems, indicating that adolescents with higher levels of stress and internalizing problems attended more sessions of the skills-training programs. It is plausible that adolescents who reported more mental health problems were also more motivated to attend and participate in the programs. It could be that this influenced the results, as half of the participants received (some) help for their perceived problems. Yet, number of attended sessions in the training programs did not alter the results of the predictor analyses for both stress and internalizing problems. Additionally, it could be that adolescents in this study are not representative for the whole (Dutch) population, given that our sample only exists of adolescents who registered to participate in a skills-training program. Yet, almost half of the students did not attend any session of the skills-

training programs and prepandemic stress levels were comparable to a community sample of adolescents (de Bruin et al., 2018). Moreover, our sample was comparable to Dutch adolescents aged 10-15 years regarding minority background (CBS, 2021a) and educational level (CBS, 2021b), suggesting that our findings are generalizable to community samples of (Dutch) adolescents.

This study showed that, from eight to 15 months after the start of the COVID-19 pandemic, differential subgroups of adolescents for mental health problems were not identified. In addition, no significant changes in stress and internalizing problems were observed during this period. Yet, most newspapers and studies report increased mental health problems during the COVID-19 pandemic, focusing on disadvantageous and negative effects. It is important that positive or adaptive effects are also highlighted, to improve knowledge of how adolescents cope with a momentous crisis. Furthermore, focusing on positivity and being more optimistic could help cope with (COVID-19-related) stressors. Indeed, recent research demonstrated that children who were optimistic about the development of the pandemic had lower depression symptoms compared to children who were not optimistic (Xie et al., 2020). Moreover, psychological resilience – the ability to successfully respond to extreme stress or an adverse experience – may be an important target for intervention, as research during the COVID-19 pandemic demonstrated that more psychological resilience was associated with less internalizing problems (Ran et al., 2020).

Additionally, we showed that adolescents with specific prepandemic vulnerabilities (e.g., higher levels of mental health problems and lower social support) were more susceptible to experiencing higher initial mental health problems during the pandemic, which might place them at risk for later adverse problems. It is important that these vulnerable adolescents know where to go for support, and are encouraged to ask for help and guidance. Schools might be the ideal environment to facilitate this, possibly by screening or monitoring (at-risk) adolescents. Moreover, (early) intervention programs could be very beneficial in reducing mental health problems. As adolescents with lower social support experienced higher initial levels of mental health problems during the pandemic, and social experiences outside the home environment and physical contact with peers were reduced as a consequence of the COVID-19 pandemic, programs to enhance adolescents' social support might be particularly helpful. Social support is an important target of prevention and intervention programs, given that social support is associated with overall positive outcomes for adolescents (Demaray & Malecki, 2014).

Furthermore, previous research demonstrated that high levels of social connection were linked to less distress during the pandemic (Magson et al., 2020).

Adolescents might not respond to the COVID-19 pandemic to the same extent, or in the same way. In order to better specify how adolescents experience and deal with the pandemic, and to provide more individualized and tailored care for vulnerable adolescents, it is important to examine heterogeneity during the COVID-19 pandemic. The current study, therefore, explored which trajectories were distinguished based on changes in stress and internalizing problems during the pandemic. Contrary to our expectations, we did not identify subgroups of adolescents with diverse trajectories of stress and internalizing problems, from eight to 15 months after the start of the COVID-19 pandemic. In addition, no significant changes in stress and internalizing problems were distinguished during this period. Certain prepandemic factors, such as higher mental health problems and lower social support, were associated with higher initial stress and internalizing problems during the pandemic. Strategies could be developed to provide individualized and tailored care to support adolescents with such prepandemic vulnerabilities, for instance programs to enhance adolescents' social support.

Appendix Figure A8.1 Estimated means and observed individual values for the stress trajectory

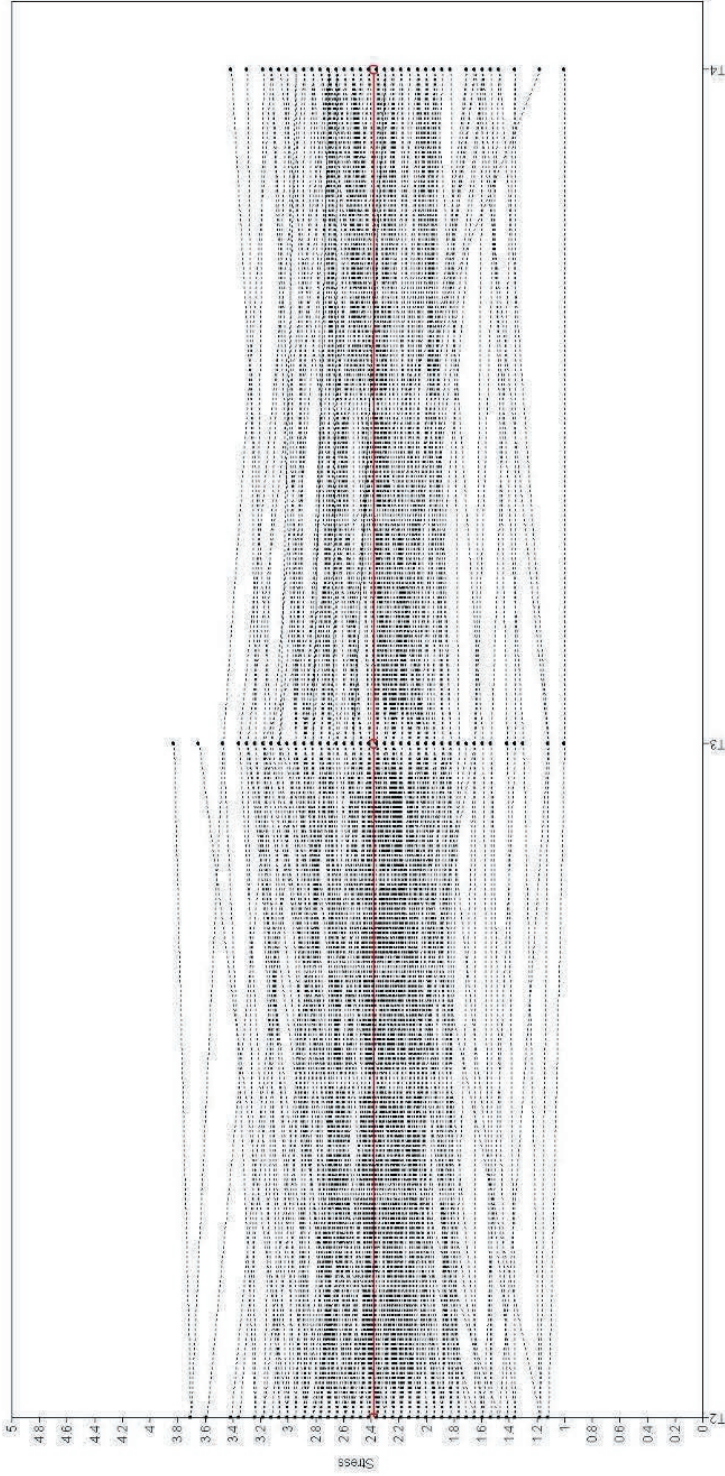
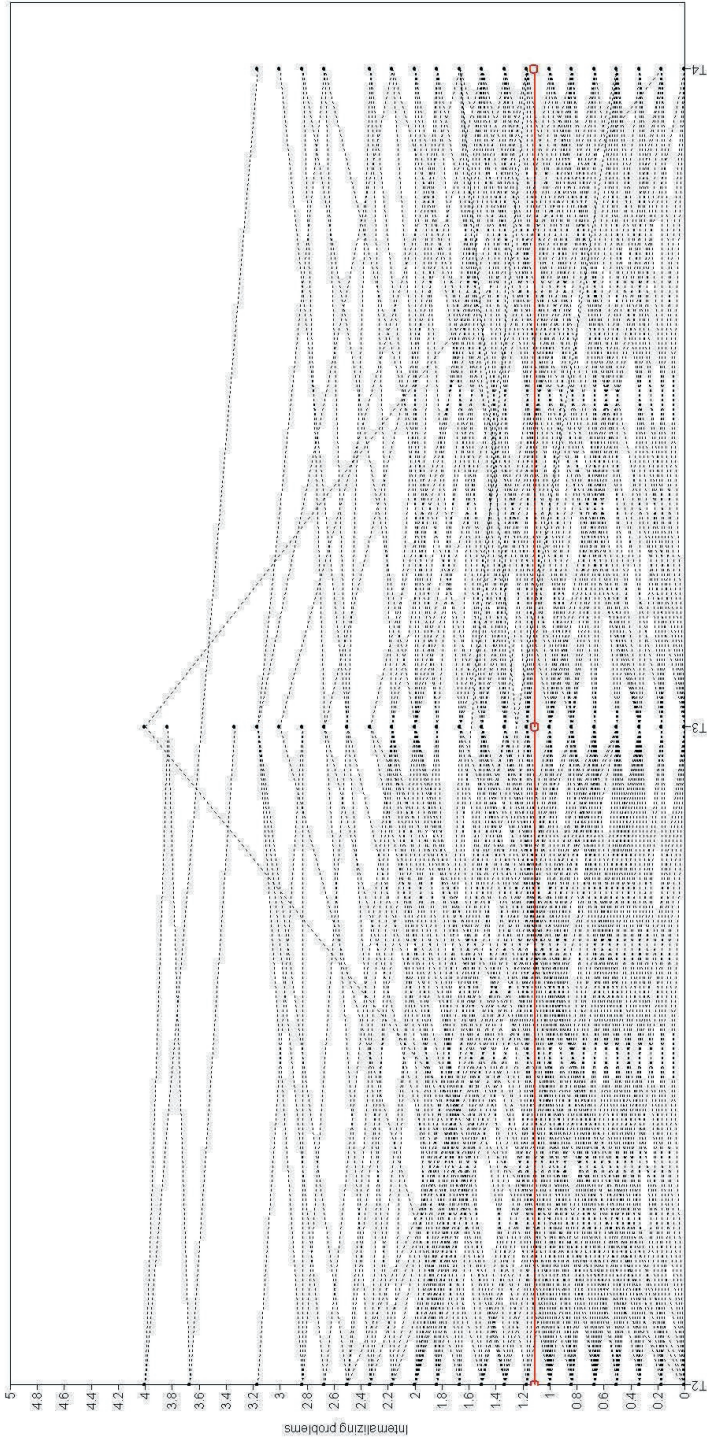


Figure A8.2 *Estimated means and observed individual values for the internalizing problems trajectory*





CHAPTER 9

General Discussion

The current dissertation is part of a larger project focusing on mental health in adolescents. This project aims to improve the use of mental health care for a diverse group of adolescents, by offering accessible and low-threshold interventions at schools. Given that stress has been associated with various mental health problems (Snyder et al., 2017) and adolescents experience various salient stressors on an everyday basis (Núñez-Regueiro & Núñez-Regueiro, 2021), stress was chosen as an overarching topic. Focusing on stress as a starting point to talk about and improve mental health in adolescents might be an appealing approach to promote adolescents' mental health. In the context of this larger project, the purpose of the present dissertation was to gain insights into the effectiveness of school-based intervention programs promoting mental health in adolescents (see Figure 1.1. for the conceptual model of this dissertation). To this end, the first goal was to provide an overview of research findings relating to the effectiveness of school-based intervention programs on reducing adolescents' psychological (*Chapter 2*) and physiological (*Chapter 3*) stress. The second goal was to gain insight into the effectiveness of two specific, targeted school-based skills-training programs promoting adolescent mental health, by addressing school stress (i.e., skills to deal with performance anxiety) or social stress (i.e., social skills; *Chapters 4-6*). Given that the COVID-19 pandemic occurred during implementation and evaluation of the effectiveness study, our third goal was to examine the effects of the COVID-19 pandemic on adolescents' COVID-19-related concerns (*Chapter 7*) and mental health (*Chapter 8*). This last *Chapter* discusses the main findings of the current dissertation, as well as its strengths and limitations, scientific and practical implications, and recommendations for future research.

Can school-based intervention programs reduce adolescent stress?

Our meta-analyses revealed that school-based intervention programs targeting stress had moderate effects on reducing psychological stress, for selected adolescent samples only (*Chapter 2*), and small overall effects on reducing blood pressure (BP), for both selected and non-selected adolescent samples (*Chapter 3*). Effects on heart rate (HR)/heart rate variability (HRV) were not significant and effects on cortisol were unclear due to large methodological variation in primary studies (*Chapter 3*), which necessitates further research. Results on psychological stress are in line with previous research that demonstrated positive effects of targeted school-based stress reduction programs relative to universal interventions (Feiss et al., 2019), suggesting that adolescents who need more help (i.e., selected high-risk adolescents), also benefit more from an intervention program. Recent research showed improvements in physiological stress,

indicated by BP, HR/HRV, and cortisol levels, after intervention programs in youth and (mainly) adults (Heckenberg et al., 2018; Pascoe, Thompson, & Ski, 2017; Pascoe, Thompson, Jenkins, et al., 2017; Pascoe & Bauer, 2015). This corresponds with our findings indicating that physiological stress (i.e., BP) can be reduced by school-based intervention programs in adolescents. However, we only observed significant improvements for BP. Not finding significant effects for HR/HRV might be a consequence of the smaller number of included effect sizes or the less beneficial characteristics of the intervention programs (e.g., less intensive, less often mindfulness and/or meditation components). Furthermore, it could be that HR/HRV is less sensitive to change (compared to BP), as previous studies observed larger or stronger effects for BP compared to HR after a breathing exercise (Bhavanani et al., 2011; Pramanik et al., 2009). Further research is necessary to investigate the effects of school-based intervention programs on physiological stress in adolescents, especially for HR/HRV and cortisol. Furthermore, cortisol measurements require extra attention, as many factors can influence the measurement of cortisol (e.g., time and location of sampling, type of assay; Sanada et al., 2016), emphasizing the need for researchers to use standardized protocols.

Remarkably, it seems that the target group (i.e., selected or non-selected sample) does not influence the reduction of physiological stress (*Chapter 3*), while it seems to matter in reducing psychological stress (i.e., significant effects were only found for selected adolescents; *Chapter 2*). One explanation could be the motivation of participants. Previous research observed larger program effects for adolescents who experienced more problems before the intervention, likely because they were more motivated to actively participate and engage in the program (Stice et al., 2009). It may be more difficult for adolescents to recognize symptoms of physiological stress (e.g., high BP, increased HR) compared to psychological stress (e.g., worrying, concentration problems). Hence, selected participants in the programs focusing on reducing physiological stress (i.e., mostly screened based on high BP; *Chapter 2*) might not recognize and experience distress about their problems, and are thus not more motivated than non-screened participants, while selected participants in the programs focusing on reducing psychological stress (i.e., mostly screened based on high symptoms of stress, anxiety or depression; *Chapter 3*) likely are recognizing and experiencing distress about their problems, and want to do something about it (i.e., are more motivated). In addition, previous research demonstrated stronger program effects for active learning or interactive approaches (e.g., exercises that allow participants to apply the skills they acquired in the intervention) rather than didactic approaches (Mertens et al., 2020; Stice &

Shaw, 2004). Therefore, it is possible that only universal programs targeting psychological stress show ineffective results (i.e., non-selected sample), as these programs are likely to contain more didactic (e.g., psychoeducation) rather than interactive components (e.g., mindfulness or relaxation). Finally, it could be that more statistical power was necessary to detect significant effects regarding the target group, as a smaller number of effect sizes was included in the meta-analysis examining the effectiveness of school-based intervention programs in terms of reducing physiological stress (i.e., BP and HR/HRV, respectively 84 and 61 effect sizes; *Chapter 3*) as opposed to psychological stress (i.e., 123 effect sizes; *Chapter 2*).

Findings of our study into the effectiveness of specific, targeted school-based skills-training programs were partly in line with the meta-analytic results on psychological stress. The performance anxiety program was effective in reducing adolescents' performance anxiety (*Chapter 6*), consistent with previous studies that demonstrated small to large effects of school-based intervention programs on reducing adolescents' test anxiety (O'Driscoll & McAleese, 2021; Putwain & von der Embse, 2021; Soares & Woods, 2020; von der Embse et al., 2013). This emphasizes the potential of such programs to support adolescents with specific needs in this area. This is promising, as high levels of test anxiety are associated with negative consequences (e.g., lower educational performance, self-esteem; von der Embse et al., 2017) and school-based stress among adolescents increased over the last decades (Cosma et al., 2020, 2021; Stevens et al., 2018).

The social skills program did not show any program effects (*Chapter 6*), which contrasts with previous research demonstrating that school-based intervention programs were effective in improving social and emotional skills in adolescents (Durlak et al., 2011; Gaspar et al., 2018; Schonert-Reichl & Lawlor, 2010). However, programs in previous studies were more intensive, suggesting that our social skills program may have been too short or did not contain enough exercises or sessions to yield substantial results. Indeed, a recent meta-analysis showed that social skills interventions for youth should contain an optimal number of exercises (de Mooij et al., 2020), which is more than the number of exercises in the current social skills program. Furthermore, our social skills program contained emotion regulation, assertiveness, and cognitive coping exercises, all related to weaker effects of school-based intervention programs as demonstrated in a recent meta-analysis (Mertens et al., 2020). Taken together, the relative short program duration and ineffective components could explain our nonsignificant findings. Future studies

should take this into account when developing school-based social skills intervention programs for adolescents.

Notwithstanding, although inclusion of both programs was based on self-selection, the performance anxiety program was effective in reducing adolescents' performance anxiety, while the social skills program yielded no positive effects (*Chapter 6*). It is possible that participants in the performance anxiety program were more motivated or expected the program to be more helpful compared to participants in the social skills program, resulting in different program effects. Moreover, it could be that adolescents can relate more to school-related stress (e.g., school pressure, workload, worry about grades) and were able to apply their learned skills to deal with performance anxiety more easily in everyday context than social skills, explaining the different findings. In addition, it is possible that the target group of the social skills program was too heterogeneous (as compared to the performance anxiety program). Since the social skills program was broad, consisting of training different social skills (e.g., assertiveness, emotion regulation, self-esteem), it might have attracted diverse groups of adolescents in terms of experienced problems (e.g., impulsive or aggressive behavior, social anxiety). This diversity of problems might have disrupted the dynamics of the group and complicated the training process, causing the absence of program effects for the social skills program. As recent research showed that specific programs (e.g., targeting disruptive behavior) were effective in some outcomes (e.g., reducing externalizing behavior), but not in others (e.g., improving emotional skills; de Mooij et al., 2020), adolescents experiencing different problems should receive distinct programs or components.

Program integrity, that is, whether an intervention program is implemented as originally planned, is an important factor to consider when drawing conclusions about the effectiveness of intervention programs. Finding nonsignificant effects may not be caused by an ineffective program, but because a program is not carried out as intended (Asscher et al., 2014; Lane et al., 2004). In our study, high program integrity was observed for both skills-training programs (*Chapter 6*), indicating that both programs were carried out as originally planned. This suggests that the nonsignificant findings of the social skills program could not be explained by incorrect program implementation and are likely the result of an ineffective program.

Notably, after signing up, actual participation in the programs was less optimal (*Chapters 5 and 6*). This was in particular the case with the postponed programs, that started

approximately six months later due to the COVID-19 pandemic (i.e., closing of schools). It is likely that dropout of participants was caused by lack of motivation, for example because participants felt they did not need the help anymore, did not have time anymore, or were signed up by parents (and did not fully agree with that decision). Nevertheless, more motivation may contribute to more beneficial program effects, as previous research showed that self-selected individuals benefitted more from intervention programs than non-self-selected individuals (Sin & Lyubomirsky, 2009). Accordingly, trainers (or persons close to the participants, such as parents or teachers) should boost the motivation of participants and encourage them to engage in the program, in particular those who are initially reluctant to participate (Sin & Lyubomirsky, 2009).

Can school-based intervention programs reduce adolescent mental health problems?

Although school-based intervention programs targeting stress were found to be effective in improving mental health in adolescents, that is, psychological (*Chapter 2*) and physiological (*Chapters 3*) stress (i.e., BP), the specific, targeted skills-training programs studied in the RCTs in this dissertation were not effective in promoting the mental health of adolescents (i.e., stress, internalizing and externalizing problems, self-esteem, well-being; *Chapter 6*). One explanation for this could be that a more intensive program was necessary to observe significant mental health changes, as previous studies that demonstrated positive mental health effects had more or longer sessions (Bradley et al., 2010; Durlak et al., 2011; Gaspar et al., 2018; Schonert-Reichl & Lawlor, 2010; Yahav & Cohen, 2008). Another possibility could be sleeper effects, that is, positive mental health changes might only be expected after a longer time period (after experiencing some challenges), not immediately after the intervention (Spence & Shortt, 2007). Finally, it could be that there were no positive effects on mental health because they were secondary or distal outcomes, and not direct targets of the program, that is, smaller or no effects could be expected immediately after the intervention. Our findings regarding the COVID-19 pandemic demonstrated that particular subgroups of adolescents are vulnerable for experiencing mental health problems during the pandemic, stressing the importance of promoting (mental health) care for vulnerable, at-risk adolescents. Therefore, it is essential to optimize and develop effective school-based intervention programs to promote adolescents' mental health.

What does (not) work in school-based intervention programs?

The studies in this dissertation pinpoint some important factors for effective school-based intervention programs. First, the selection method seems to be key. Stress-reduction programs aimed at selected, high-risk adolescents were more effective in reducing psychological stress than programs aimed at non-selected adolescents (i.e., community samples; *Chapter 2*). Hence, it appears that targeted intervention programs are most beneficial, replicating previous findings (Feiss et al., 2019; Stice et al., 2009; Werner-Seidler et al., 2017). An explanation for this could be the difference in baseline symptoms between selected adolescents and adolescents of the general population, with selected adolescents generally experiencing higher levels of problems. Indeed, previous research showed that program improvement was more evident in adolescents with high levels of baseline problems (Stjerneklar et al., 2019). Moreover, adolescents who experience distress about their problems may be more motivated to actively participate and engage in the program, resulting in stronger program effects (Stice et al., 2009). In other words, there is more to gain or improve for this group of adolescents. Second, the intensity of a program matters. Higher intensity programs appear to be necessary to reduce physiological stress (as programs with a higher intensity were more effective; *Chapter 3*) and to improve social skills (*Chapter 6*). Likewise, a recent meta-analysis suggested that longer and more extensive interventions may be necessary to stimulate adolescents' interpersonal domains (e.g., ability to build and maintain positive relationships; Mertens et al., 2020). Third, the focus and content of an intervention program should match the target group (e.g., problems of participants). Our findings showed positive effects for matched programs, that is, the performance anxiety program was effective in reducing performance anxiety (*Chapter 6*). This corresponds with recent meta-analyses that underscore the necessity of matching intervention programs to specific competencies or problems of participants (de Mooij et al., 2020; Mertens et al., 2020).

A potential theoretical framework to strengthen and enhance the development of effective intervention programs promoting adolescent mental health may be the Risk-Need-Responsivity (RNR) model, known from criminology (Bonta & Andrews, 2007). The RNR model states that there are three core principles to improve the implementation of effective interventions (i.e., risk, need, and responsivity principle; Bonta & Andrews, 2007), which aligns with our findings that programs aimed at selected groups (i.e., risk principle) and a proper match between a program and the target group (i.e. need principle) are important factors for effective school-based intervention programs. First,

the risk principle indicates that the level of treatment should match the offender's risk to reoffend and that treatment should focus on higher risk offenders (i.e., who should be treated), since improper matching of treatment intensity with the risk level of the offender might make outcomes worse (Bonta & Andrews, 2007). Second, the need principle states that risk factors of the offender should be assessed and be targeted in treatment (i.e., what should be treated) and that treatment should target needs that have direct relevance to reducing the risk of recidivism (Bonta & Andrews, 2007). The third principle, responsivity, indicates that the offender's ability to learn from an intervention should be maximized by tailoring the intervention to the learning style, motivation, abilities, and strengths of the offender (i.e., how to treat), as personal factors could facilitate or hinder treatment (Bonta & Andrews, 2007). A previous meta-analysis showed that young offender treatment programs that were carried out in conformity with the RNR principles yielded the strongest program effects (Koehler et al., 2013). This raises the question whether treatment in accordance with the RNR model could also be a useful framework to optimize and improve effective intervention programs for adolescents with psychological needs in secondary schools. Therefore, future studies should explore whether the RNR model is a useful framework to effectively treat adolescents with (emerging) mental health problems.

Impact of the COVID-19 pandemic

The studies in this dissertation showed that the COVID-19 pandemic, a major stressor of the last two years, was burdensome but did not seem to have a large negative impact on adolescents' mental health (*Chapters 7 and 8*). Most adolescents experienced medium to high levels of COVID-19-related concerns during the pandemic, specifically related to social activities and school (*Chapter 7*). This is in line with previous research conducted at the beginning of the pandemic (Ellis et al., 2020; Magson et al., 2020; Muñoz-Fernández & Rodríguez-Meirinhos, 2021). Previous research also demonstrated increased mental health problems among adolescents from before to during the first months of the COVID-19 pandemic (Hussong et al., 2021; Magson et al., 2020; Munasinghe et al., 2020; Rogers et al., 2021). Our findings indicated that, during the COVID-19 pandemic, adolescent mental health problems were fairly stable (*Chapter 8*). This suggests that even though adolescents experienced COVID-19-related concerns, these concerns did not (further) affect their mental health over the course of the pandemic (i.e., eight to 15 months after the start of the pandemic). It appears that the majority of adolescents were resilient to the abrupt changes as a consequence of the COVID-19 pandemic, probably because adolescents found a way to deal with these changes. Furthermore, observed benefits of

the pandemic, such as more free time or more time with family, might have compensated for the experienced adversities.

Notwithstanding, some adolescents do seem to be vulnerable for negative effects of the COVID-19 pandemic. Our results showed that adolescents with vulnerabilities before the pandemic (e.g., higher stress, internalizing problems) experienced more COVID-19-related concerns (*Chapter 7*) and higher initial levels of mental health problems during the pandemic (*Chapter 8*), which was also demonstrated in previous studies (Brailovskaia & Margraf, 2020; Hafstad et al., 2021). As adolescents with specific prepandemic problems are at increased risk of experiencing problems during the pandemic, they might also be susceptible for adverse developmental outcomes at a later stage, including school or mental health problems (Wade et al., 2020). Our findings highlight that negative consequences of the COVID-19 pandemic mainly apply for adolescents who already had problems before the pandemic, stressing the need of identifying vulnerable adolescents (e.g., with psychological needs) and provide them with adequate support. For example, as social support appeared to function as a protective factor for experiencing increased mental health problems during the pandemic (*Chapter 8*), strategies could be developed to enhance adolescents' social support.

Strengths and limitations

The current dissertation had several strengths and limitations. Strengths of this dissertation relate mainly to its broad framework. First, two approaches were used to gain insight into the effectiveness of school-based intervention programs, that is, meta-analytic reviews and RCTs. Both meta-analyses examined the effectiveness of (universal) school-based intervention programs (*Chapters 2 and 3*), while the experimental studies investigated the effectiveness of two specific, targeted skills-training programs, addressing either skills to deal with performance anxiety or social skills (*Chapters 4-6*). This way, we aimed to target two of the main sources of stress in adolescents, that is, school and social stress (Núñez-Regueiro & Núñez-Regueiro, 2021). Furthermore, one meta-analysis focused on physiological stress (*Chapter 3*), which is important, as knowledge about the neurobiological effects of school-based intervention programs in adolescents was lacking (Pascoe, Thompson, Jenkins, et al., 2017). Additionally, a longitudinal approach was used to examine the impact of the COVID-19 pandemic on adolescents' mental health (*Chapters 7 and 8*). Overall, these different approaches provided a broad framework to gain more knowledge about mental health risk factors in adolescence and ways to promote adolescent mental health.

Second, despite the COVID-19 pandemic and difficulties of recruiting hard-to-reach participants, such as groups of lower socioeconomic status and ethnic minority groups (Bonevski et al., 2014), we conducted two RCTs in a large, diverse sample of adolescents aged between 12 and 17 years (*Chapters 4-6*). Adolescents were recruited from nine secondary schools located in one of the four largest cities in the Netherlands, and consisted of adolescents from various educational and cultural backgrounds (e.g., educational levels ranged from prevocational to preuniversity education and about half had a non-Western ethnic identity). As such, it is likely that our findings are representative for a broad group of adolescents, making it useful for others (e.g., schools, governments, scholars).

Third, the occurrence of the COVID-19 pandemic during the course of the effectiveness study provided us with a unique opportunity to investigate its longitudinal mental health impact on adolescents (*Chapters 7 and 8*). A subsample of adolescents filled out questionnaires before the COVID-19 pandemic, as well as during the pandemic at three timepoints (i.e., at eight, ten, and 15 months after the start of the pandemic in the Netherlands). Since there is limited longitudinal knowledge about the impact of the pandemic in adolescents, in particular with prepandemic information (Wade et al., 2020), our data provide unique insights. It is important to gain more information about prepandemic factors with longitudinal studies, as this approach can help identify adolescents who might have an increased risk of developing adverse outcomes at a later stage, such as school or mental health problems (Wade et al., 2020).

Last, a strength of this dissertation is that we provided information on program implementation and integrity, in the effectiveness study (*Chapter 6*) and in a separate study that focused on encountered challenges and lessons learned during the implementation and evaluation of the skills-training programs (*Chapter 5*). In effectiveness studies, information about implementation is necessary to correctly interpret the effectiveness of intervention programs, as non-significant or negative results might be a consequence of incorrect or insufficient program implementation, and not caused by an ineffective program (Asscher et al., 2014; Lane et al., 2004). Yet, few studies evaluating psychosocial interventions report about program integrity (Perepletchikova et al., 2007). Hence, more awareness should be given to (reporting about) the implementation process of intervention studies, as this makes it easier to determine whether the intervention itself produces changes (or lack of changes) in outcome variables (Lane et al., 2004; Perepletchikova et al., 2007).

This dissertation also has some limitations. First, although we included a diverse group of adolescents regarding educational and cultural backgrounds, it is unclear whether all adolescents with psychological needs were reached and included in our study. As participation was based on self-selection (and not screening), it is possible that some adolescents did not sign up because they did not want help, were unaware that they needed help, or had parents who did not want them to participate (and did not want to give permission).

Second, the occurrence of the COVID-19 pandemic and government measures threatened the effectiveness study: In some schools the programs were discontinued, in other schools the recruitment of participants had to be put on hold. Although we restarted the project as soon as schools re-opened, the postponements affected program attendance; there was high dropout of participants in the postponed programs (i.e., about half of participants did not attend any session of the performance anxiety program and a quarter of participants did not attend any session of the social skills program; *Chapter 6*). As a result of the high dropout, we were unable to test moderators of program effectiveness, for instance social support, perfectionism, or educational level. Hence, we could not contribute to a better understanding of which subgroups benefitted the most from the skills-training programs, while this information is important for the optimization and improvement of intervention programs. For instance, by tailoring the intervention program to the learning style and abilities of the participant (i.e., risk principle of the RNR model; Bonta & Andrews, 2007). Furthermore, there was high attrition in the fourth measurement wave (i.e., 15 months after the start of the pandemic), because we were unable to reach all adolescents online and some adolescents did not want to participate anymore. Nevertheless, our results indicated that the COVID-19 pandemic did not influence program effects (*Chapter 8*).

Last, we aimed to use a multi-informant (i.e., adolescents, parents, and trainers) approach to assess program outcomes (*Chapter 4*). At the start of the project, we asked parents to contribute to the research by filling out some questionnaires (about their child and themselves). However, due to low response rates (i.e., 41%, less than half of the participants), we decided to drop this component. Although it is desirable to include parents, in both research and intervention, it is often difficult to achieve (Gee et al., 2021). Yet, parental reports of adolescents' behavior might have yielded different results, as previous research observed differences between self- and parental report on mental health outcomes in early adolescents (Vollebergh et al., 2005). Furthermore, although we

included information about program integrity, we only used self-report data of trainers (*Chapter 6*). Other, more objective measurements, such as observations or recordings, might have revealed other results.

Future research

The studies in the current dissertation yield several recommendations for future research. Overall, there is a need for more robust research on targeted school-based intervention programs. As randomized controlled research is often referred to as the ‘gold standard’ for effectiveness studies, since randomization reduces bias (Hariton & Locascio, 2018), future studies should conduct RCTs with larger sample sizes. Relatedly, to reduce publication and selective reporting bias and improve the credibility and reproducibility of research findings, it is recommended to preregister future effectiveness studies (van ’t Veer & Giner-Sorolla, 2016). Publication bias was indicated in our meta-analysis (*Chapter 2*), suggesting that studies with positive results are still more likely to be published than studies with negative or non-significant results. Preregistration of studies might promote the publication of studies with negative or nonsignificant results (van ’t Veer & Giner-Sorolla, 2016), enhancing the knowledge about the effectiveness of school-based intervention programs.

While we did not observe differences regarding age, a previous meta-analysis examining the effectiveness of depression prevention programs observed larger program effects for older adolescents compared to younger adolescents, possibly related to the improved cognitive ability of the older adolescents (e.g., abstract reasoning; Stice et al., 2009). Yet, a recent review demonstrated that many mental health problems manifest much earlier than the age of 14 years, advocating for the implementation of prevention and early intervention programs in children, for instance in the last years of elementary school (Mulraney et al., 2021). Future research should therefore investigate the effectiveness of school-based intervention programs in more widespread age groups, from children to young adults. Moreover, programs should be tailored to the specific needs and (cognitive) ability of the target group (e.g., children, preadolescents, young adults), to improve program effectiveness and the prevention of emerging mental health problems.

Interestingly, our meta-analysis showed (trend-significant) larger program effects for screened participants compared to participants who self-selected into a program (*Chapter 2*). Although our experiences indicated that adolescents with psychological needs were willing to seek help for their problems (i.e., based on self-selection into either

the performance anxiety or social skills program; *Chapters 5 and 6*), our meta-analytic review suggests that it may be more beneficial to screen participants based on severity of problems (e.g., by using a cutoff score; *Chapter 2*). On the one hand, inclusion based on self-selection may increase program attendance and a more beneficial outcome, as adolescents are likely more motivated to participate (i.e., provided that the program is offered soon after registration). On the other hand, some adolescents might be missed because they did not sign up (e.g., did not want help, were not aware of their problems) or did not receive the information, even though they were experiencing problems. Hence, future studies should examine which screening method is most beneficial. Moreover, as motivation of participants has been associated with beneficial program outcomes (Sin & Lyubomirsky, 2009; Stice et al., 2009), it is important that information about motivation is reported in forthcoming studies to gain more insight into this factor.

The main focus for further research on school-based intervention programs should be to study long-term effects, and not only immediate (postintervention) effects. By only examining immediate effects, sleeper effects (i.e., improved longer term outcomes) may be missed, while reductions in (mental health) problems might only be expected at a later stage when adolescents have experienced challenging situations (Spence & Shortt, 2007). Although it is important to identify if an intervention program effectively changes participants' development on the long term, few effectiveness studies include follow-up assessments (*Chapters 2 and 3*). If positive effects still exist after a couple of months or years, it is likely that adolescents actually learned from the intervention program and changed their behavior. It is possible that program duration influences the occurrence of sleeper effects, as a recent meta-analysis showed that program effects of child maltreatment preventions increased as follow-up duration increased (i.e., sleeper effect) and larger effects were found for programs with a shorter duration (i.e., 0-6 months; van der Put et al., 2018). Future studies should investigate under what circumstances intervention programs show sleeper effects, for example shorter programs or programs with specific treatment aims.

Scientific implications for the development of school-based intervention programs

Although school-based intervention programs showed potential in reducing stress (*Chapters 2 and 3*) and performance anxiety (*Chapter 6*) in adolescents, positive effects were limited (e.g., no change in social skills or mental health was found; *Chapter 6*), indicating the importance of optimizing and improving the effectiveness of such

programs. The results of our meta-analyses suggest that some programs were more effective than others (e.g., programs with a mindfulness and/or mediation component, higher intensity programs; *Chapters 2 and 3*). Furthermore, recent research observed that some components (of universal school-based interventions addressing intrapersonal and interpersonal domains) show stronger (e.g., self-awareness, problem solving) or weaker (e.g., emotion regulation, assertiveness) program effects (Mertens et al., 2020) and that effective intervention programs consist of an optimal number of components and exercises (de Mooij et al., 2020). Therefore, future studies should identify which components are (in)effective and in which order and number these components are most beneficial. New intervention programs should only include components that are related to stronger effects on relevant outcomes, and not solely focus on previous intervention programs and their components (Mertens et al., 2020). Finally, existing intervention programs may be improved by adding or removing components, or changing the order of (effective) components. Moreover, it is also important to examine for which subgroups of adolescents these programs are most beneficial. This way, schools can offer tailored intervention programs for adolescents who need help and support. For example, programs could be customized to specific age groups (i.e., younger versus older adolescents) or specific educational levels (i.e., prevocational versus preuniversity education).

Implications for practice

Our results revealed that stress can be a promising concept to stimulate (mental health) help-seeking of adolescents, as adolescents were willing to self-select into a skills-training program at school (*Chapters 5 and 6*). Moreover, adolescents with different ethnic identities (i.e., about half of the participants had a non-Western background) and educational levels (i.e., from prevocational to preuniversity education) self-selected into the programs, indicating that the programs were low-threshold and accessible for a diverse group of adolescents. Since stress is very broad in terms of experiences, feelings, and behavior (e.g., related to school, family, health, situations), it is an accessible way to stimulate the use of mental health care for a large, diverse group of adolescents. It might be easier to talk about stress (and thus sign up for a program related to stress) than for instance anxiety or depression, for both adolescents and teachers. Therefore, when offering intervention programs at schools, it might be a good idea to frame programs as stress reduction program. This way, programs might be more approachable for schools, as well as for vulnerable or hard-to-reach adolescents (e.g., adolescents with lower educational levels).

The COVID-19 pandemic and government measures, including social distancing and the closing of public spaces, affected society at large. Adolescents might be especially vulnerable to the drastic changes in daily life (Blakemore, 2019). However, our findings suggest that the COVID-19 pandemic did not have a substantial negative effect on adolescents' mental health (*Chapter 8*). Yet, a subgroup of adolescents does need special attention. Adolescents with prepandemic vulnerabilities, such as high levels of stress and internalizing problems, experienced more COVID-19-related concerns during the pandemic (*Chapter 7*), as well as higher initial levels of mental health problems during the pandemic (*Chapter 8*). These vulnerable adolescents should be identified and supported, also after the pandemic, to prevent emerging mental health problems at a later stage. For example, schools and professionals could monitor adolescents' mental health by asking adolescents, parents, and/or teachers to complete a questionnaire on a regular basis. Monitoring adolescents enables schools and professionals to identify adolescents at-risk for developing adverse outcomes. In addition, talking with and providing support for adolescents (e.g., paying attention, starting a conversation), by teachers or parents, may also be helpful for (most) adolescents, as social support is positively associated with well-being and mental health (Chu et al., 2010; Rothon et al., 2011). Moreover, offering school-based skills-training programs on a regular basis or multiple times in secondary school (e.g., two times a year), might reduce stigma and promote accessible (mental health) care for adolescents.

Remarkably, even though adolescents spend most of their time at school (Hofferth, 2009) and the school environment is important for adolescents' emotional, social, and cognitive development (Roeser et al., 2000), there is limited attention to intervention programs related to adolescents' socioemotional development and mental health in most schools (Kratochwill et al., 2004). Yet, it is essential to address these topics, as many mental health problems manifest before or during adolescence (McGorry et al., 2011) and the majority of adolescents do not receive treatment for such problems (Merikangas et al., 2011). Given the pressures and stressors adolescents face in the current society, such as academic difficulties, dealing with social media, and future (job) uncertainty, it is important to address heightened stress levels at an early stage (e.g., by prevention or early intervention programs). Although the COVID-19 pandemic resulted in drastic changes in individuals' daily lives, and was mainly perceived as negative, it brought attention to mental health problems in the general population, with a specific focus on youth. For instance, many scholars necessitated the planning of longitudinal and developmental studies, as well as strategies to increase adolescents' access to mental health care and

the implementation of evidence-based interventions (e.g., Singh et al., 2020). Parties concerned with adolescent mental health (e.g., governments, schools, professionals) should take advantage of the increased awareness of mental health (problems) among adolescents, and invest in enhancing mental health literacy and access to (mental health) care for adolescents, in particular for vulnerable, at-risk adolescents.

CONCLUSION

Our findings showed that school-based stress-reduction programs were effective in reducing adolescents' psychological and physiological stress and targeted school-based performance anxiety programs in reducing adolescents' performance anxiety. In addition, reactions of involved parties (e.g., school personnel, trainers of youth care organizations) regarding the implementation and evaluation of targeted skills-training programs were positive and adolescents were willing to sign up to attend a skills-training program at school. This illustrates that despite the challenges, it is possible to successfully implement and evaluate targeted skills-training intervention programs within schools. Governments and schools should be aware that such programs exist and offer them to adolescents with emerging mental health problems. In addition, having vulnerabilities before the COVID-19 pandemic was a risk factor for experiencing problems during the pandemic, stressing the importance of providing help and support for adolescents with psychological needs. This dissertation adds to the research on the effectiveness of intervention programs offered within schools, focusing on promoting adolescent mental health by improving (access to) mental health care and support.



ADDENDUM

Summary

Nederlandse Samenvatting (Summary in Dutch)

References

Publication List

About the Author

Dankwoord (Acknowledgements)

SUMMARY

Adolescence is a period of physical, social, and psychological development (Christie & Viner, 2005), which increases sensitivity to stress and the risk of developing mental health problems (Blakemore, 2019; Romeo, 2010). Mental health problems affect 10-20% of children and adolescents (Kieling et al., 2011), but the majority of adolescents do not receive treatment for their mental health problems (Merikangas et al., 2011). To reach and support adolescents with psychological needs, it is important to provide accessible and effective mental health care. Given that stress is an important factor contributing to adolescents' vulnerability to mental health problems (Romeo, 2010), it seems a promising target to promote adolescent mental health. In addition, school-based intervention programs targeting stress may be perceived by adolescents as an approachable, low-threshold, and encouraging way to address their psychological needs. As the most salient stressors for adolescents encompass stress related to school and social situations (Núñez-Regueiro & Núñez-Regueiro, 2021), school and social stress may be promising targets. Yet, knowledge about the effectiveness of school-based intervention programs targeting (school or social) stress is scarce. The purpose of the present dissertation was, therefore, to increase the knowledge on the effectiveness of school-based intervention programs promoting adolescent mental health by targeting (school or social) stress, as well as to investigate the impact of a major stressor of the past two years, the COVID-19 pandemic, on adolescents' mental health.

The first goal of this dissertation was to provide an overview of the effectiveness of school-based intervention programs on reducing psychological and physiological stress in adolescents by conducting two multilevel meta-analyses (*Chapters 2 and 3*, respectively). Results demonstrated that school-based intervention programs had a moderate effect on psychological stress, for selected adolescents only, not for community samples (*Chapter 2*). These findings are in line with earlier research that observed stronger effects for targeted programs (i.e., selected, at-risk samples) compared to universal programs (Feiss et al., 2019; Stice et al., 2009; Werner-Seidler et al., 2017). In addition, based on a subsample of studies, intervention programs were effective in reducing school stress, but not social stress. Moreover, larger effects were found at follow-up compared to postintervention, which might indicate a sleeper effect (i.e., improved longer term outcomes; Spence & Shortt, 2007). In the multilevel meta-analysis on the effectiveness of school-based intervention programs in reducing physiological stress (*Chapter 3*), results demonstrated a small effect on reducing blood pressure (BP) and no

significant effect was found for heart rate (HR)/heart rate variability (HRV). For cortisol, the large methodological variation in the few primary studies did not allow for meta-analytic analyses, but a qualitative review yielded inconsistent results. For BP and HR/HRV, larger effects were found for intervention programs with a mindfulness and/or meditation component, for programs without a cognitive-behavioral component, and for programs with a higher intensity. For BP only, significant effects were demonstrated in (cluster) RCTs; not in studies with quasi-experimental designs. Moreover, larger effects were found for intervention programs with a relaxation component and programs without a yoga component. Notably, to reduce physiological stress, intervention programs should include a mindfulness, meditation, or relaxation component and programs with a higher intensity should be encouraged.

In conclusion, *Chapters 2 and 3* show that school-based intervention programs have the potential to 1) reduce psychological stress in adolescents, specifically programs directed at adolescents who self-select or enroll following a screening (*Chapter 2*), and 2) reduce physiological stress in adolescents, in particular BP (*Chapter 3*). Although program effects were small to moderate, heterogeneity in program effectiveness was demonstrated (e.g., regarding stress outcome, timing of measurements, components), emphasizing that some intervention programs are more beneficial than others. Notwithstanding, further research is necessary, including more robust research regarding physiological parameters of stress (i.e., cortisol), as previous research was impeded by large methodological variation, and examining intervention programs targeting specific forms of stress, such as school or social stress, which was addressed in the subsequent *Chapters*.

The second goal was to study the effectiveness of school-based skills-training programs promoting adolescent mental health by addressing either school stress (i.e., skills to deal with performance anxiety) or social stress (i.e., social skills). To this end, two RCTs were conducted (*Chapters 4-6*). *Chapter 4* contains the study protocol, which describes the design, methods, instruments, and analyses of the effectiveness study. The effectiveness study was performed in the context of a Response to Intervention model (RtI), aiming to identify vulnerable adolescents and provide them with appropriate (preventive) interventions (Kearney & Graczyk, 2014). After adolescents received three classical educative lessons about stress (i.e., Tier 1: Universal intervention targeting non-selected adolescents), adolescents were asked if they would like to follow a skills-training program (i.e., Tier 2: Targeted intervention directed at selected at-risk adolescents). Adolescents self-selected into either the performance anxiety program or social skills

program and were randomly allocated to the experimental or waitlist control group. The skills-training programs were delivered by external facilitators (i.e., trainers of youth care organizations) and consisted of seven 45-min small-group weekly sessions at school. Data were collected before (T1) and after the completion of the programs (T2), with self-report questionnaires covering demographics, program targets (i.e., skills to deal with performance anxiety or social skills), direct program outcomes (i.e., performance or social anxiety) and mental health outcomes (i.e., stress, internalizing and externalizing problems, well-being, and self-esteem).

Chapter 5 discusses challenges encountered and lessons learned during the implementation and evaluation of these programs. Our experiences, together with those of involved parties (i.e., school liaisons and trainers), indicated that it is possible to successfully implement and evaluate targeted skills-training programs promoting mental health in secondary schools. The importance of investing time in communication between the involved parties, that is, close and regular contact (i.e., at least once a week) was stressed as one of the critical success factors. Furthermore, school-specific protocols were recommended to benefit from the unique opportunities at each site, while at the same time assuring adherence to a standardized approach. Moreover, flexibility in adjusting scheduled meetings for intervention and research is necessary, whilst keeping track of the entire process for each school and individual participant. Tackling (and thus limiting) challenges of program implementation is essential for effectiveness research to improve care and support for adolescents.

Chapter 6 provides the results of the effectiveness study. In total, 361 participants from nine secondary schools in the Netherlands participated (i.e., mixed ethnic identity sample of adolescents attending different educational levels, from prevocational to preuniversity education), including $N = 196$ participants in the performance anxiety program ($n = 95$ in the experimental group) and $N = 165$ participants in the social skills program ($n = 86$ in the experimental group). The performance anxiety program had a small effect on reducing adolescents' test anxiety. In addition, for adolescents who attended more than half of the sessions (i.e., subgroup of adolescents), the program had small effects on reducing test anxiety and fear of failure (i.e., performance anxiety). There were no effects on improving adolescents' coping skills or mental health. The social skills program was not effective on any of the selected outcomes (i.e., social skills, social anxiety, mental health), possibly because the program was not intensive enough (e.g., did not contain enough exercises or sessions), was too broad (e.g., contained too

many different social-skill building exercises), or the group was too heterogeneous (e.g., problems of participants were too diverse). In conclusion, *Chapter 6* shows that a relative short, targeted performance anxiety program was beneficial in reducing adolescents' performance anxiety, which should encourage governments and schools to offer and implement such programs to reduce performance anxiety in the first years of secondary school. Nevertheless, follow-up research is necessitated to establish long-term effects, as well as effective ingredients of such programs, in particular for social skills programs.

An unexpected mental health risk for adolescents was the outbreak of the COVID-19 pandemic and the accompanied government restrictions. Our third goal was to examine the impact of the COVID-19 pandemic on adolescents' COVID-19-related concerns and mental health (*Chapter 7* and *8*, respectively). *Chapter 7* presents the findings of the impact of the COVID-19 pandemic on adolescents' COVID-19-related concerns. A subsample of adolescents from the effectiveness study ($n = 188$) was assessed before and during the COVID-19 pandemic (i.e., at eight and ten months after the start of the pandemic in the Netherlands). Results revealed that more than half of the adolescents experienced medium to high levels of COVID-19-related concerns during the pandemic. In addition, adolescents most frequently reported concerns about social activities (i.e., restricted possibilities to do fun things, seeing friends less) and getting delayed in school. Furthermore, adolescents with specific vulnerabilities before the pandemic (i.e., higher stress, maladaptive coping, or internalizing problems) experienced more COVID-19-related concerns during the pandemic, stressing the importance of supporting these vulnerable adolescents in order to prevent adverse developmental outcomes at a later stage. *Chapter 8* presents the findings of the impact of the COVID-19 pandemic on adolescents' mental health. Contrary to our expectations, results showed that no differential subgroups of adolescents with deviating trajectories for stress and internalizing problems were observed during the pandemic (i.e., from eight to 15 months after the start of the pandemic) and no changes in mental health problems were identified. On average, over the course of the pandemic, adolescents experienced stable moderate levels of stress and stable low levels of internalizing problems. Yet, certain prepandemic factors, including higher stress and internalizing problems, being female, and lower social support, predicted higher initial mental health problems during the COVID-19 pandemic. Our findings thus highlight that adolescents with specific prepandemic vulnerabilities are at increased risk of experiencing problems, emphasizing that these vulnerable adolescents need guidance and support.

Chapter 9 concludes with a discussion of the main findings, as well as the strengths and limitations of this project, scientific and practical implications, and recommendations for future research. The studies in this dissertation provide important insights into the potential of school-based stress-reduction and specific, targeted skills-training programs, together with information about the impact of the COVID-19 pandemic on adolescents' COVID-19-related concerns and mental health. The meta-analyses and the performance anxiety program indicated promising results for selected groups on reducing (psychological and physiological) stress and performance anxiety, respectively. However, a positive effect was not observed in the social skills program. Nonetheless, despite the challenges, it was possible to successfully implement and evaluate targeted skills-training programs within schools, in a diverse sample of adolescents. In addition, our results revealed that adolescents with prepandemic vulnerabilities were at risk for experiencing problems during the pandemic, emphasizing the significance of providing help and support for adolescents with psychological needs. Taken together, the present dissertation demonstrated that targeted school-based intervention programs were effective in reducing stress and performance anxiety and indicated recommendations to further optimize and improve the effectiveness of school-based intervention programs.

NEDERLANDSE SAMENVATTING (SUMMARY IN DUTCH)

De adolescentie is een periode van fysieke, sociale, en psychologische ontwikkeling (Christie & Viner, 2005), en een periode waarin de gevoeligheid voor stress en het risico op het ontwikkelen van mentale gezondheidsproblemen toenemen (Blakemore, 2019; Romeo, 2010). Ondanks dat 10-20% van de adolescenten mentale gezondheidsproblemen krijgen (Kieling et al., 2011), worden de meeste adolescenten niet behandeld voor deze problemen (Merikangas et al., 2011). Om adolescenten met (beginnende) mentale problemen te bereiken en te ondersteunen is het belangrijk om toegankelijke en effectieve mentale gezondheidszorg te bieden. Aangezien stress een belangrijke factor is die bijdraagt aan de kwetsbaarheid van adolescenten voor mentale gezondheidsproblemen (Romeo, 2010), lijkt het reduceren van stress een veelbelovend doel om de mentale gezondheid van adolescenten te bevorderen. Schoolinterventies gericht op stress bij adolescenten vormen mogelijk een toegankelijke, laagdrempelige, en stimulerende manier om mentale gezondheidsproblemen aan te pakken. Aangezien de meest voorkomende en intensieve stressoren voor adolescenten gerelateerd zijn aan school en sociale situaties (Núñez-Regueiro & Núñez-Regueiro, 2021), kunnen het verminderen van school stress en sociale stress veelbelovende doelen zijn om de mentale gezondheid van adolescenten te bevorderen. Echter, de kennis over de effectiviteit van schoolinterventies gericht op het reduceren van (school of sociale) stress is schaars. Het doel van dit proefschrift was daarom om meer zicht te krijgen op de effectiviteit van schoolinterventies die zich richten op (school of sociale) stress in het bevorderen van de mentale gezondheid van adolescenten, zowel als het onderzoeken van de impact van een belangrijke stressor van de afgelopen twee jaar, de COVID-19 pandemie, op de mentale gezondheid van adolescenten.

Dit proefschrift start met literatuuronderzoek naar de effectiviteit van schoolinterventies in het verminderen van psychologische en fysiologische stress bij adolescenten, door het uitvoeren van twee multilevel meta-analyses (*Hoofdstukken 2 en 3, respectievelijk*). De resultaten toonden aan dat schoolinterventies, voor adolescenten die deelnamen op basis van screening of zelfselectie, een middelgroot effect hadden op het verminderen van psychologische stress (*Hoofdstuk 2*). Deze bevindingen zijn in lijn met eerder onderzoek dat sterkere effecten aantoonde voor selectieve schoolinterventies, dat wil zeggen, interventies voor een selectieve groep (hoog risico) adolescenten, in vergelijking met universele schoolinterventies die aan hele klassen aangeboden worden (Feiss et al., 2019; Stice et al., 2009; Werner-Seidler et al., 2017). Schoolinterventies bleken effectief

in het verminderen van school stress, niet van sociale stress. Daarnaast werden er sterkere effecten gevonden op follow-up metingen vergeleken met metingen direct na de interventie (postinterventie), wat zou kunnen wijzen op een ‘sleeper effect’, dat wil zeggen, betere uitkomsten op de langere termijn (Spence & Shortt, 2007). In de multilevel meta-analyse naar de effectiviteit van schoolinterventies in het verminderen van fysiologische stress (*Hoofdstuk 3*), lieten de resultaten een klein effect zien op het verlagen van de bloeddruk (BP). Voor hartslag (HR)/hartslagvariabiliteit (HRV) werd er geen significant effect gevonden. Voor cortisol liet de grote methodologische variatie in de (enkele) primaire studies geen meta-analyse toe. Een kwalitatieve review suggereerde inconsistente resultaten. Voor BP en HR/HRV werden sterkere effecten gevonden voor schoolinterventies met een mindfulness en/of meditatiecomponent, voor interventies zonder cognitieve gedragscomponent, en voor interventies met een hogere intensiteit. Voor BP werden significante effecten aangetoond in (cluster) RCTs; niet in studies met een quasi-experimenteel design. Daarnaast werden voor BP sterkere effecten gevonden voor schoolinterventies met een ontspanningscomponent (zoals relaxatie-oefeningen) en interventies zonder een yoga component. Samengevat, om fysiologische stress te verminderen zouden schoolinterventies een mindfulness, meditatie of ontspanningscomponent moeten bevatten en zouden interventies met een hogere intensiteit moeten worden aangemoedigd.

Samengevat laten *Hoofdstuk 2* en *3* zien dat schoolinterventies de potentie hebben om 1) psychologische stress bij adolescenten te verminderen, specifiek schoolinterventies gericht op adolescenten die zich aanmelden na een screening of zichzelf selecteren (*Hoofdstuk 2*), en 2) fysiologische stress bij adolescenten te verminderen, in het bijzonder bloeddruk (*Hoofdstuk 3*). De gevonden effecten van de interventies waren klein tot middelgroot, en verschilden tussen interventies, uitkomsten, en meetmomenten. Meer onderzoek naar fysiologische parameters van stress, met name cortisol, is nodig, aangezien de synthese van de resultaten uit eerder onderzoek werd belemmerd door grote methodologische variatie. Daarnaast is meer robuust onderzoek nodig naar schoolinterventies gericht op specifieke vormen van stress, zoals school of sociale stress, wat in de volgende *Hoofdstukken* wordt behandeld.

Het tweede doel was het onderzoeken van de effectiviteit van twee vaardigheidstrainingen op school die de mentale gezondheid van adolescenten trachten te bevorderen door zich te richten op reductie van 1) schoolstress, dat wil zeggen, vaardigheden om met faalangst om te gaan of 2) sociale stress, dat wil zeggen, sociale vaardigheden.

Hiertoe werden twee RCTs (gerandomiseerde gecontroleerde studies) uitgevoerd (*Hoofdstukken 4-6*). *Hoofdstuk 4* bevat het studieprotocol, waarin de opzet, methoden, instrumenten, en voorgenomen analyses van de effectiviteitsstudie worden beschreven. De effectiviteitsstudie werd uitgevoerd in de context van een *Response to Intervention* (RtI) model, gericht op het identificeren van kwetsbare adolescenten en hen te voorzien van passende (preventieve) interventies (Kearney & Graczyk, 2014). Nadat adolescenten drie klassikale lessen over stress hadden gekregen (een universele interventie gericht op niet-geselecteerde adolescenten), werd deze adolescenten gevraagd of zij een vaardigheidstraining wilden volgen (een selectieve interventie gericht op kwetsbare adolescenten met een verhoogd risico). Adolescenten konden kiezen om deel te nemen aan ofwel de faalangsttraining ofwel de sociale vaardigheidstraining, en werden willekeurig toegewezen aan de experimentele groep of aan de wachtlijst controlegroep. De vaardigheidstrainingen werden gegeven door externe professionals (van jeugdzorgorganisaties) en bestonden uit zeven wekelijkse sessies van 45 minuten in kleine groepen op school. Gegevens werden voorafgaand aan (T1) en na de afronding van de vaardigheidstrainingen (T2) verzameld. Zelfrapportage vragenlijsten werden afgenomen om demografische gegevens, programmadoelen (vaardigheden om met faalangst om te gaan of sociale vaardigheden), directe programma uitkomsten (faalangst of sociale angst), en mentale gezondheid (stress, internaliserende en externaliserende problemen, welzijn, en zelfvertrouwen) te meten.

Hoofdstuk 5 geeft een overzicht van de uitdagingen die we zijn tegengekomen en de lessen die we hebben geleerd tijdens het effectonderzoek naar de vaardigheidstrainingen. Onze ervaringen, samen met die van de betrokken partijen (contactpersonen van scholen, trainers), gaven aan dat het mogelijk is om met succes selectieve vaardigheidstrainingen ter bevordering van de mentale gezondheid op middelbare scholen te implementeren en onderzoeken. Het belang van het investeren van tijd in communicatie tussen de betrokken partijen, dat wil zeggen, nauw en regelmatig contact (ten minste eenmaal per week), werd benadrukt als één van de cruciale succesfactoren. Verder werden school-specifieke protocollen aanbevolen, om te profiteren van de unieke mogelijkheden op elke locatie, en tegelijkertijd te zorgen voor een gestandaardiseerde aanpak. Bovendien is het nodig om flexibiliteit te tonen bij het aanpassen van geplande bijeenkomsten voor interventie en onderzoek. Tegelijkertijd moet het hele proces voor elke school en individuele deelnemer goed in de gaten gehouden worden. Het aanpakken (en daarmee beperken) van uitdagingen rondom de implementatie van interventies op school is

essentieel voor effectiviteitsonderzoek ter verbetering van zorg en ondersteuning voor adolescenten.

Hoofdstuk 6 geeft de resultaten weer van het effectiviteitsonderzoek. In totaal namen 361 adolescenten uit de onderbouw van negen middelbare scholen in Nederland deel aan het onderzoek (met diverse etnische identiteiten en onderwijsniveaus, van vmbo tot vwo). Er waren $N = 196$ deelnemers in de faalangsttraining ($n = 95$ in de experimentele groep) en $N = 165$ deelnemers in de sociale vaardigheidstraining ($n = 86$ in de experimentele groep). De faalangsttraining had een klein effect in het verminderen van testangst bij adolescenten. Daarnaast had de faalangsttraining, voor adolescenten die meer dan de helft van de sessies bijwoonden, ook kleine effecten op het verminderen van faalangst. De training was niet effectief in het verbeteren van coping vaardigheden of de mentale gezondheid van adolescenten. De sociale vaardigheidstraining was op geen van de uitkomsten effectief, dat wil zeggen, voor sociale vaardigheden, sociale angst, mentale gezondheid. Mogelijke verklaringen hiervoor kunnen zijn dat de training niet intensief genoeg was, te breed was, of dat de groep te divers was. Concluderend kan worden gesteld dat een relatief korte faalangsttraining effectief was in het verminderen van test- en faalangst bij adolescenten, wat overheden en scholen kan aanmoedigen om dergelijke interventies aan te bieden en te implementeren om faalangst te verminderen in de onderbouw van de middelbare school. Niettemin is vervolgonderzoek nodig om langetermijneffecten vast te stellen, evenals effectieve componenten van dergelijke interventies.

Een onverwacht risico voor de mentale gezondheid van adolescenten was de uitbraak van de COVID-19 pandemie en de daarmee gepaard gaande overheidsbeperkingen vanaf maart 2020. Ons derde doel was om de impact van de COVID-19 pandemie op COVID-19-gerelateerde zorgen en de mentale gezondheid van adolescenten te onderzoeken (*Hoofdstuk 7* en *8*, respectievelijk). *Hoofdstuk 7* presenteert de bevinden van de impact van de COVID-19 pandemie op COVID-19-gerelateerde zorgen van adolescenten. Een subgroep van adolescenten uit de effectiviteitsstudie ($n = 188$) kreeg vragenlijsten kort voor en tijdens de COVID-19 pandemie (acht en tien maanden na het begin van de pandemie in Nederland). Uit de resultaten bleek dat meer dan de helft van de adolescenten tijdens de pandemie middelgroot tot hoge niveaus van COVID-19-gerelateerde stress ervoer. Adolescenten rapporteerden het vaakst zorgen over sociale activiteiten (beperkte mogelijkheden om leuke dingen te doen, vrienden minder zien) en het oplopen van vertraging op school. Bovendien ondervonden adolescenten die

voor de pandemie al kwetsbaar waren door hogere niveaus van stress, maladaptieve coping, of internaliserende problemen meer COVID-19-gerelateerde zorgen tijdens de pandemie, wat het belang benadrukt van het ondersteunen van deze adolescenten om nadelige uitkomsten in een later stadium te voorkomen. *Hoofdstuk 8* presenteert de bevindingen van de impact van de COVID-19 pandemie op de mentale gezondheid van adolescenten. In tegenstelling tot de verwachtingen toonden de resultaten aan dat er geen subgroepen van adolescenten met afwijkende trajecten voor stress en internaliserende problemen tijdens de pandemie (van acht tot 15 maanden na het begin van de pandemie) onderscheiden kunnen worden. Gemiddeld ervoeren adolescenten tijdens de pandemie stabiele, gemiddelde niveaus van stress en stabiele lage niveaus van internaliserende problemen. Sommige kenmerken, namelijk hogere niveaus van stress en internaliserende problemen voorafgaand aan de pandemie, vrouw zijn, en het ervaren van minder sociale steun, voorspelden hogere mentale gezondheidsproblemen tijdens de COVID-19 pandemie. Onze bevindingen tonen dus aan dat sommige adolescenten een verhoogd risico lopen op het ervaren van problemen tijdens de pandemie, en passende begeleiding en ondersteuning nodig hebben.

Hoofdstuk 9 sluit dit proefschrift af met een discussie van de belangrijkste bevindingen, evenals de sterke punten en beperkingen van dit proefschrift, wetenschappelijke en praktische implicaties, en aanbevelingen voor vervolgonderzoek. De studies in dit proefschrift bieden belangrijke inzichten in de effectiviteit van schoolinterventies gericht op stress reductie en specifieke, selectieve vaardigheidstrainingen. Daarnaast bieden ze inzicht in de impact van de COVID-19 pandemie op COVID-19-gerelateerde zorgen en de mentale gezondheid van adolescenten. De meta-analyses en de RCT naar de effectiviteit van de faalangsttraining wezen op veelbelovende resultaten voor geselecteerde groepen wat betreft het verminderen van respectievelijk (psychologische en fysiologische) stress en faalangst. De RCT naar de effectiviteit van de sociale vaardigheidstraining toonde geen significante effecten. Dit onderzoek toonde verder aan dat het, ondanks de uitdagingen, mogelijk is om met succes selectieve vaardigheidstrainingen te implementeren en evalueren binnen scholen, in een diverse steekproef van adolescenten. Daarnaast toonden onze resultaten aan dat adolescenten die voor de pandemie al kwetsbaar waren, meer risico liepen om problemen te ervaren tijdens de pandemie, wat het belang benadrukt van het bieden van hulp en ondersteuning aan adolescenten met (beginnende) mentale problemen.

REFERENCES

A

- Acharya, U. R., Joseph, K. P., Kannathal, N., Lim, C. M., & Suri, J. S. (2006). Heart rate variability: A review. In *Medical and Biological Engineering and Computing* (Vol. 44, Issue 12, pp. 1031–1051). <https://doi.org/10.1007/s11517-006-0119-0>
- Achterberg, M., Dobbelaar, S., Boer, O. D., & Crone, E. A. (2021). Perceived stress as mediator for longitudinal effects of the COVID-19 lockdown on wellbeing of parents and children. *Scientific Reports*, *11*(1), 1–14. <https://doi.org/10.1038/s41598-021-81720-8>
- Adkins, D. E., Wang, V., Dupre, M. E., Van Den Oord, E. J. C. G., & Elder, G. H. (2009). Structure and stress: Trajectories of depressive symptoms across adolescence and young adulthood. *Social Forces*, *88*(1), 31–60. <https://doi.org/10.1353/sof.0.0238>
- Ahrens, K. F., Neumann, R. J., Kollmann, B., Brokelmann, J., von Werthern, N. M., Malyschau, A., Weichert, D., Lutz, B., Fiebach, C. J., Wessa, M., Kalisch, R., Plichta, M. M., Lieb, K., Tüscher, O., & Reif, A. (2021). Impact of COVID-19 lockdown on mental health in Germany: longitudinal observation of different mental health trajectories and protective factors. *Translational Psychiatry*, *11*(1). <https://doi.org/10.1038/s41398-021-01508-2>
- Allen, A. P., Kennedy, P. J., Cryan, J. F., Dinan, T. G., & Clarke, G. (2014). Biological and psychological markers of stress in humans: Focus on the Trier Social Stress Test. *Neuroscience and Biobehavioral Reviews*, *38*, 94–124. <https://doi.org/10.1016/j.neubiorev.2013.11.005>
- Allgaier, A. K., Pietsch, K., Frühe, B., Prast, E., Sigl-Glöckner, J., & Schulte-Körne, G. (2012). Depression in pediatric care: Is the WHO-Five Well-Being Index a valid screening instrument for children and adolescents? *General Hospital Psychiatry*, *34*(3), 234–241. <https://doi.org/10.1016/j.genhosppsych.2012.01.007>
- Andersen, S. L., & Teicher, M. H. (2008). Stress, sensitive periods and maturational events in adolescent depression. *Trends in Neurosciences*, *31*(4), 183–191. <https://doi.org/10.1016/j.tins.2008.01.004>
- Anderson, R. E. E., Spence, S. H., Donovan, C. L., March, S., Prosser, S., & Kenardy, J. (2012). Working alliance in online cognitive behavior therapy for anxiety disorders in youth: Comparison with clinic delivery and its role in predicting outcome. *Journal of Medical Internet Research*, *14*(3), e88. <https://doi.org/10.2196/jmir.1848>
- Andruff, H., Carraro, N., Thompson, A., Gaudreau, P., & Louvet, B. (2009). Latent class growth modelling: A tutorial. *Tutorials in Quantitative Methods for Psychology*, *5*(1), 11–24. <https://doi.org/10.20982/tqmp.05.1.p011>
- Anniko, M. K., Boersma, K., & Tillfors, M. (2019). Sources of stress and worry in the development of stress-related mental health problems: A longitudinal investigation from early- to mid-adolescence. *Anxiety, Stress and Coping*, *32*(2), 155–167. <https://doi.org/10.1080/10615806.2018.1549657>
- Arrindel, W. A., de Groot, P. M., & Walburg, J. A. (1984). Handleiding Schaal voor Interpersoonlijk Gedrag. SIG, deel 1. Lisse: Swets & Zeitlinger.
- Arsenio, W. F., & Loria, S. (2014). Coping with negative emotions: Connections with adolescents' academic performance and stress. *Journal of Genetic Psychology*, *175*(1), 76–90. <https://doi.org/10.1080/00221325.2013.806293>

- Asscher, J. J., Deković, M., Van Der Laan, P. H., Prins, P. J. M., & Van Arum, S. (2007). Implementing randomized experiments in criminal justice settings: An evaluation of multi-systemic therapy in the Netherlands. *Journal of Experimental Criminology*, 3(2), 113–129. <https://doi.org/10.1007/s11292-007-9028-y>
- Asscher, J. J., Dijkstra, S., Stams, G. J. J. M., Deković, M., & Creemers, H. E. (2014). Family group conferencing in youth care: Characteristics of the decision making model, implementation and effectiveness of the Family Group (FG) plans. *BMC Public Health*, 14(1), 154.
- Assink, M., & Wibbelink, C. J. M. (2016). Fitting three-level meta-analytic models in R: A step-by-step tutorial. *The Quantitative Methods for Psychology*, 12(3), 154–174. <https://doi.org/10.20982/tqmp.12.3.p154>
- B**
- Barendse, M. E. A., Flannery, J., Cavanagh, C., Aristizabel, M., Becker, S. P., Berger, E., Breaux, R., Campione-Barr, N., Church, J. A., Crone, E. A., Dahl, R. E., Dennis-Tiway, T. A., Dvorsky, M. R., Dziuara, S. L., van de Groep, S., Ho, T. C., Killoren, S. E., Langberg, J. M., Larguinho, T. L., ... Pfeifer, J. H. (2021). *Longitudinal change in adolescent depression and anxiety symptoms from before to during the COVID-19 pandemic: A collaborative of 12 samples from 3 countries.*
- Barnes, V. A., Davis, H. C., Murzynowski, J. B., & Treiber, F. A. (2004). Impact of meditation on resting and ambulatory blood pressure and heart rate in youth. *Psychosomatic Medicine*, 66(6), 909–914. <https://doi.org/10.1097/01.psy.0000145902.91749.35>
- Barnes, V. A., Johnson, M. H., Williams, R. B., & Williams, V. P. (2012). Impact of Williams LifeSkills® training on anger, anxiety, and ambulatory blood pressure in adolescents. *Translational Behavioral Medicine*, 2(4), 401–410. <https://doi.org/10.1007/s13142-012-0162-3>
- Barnes, V. A., Treiber, F. A., & Davis, H. (2001). Impact of Transcendental Meditation® on cardiovascular function at rest and during acute stress in adolescents with high normal blood pressure. *Journal of Psychosomatic Research*, 51(4), 597–605. [https://doi.org/10.1016/S0022-3999\(01\)00261-6](https://doi.org/10.1016/S0022-3999(01)00261-6)
- Barnes, V. A., Treiber, F. A., & Johnson, M. H. (2004). Impact of transcendental meditation on ambulatory blood pressure in African-American adolescents. *American Journal of Hypertension*, 17(4), 366–369. <https://doi.org/10.1016/j.amjhyper.2003.12.008>
- Barrett, P. M., Lock, S., & Farrell, L. J. (2005). Developmental differences in universal preventive intervention for child anxiety. *Clinical Child Psychology and Psychiatry*, 10(4), 539–555. <https://doi.org/10.1177/1359104505056317>
- Batterham, P. J., Cleave, A. L., McCallum, S. M., Morse, A. R., Banfield, M., Farrer, L. M., Gulliver, A., Cherbuin, N., Rodney Harris, R. M., Shou, Y., & Dawel, A. (2021). Trajectories of depression and anxiety symptoms during the COVID-19 pandemic in a representative Australian adult cohort. *The Medical Journal of Australia*, 1–7. <https://doi.org/10.5694/mja2.51043>
- Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology*, 5(4), 323–370. <https://doi.org/10.1037/1089-2680.5.4.323>
- Bayne-Smith, M., Fardy, P. S., Azzollini, A., Magel, J., Schmitz, K. H., & Agin, D. (2004). Improvements in heart health behaviors and reduction in coronary artery disease risk factors in urban teenaged girls through a school-based intervention: The PATH program. *American Journal of Public Health*, 94(9), 1538–1543. <https://doi.org/10.2105/AJPH.94.9.1538>
- Beckner, V., Howard, I., Vella, L., & Mohr, D. C. (2010). Telephone-administered psychotherapy for depression in MS patients: Moderating role of social support. *Journal of Behavioral Medicine*, 33(1), 47–59. <https://doi.org/10.1007/s10865-009-9235-2>

- Belfer, M. L. (2008). Child and adolescent mental disorders: The magnitude of the problem across the globe. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 49(3), 226–236. <https://doi.org/10.1111/j.1469-7610.2007.01855.x>
- Bennett, K., & Dorjee, D. (2016). The impact of a Mindfulness-Based Stress Reduction course (MBSR) on well-being and academic attainment of sixth-form students. *Mindfulness*, 7(1), 105–114. <https://doi.org/10.1007/s12671-015-0430-7>
- Benson, H., Kornhaber, A., Kornhaber, C., LeChanu, M. N., Zuttermeister, P. C., Myers, P., & Friedman, R. (1994). Increased in positive psychological characteristics with a new relaxation-response curriculum in high school students. *The Journal of Research and Development in Education*, 4, 226–231.
- Bhavanani, A. B., Sanjay, Z., & Madanmohan. (2011). Immediate effect of sukha pranayama on cardiovascular variables in patients of hypertension. *International Journal of Yoga Therapy*, 21(21), 73–76.
- Bijstra, J. O., & Oostra, L. (2000). Sociale vaardigheid van adolescenten in kaart gebracht. *Kind En Adolescent*, 21, 166–171. <https://doi.org/10.1007/BF03060781>
- Blakemore, S. J. (2019). Adolescence and mental health. *The Lancet*, 393(10185), 2030–2031. [https://doi.org/10.1016/S0140-6736\(19\)31013-X](https://doi.org/10.1016/S0140-6736(19)31013-X)
- Blakemore, S. J., & Mills, K. L. (2014). Is adolescence a sensitive period for sociocultural processing? *Annual Review of Psychology*, 65, 187–207. <https://doi.org/10.1146/annurev-psych-010213-115202>
- Blanco, P. J., Muro, J. H., Holliman, R., Stickley, V. K., & Carter, K. (2015). Effect of child-centered play therapy on performance anxiety and academic achievement. *Journal of Child and Adolescent Counseling*, 1(2), 66–80. <https://doi.org/10.1080/23727810.2015.1079117>
- Bluth, K., Campo, R. A., Pruteanu-Malinici, S., Reams, A., Mullarkey, M., & Broderick, P. C. (2016). A school-based mindfulness pilot study for ethnically diverse at-risk adolescents. *Mindfulness*, 7(1), 90–104. <https://doi.org/10.1007/s12671-014-0376-1>
- Bonevski, B., Randell, M., Paul, C., Chapman, K., Twyman, L., Bryant, J., Brozek, I., & Hughes, C. (2014). Reaching the hard-to-reach: A systematic review of strategies for improving health and medical research with socially disadvantaged groups. *BMC Medical Research Methodology*, 14, 42. <https://doi.org/10.1186/1471-2288-14-42>
- Bonta, J., & Andrews, D. A. (2007). Risk-Need-Responsivity Model for offender assessment and rehabilitation. In *Rehabilitation* (Vol. 6, Issue 1). <https://doi.org/10.1185/03007997709110168>
- Bouter, D. C., Zarchev, M., Ravensbergen, S. J., Kamperman, A. M., Hoogendijk, W. J. G., & Grootendorst-van Mil, N. H. (2021). A longitudinal study of mental health in adolescents before and during the COVID-19 pandemic. *Preprint*, 1–16.
- Bradley, R. T., McCraty, R., Atkinson, M., Tomasino, D., Daugherty, A., & Arguelles, L. (2010). Emotion self-regulation, psychophysiological coherence, and test anxiety: Results from an experiment using electrophysiological measures. *Applied Psychophysiology Biofeedback*, 35(4), 261–283. <https://doi.org/10.1007/s10484-010-9134-x>
- Brailovskaia, J., & Margraf, J. (2020). Predicting adaptive and maladaptive responses to the Coronavirus (COVID-19) outbreak: A prospective longitudinal study. *International Journal of Clinical and Health Psychology*, 20(3), 183–191. <https://doi.org/10.1016/j.ijchp.2020.06.002>
- Breaux, R., Dvorsky, M. R., Marsh, N. P., Green, C. D., Cash, A. R., Shroff, D. M., Buchen, N., Langberg, J. M., & Becker, S. P. (2021). Prospective impact of COVID-19 on mental health functioning in adolescents with and without ADHD: protective role of emotion regulation abilities. *Journal of Child Psychology and Psychiatry and Allied Disciplines*. <https://doi.org/10.1111/jcpp.13382>

- Bruzzese, J. M., Gallagher, R., McCann-Doyle, S., Reiss, P. T., & Wijetunga, N. A. (2009). Effective methods to improve recruitment and retention in school-based substance use prevention studies. *Journal of School Health, 79*(9), 400–407. <https://doi.org/10.1111/j.1746-1561.2009.00427.x>
- Burckhardt, R., Manicavasagar, V., Batterham, P. J., & Hadzi-Pavlovic, D. (2016). A randomized controlled trial of strong minds: A school-based mental health program combining acceptance and commitment therapy and positive psychology. *Journal of School Psychology, 57*, 41–52. <https://doi.org/10.1016/j.jsp.2016.05.008>
- Burger, K., & Samuel, R. (2017). The role of perceived stress and self-efficacy in young people's life satisfaction: A longitudinal study. *Journal of Youth and Adolescence, 46*, 78–90. <https://doi.org/10.1038/nature01403>
- Burin, A. B., & Osório, F. de L. (2016). Interventions for music performance anxiety: Results from a systematic literature review. *Revista de Psiquiatria Clinica, 43*(5), 116–131. <https://doi.org/10.1590/0101-60830000000097>
- Butzer, B., LoRusso, A., Shin, S. H., & Khalsa, S. B. S. (2017). Evaluation of yoga for preventing adolescent substance use risk factors in a middle school setting: A preliminary group-randomized controlled trial. *Journal of Youth and Adolescence, 46*(3), 603–632. <https://doi.org/10.1007/s10964-016-0513-3>
- C**
- Cadieux, E. G., Gemme, C., & Dupuis, G. (2021). Effects of yoga interventions on psychological health and performance of competitive athletes: A systematic review. *Journal of Science in Sport and Exercise, 3*(2), 158–166. <https://doi.org/10.1007/s42978-020-00104-y>
- Calvete, E., Fernández-Gonzalez, L., Orue, I., Echezarraga, A., Royuela-Colomer, E., Cortazar, N., Muga, J., Longa, M., & Yeager, D. S. (2019). The effect of an intervention teaching adolescents that people can change on depressive symptoms, cognitive schemas, and hypothalamic-pituitary-adrenal axis hormones. *Journal of Abnormal Child Psychology, 47*(9), 1533–1546. <https://doi.org/10.1007/s10802-019-00538-1>
- Camara, M., Bacigalupe, G., & Padilla, P. (2017). The role of social support in adolescents: Are you helping me or stressing me out? *International Journal of Adolescence and Youth, 22*(2), 123–136. <https://doi.org/10.1080/02673843.2013.875480>
- Campbell, A. J., Lanthier, R. P., Weiss, B. A., & Shaine, M. D. (2019). The impact of a schoolwide mindfulness program on adolescent well-being, stress, and emotion regulation: A nonrandomized controlled study in a naturalistic setting. *Journal of Child and Adolescent Counseling, 5*(1), 18–34. <https://doi.org/10.1080/23727810.2018.1556989>
- Carlson, L. E., Speca, M., Farris, P., & Patel, K. D. (2007). One year pre-post intervention follow-up of psychological, immune, endocrine and blood pressure outcomes of mindfulness-based stress reduction (MBSR) in breast and prostate cancer outpatients. *Brain, Behavior, and Immunity, 21*(8), 1038–1049. <https://doi.org/10.1016/j.bbi.2007.04.002>
- Carreres-Ponsoda, F., Escartí, A., Llopis-Goig, R., & Cortell-Tormo, J. M. (2017). The effect of an out-of-school mindfulness program on adolescents' stress reduction and emotional wellbeing. *Cuadernos de Psicología Del Deporte, 17*(3), 35–44.
- Carter, A. E. (2010). Evaluating the Best of Coping Program: Enhancing coping skills in adolescents. *ProQuest Dissertations and Theses*.
- CBS. (2021a). *Centraal Bureau voor de Statistiek (i.e., gender, age, generation and migration background)*. <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37325/table?ts=1623680202114>

- CBS. (2021b). *Centraal Bureau voor de Statistiek (i.e., highest attained level of education and education tracks)*. <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/82816NED/table?ts=1623676945026>
- Chang, C., Tsai, G., & Hsieh, C. J. (2013). Psychological, immunological and physiological effects of a Laughing Qigong Program (LQP) on adolescents. *Complementary Therapies in Medicine, 21*(6), 660–668. <https://doi.org/10.1016/j.ctim.2013.09.004>
- Chappel, A. M., Suldo, S. M., & Ogg, J. A. (2014). Associations between adolescents' family stressors and life satisfaction. *Journal of Child and Family Studies, 23*(1), 76–84. <https://doi.org/10.1007/s10826-012-9687-9>
- Charmandari, E., Tsigos, C., & Chrousos, G. (2005). Endocrinology of the stress response. *Annual Review of Physiology, 67*(1), 259–284. <https://doi.org/10.1146/annurev.physiol.67.040403.120816>
- Chorpita, B. F., Yim, L., Moffitt, C., Umemoto, L. A., & Francis, S. E. (2000). Assessment of symptoms of DSM-IV anxiety and depression in children: A revised child anxiety and depression scale. *Behaviour Research and Therapy, 38*(8), 835–855. [https://doi.org/10.1016/S0005-7967\(99\)00130-8](https://doi.org/10.1016/S0005-7967(99)00130-8)
- Christie, D., & Viner, R. (2005). Adolescent development. *BMJ: British Medical Journal, 330*(7486), 301–304. <https://doi.org/10.1136/bmj.330.7486.301>
- Chu, P. Sen, Saucier, D. A., & Hafner, E. (2010). Meta-analysis of the relationships between social support and well-being in children and adolescents. *Journal of Social and Clinical Psychology, 29*(6), 624–645. <https://doi.org/10.1521/jscp.2010.29.6.624>
- Clarke, A. M., Kuosmanen, T., & Barry, M. M. (2015). A systematic review of online youth mental health promotion and prevention interventions. *Journal of Youth and Adolescence, 44*(1), 90–113. <https://doi.org/10.1007/s10964-014-0165-0>
- Coffey, A. (2013). Relationships: The key to successful transition from primary to secondary school? *Improving Schools, 16*(3), 261–271. <https://doi.org/10.1177/1365480213505181>
- Cohen, J. (1988). *Statistical power analysis for the social sciences*. Hillsdale, NJ: Erlbaum.
- Collado, A., Felton, J. W., MacPherson, L., & Lejuez, C. W. (2014). Longitudinal trajectories of sensation seeking, risk taking propensity, and impulsivity across early to middle adolescence. *Addictive Behaviors, 39*(11), 1580–1588. <https://doi.org/10.1016/j.addbeh.2014.01.024>
- Compas, B. E., Jaser, S. S., Dunbar, J. P., Watson, K. H., Bettis, A. H., Gruhn, M. A., & Williams, E. K. (2014). Coping and emotion regulation from childhood to early adulthood: Points of convergence and divergence. *Australian Journal of Psychology, 66*(2), 71–81. <https://doi.org/10.1111/ajpy.12043>
- Conley, C. S., Durlak, J. A., Shapiro, J. B., Kirsch, A. C., & Zahniser, E. (2016). A meta-analysis of the impact of universal and indicated preventive technology-delivered interventions for higher education students. *Prevention Science, 17*(6), 659–678. <https://doi.org/10.1007/s11121-016-0662-3>
- Conroy, D. E., & Coatsworth, J. D. (2004). The effects of coach training on fear of failure in youth swimmers: A latent growth curve analysis from a randomized, controlled trial. *Journal of Applied Developmental Psychology, 25*(2), 193–214. <https://doi.org/10.1016/j.appdev.2004.02.007>
- Conroy, D. E., Willow, J. P., & Metzler, J. N. (2002). Multidimensional fear of failure measurement: The Performance Failure Appraisal Inventory. *Journal of Applied Sport Psychology, 14*, 76–90. <https://doi.org/10.1080/10413200252907752>
- Cosma, A., Stevens, G., Martin, G., Duinhof, E. L., Walsh, S. D., Garcia-Moya, I., Költő, A., Gobina, I., Canale, N., Catunda, C., Inchley, J., & de Looze, M. (2020). Cross-national time trends in adolescent mental well-being from 2002 to 2018 and the explanatory role of schoolwork pressure. *Journal of Adolescent Health, 66*(6), S50–S58. <https://doi.org/10.1016/j.jadohealth.2020.02.010>

- Cosma, A., Stevens, G. W. J. M., Vollebergh, W. A. M., & De Looze, M. (2021). Time trends in schoolwork pressure among Dutch adolescents, 2001–2017: Gender and educational differences. *Scandinavian Journal of Public Health, April*, 9–12. <https://doi.org/10.1177/14034948211018388>
- Cost, K. T., Crosbie, J., Anagnostou, E., Birken, C. S., Charach, A., Monga, S., Kelley, E., Nicolson, R., Maguire, J. L., Burton, C. L., Schachar, R. J., Arnold, P. D., & Korczak, D. J. (2021). Mostly worse, occasionally better: impact of COVID-19 pandemic on the mental health of Canadian children and adolescents. *European Child and Adolescent Psychiatry, 0123456789*. <https://doi.org/10.1007/s00787-021-01744-3>
- Cross, D., Shaw, T., Epstein, M., Pearce, N., Barnes, A., Burns, S., Waters, S., Lester, L., & Runions, K. (2018). Impact of the Friendly Schools whole-school intervention on transition to secondary school and adolescent bullying behaviour. *European Journal of Education, 53*(4), 495–513. <https://doi.org/10.1111/ejed.12307>
- D**
- da Silva, L. A., Doyenart, R., Henrique Salvan, P., Rodrigues, W., Felipe Lopes, J., Gomes, K., Thirupathi, A., De Pinho, R. A., & Silveira, P. C. (2019). Swimming training improves mental health parameters, cognition and motor coordination in children with Attention Deficit Hyperactivity Disorder. *International Journal of Environmental Health Research, 1*–9. <https://doi.org/10.1080/09603123.2019.1612041>
- de Anda, D. (1998). The evaluation of a stress management program for middle school adolescents. *Child and Adolescent Social Work Journal, 15*(1), 73–85.
- de Anda, D., Baroni, S., Boskin, L., Buchwald, L., Morgan, J., Ow, J., Gold, J. S., & Weiss, R. (2000). Stress, stressors and coping among high school students. *Children and Youth Services Review, 22*(6), 441–463. [https://doi.org/10.1016/S0190-7409\(00\)00096-7](https://doi.org/10.1016/S0190-7409(00)00096-7)
- de Bruin, E. I., Sieh, D. S., Zijlstra, B. J. H., & Meijer, A. M. (2018). Chronic childhood stress: Psychometric properties of the Chronic Stress Questionnaire for Children and Adolescents (CSQ-CA) in three independent samples. *Child Indicators Research, 11*(4), 1389–1406. <https://doi.org/10.1007/s12187-017-9478-3>
- de Goede, I. H. A., Branje, S. J. T., de Delsing, M. J. M. H., & Meeus, W. H. J. (2009). Linkages over time between adolescents' relationships with parents and friends. *Journal of Youth and Adolescence, 38*(10), 1304–1315. <https://doi.org/10.1007/s10964-009-9403-2>
- de Mooij, B., Fekkes, M., Scholte, R. H. J., & Overbeek, G. (2020). Effective components of social skills training programs for children and adolescents in nonclinical samples: A multilevel meta-analysis. *Clinical Child and Family Psychology Review, 23*(2), 250–264. <https://doi.org/10.1007/s10567-019-00308-x>
- de Wit, M., Pouwer, F., Gemke, R. J. B. J., Delemarre-Van De Waal, H. A., & Snoek, F. J. (2007). Validation of the WHO-5 well-being index in adolescents with type 1 diabetes. *Diabetes Care, 30*(8), 2003–2006. <https://doi.org/10.2337/dc07-0447>
- De Wolfe, A. S., & Saunders, A. M. (1995). Stress reduction in sixth-grade students. *Journal of Experimental Education, 63*(4), 315–329. <https://doi.org/10.1080/00220973.1995.9943467>
- Dean, S., Britt, E., Bell, E., Stanley, J., & Collings, S. (2016). Motivational interviewing to enhance adolescent mental health treatment engagement: A randomized clinical trial. *Psychological Medicine, 46*(9), 1961–1969. <https://doi.org/10.1017/S0033291716000568>
- Demaray, M. K., & Malecki, C. (2014). Best practices in assessing and promoting social support. In *Best Practices in School Psychology* (Issue 0, pp. 79–95).
- DeVet, K. A., Kim, Y. J., Charlot-Swillely, D., & Ireys, H. T. (2003). The therapeutic relationship in child therapy: Perspectives of children and mothers. *Journal of Clinical Child and Adolescent Psychology, 32*(2), 277–283. https://doi.org/10.1207/S15374424JCCP3202_13

- Ditzen, B., & Heinrichs, M. (2014). Psychobiology of social support: The social dimension of stress buffering. *Restorative Neurology and Neuroscience*, 32(1), 149–162. <https://doi.org/10.3233/RNN-139008>
- Dowling, K., Simpkin, A. J., & Barry, M. M. (2019). A cluster randomized-controlled trial of the MindOut Social and Emotional Learning Program for disadvantaged post-primary school students. *Journal of Youth and Adolescence*. <https://doi.org/10.1007/s10964-019-00987-3>
- Duan, L., Shao, X., Wang, Y., Huang, Y., Miao, J., Yang, X., & Zhu, G. (2020). An investigation of mental health status of children and adolescents in china during the outbreak of COVID-19. *Journal of Affective Disorders*, 275, 112–118. <https://doi.org/10.1016/j.jad.2020.06.029>
- Dunn, T. W., Burlingame, G. M., Walbridge, M., Smith, J., & Crum, M. J. (2005). Outcome assessment for children and adolescents: Psychometric validation of the Youth Outcome Questionnaire 30.1 (Y-OQ®-30.1). *Clinical Psychology and Psychotherapy*, 12(5), 388–401. <https://doi.org/10.1002/cpp.461>
- Dupéré, V., Leventhal, T., Dion, E., Crosnoe, R., Archambault, I., & Janosz, M. (2015). Stressors and turning points in high school and dropout. *Review of Educational Research*, 85(4), 591–629. <https://doi.org/10.3102/0034654314559845>
- Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, 82(1), 405–432. <https://doi.org/10.1111/j.1467-8624.2010.01564.x>
- Durlak, J. A., Weissberg, R. P., & Pachan, M. (2010). A meta-analysis of after-school programs that seek to promote personal and social skills in children and adolescents. *American Journal of Community Psychology*, 45(3–4), 294–309. <https://doi.org/10.1007/s10464-010-9300-6>
- Duval, S., & Tweedie, R. (2000a). A nonparametric “Trim and Fill” method of accounting for publication bias in meta-analysis. *Journal of the American Statistical Association*, 95(449), 89–98. <https://doi.org/10.1080/01621459.2000.10473905>
- Duval, S., & Tweedie, R. (2000b). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, 56(2), 455–463.
- Dvorsky, M. R., Breaux, R., & Becker, S. P. (2020). Finding ordinary magic in extraordinary times: child and adolescent resilience during the COVID-19 pandemic. *European Child and Adolescent Psychiatry*, 8–10. <https://doi.org/10.1007/s00787-020-01583-8>

E

- Ebrahmimi, M., Jaliabadi, Z., Gholami Ghareh Chenagh, K. H., Amini, F., & Arkian, F. (2015). Effectiveness of training of spiritual intelligence components on consequences of psychological and self-esteem of adolescents. *Journal of Medicine and Life*, 8(4), 87–92.
- Egger, M., Davey Smith, G., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, 315, 629–634.
- Eggert, L. L., Thompson, E. A., Herting, J. R., & Nicholas, L. J. (1995). Reducing suicide potential among high-risk youth: Tests of a school-based prevention program. *Suicide and Life-Threatening Behavior*, 25(2), 276–296.
- Elbaum, B., Vaughn, S., Hughes, M. T., & Moody, S. W. (2000). How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology*, 92(4), 605–619. <https://doi.org/10.1037/0022-0663.92.4.605>
- Ellis, W. E., Dumas, T. M., & Forbes, L. M. (2020). Physically isolated but socially connected: Psychological adjustment and stress among adolescents during the initial COVID-19 crisis. *Canadian Journal of Behavioural Science*, 52(3), 177–187. <https://doi.org/10.1037/cbs0000215>

- Eskin, M. (2003). Self-reported assertiveness in Swedish and Turkish adolescents: A cross-cultural comparison. *Scandinavian Journal of Psychology, 44*(1), 7–12. <https://doi.org/10.1111/1467-9450.t01-1-00315>
- Eslami, A. A., Rabiei, L., Afzali, S. M., Hamidzadeh, S., & Masoudi, R. (2016). The effectiveness of assertiveness training on the levels of stress, anxiety, and depression of high school students. *Iranian Red Crescent Medical Journal, 18*(1), 1–10. <https://doi.org/10.5812/ircmj.21096>
- Evans, S., Lung, K. C., Seidman, L. C., Sternlieb, B., Zeltzer, L. K., & Tsao, J. C. I. (2014). Iyengar yoga for adolescents and young adults with irritable bowel syndrome. *Journal of Pediatric Gastroenterology and Nutrition, 59*(2), 244–253. <https://doi.org/10.1097/MPG.0000000000000366>
- Ewart, C. K., Harris, W. L., Iwata, M. M., Coates, T. J., Bullock, R., & Simon, B. (1987). Feasibility and effectiveness of school-based relaxation in lowering blood pressure. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association, 6*(5), 399–416. <https://doi.org/10.1037/0278-6133.6.5.399>
- F**
- Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Psychonomic Society Inc., 39*(2), 175–191. http://www.gpower.hhu.de/fileadmin/redaktion/Fakultaeten/Mathematisch-Naturwissenschaftliche_Fakultaet/Psychologie/AAP/gpower/GPower3-BRM-Paper.pdf
- Feiss, R., Dolinger, S. B., Merritt, M., Reiche, E., Martin, K., Yanes, J. A., Thomas, C. M., & Pangelinan, M. (2019). A systematic review and meta-analysis of school-based stress, anxiety, and depression prevention programs for adolescents. *Journal of Youth and Adolescence, 48*(9), 1668–1685. <https://doi.org/10.1007/s10964-019-01085-0>
- Ferdinand, R. F., Lang, N. D. J. V., Ormel, J., & Verhulst, F. C. (2006). No distinctions between different types of anxiety symptoms in pre-adolescents from the general population. *Journal of Anxiety Disorders, 20*(2), 207–221. <https://doi.org/10.1016/j.janxdis.2004.12.003>
- Fernández-Sogorb, A., Sanmartín, R., Vicent, M., & González, C. (2021). Identifying profiles of anxiety in late childhood and exploring their relationship with school-based distress. *International Journal of Environmental Research and Public Health, 18*(3), 1–15. <https://doi.org/10.3390/ijerph18030948>
- Festen, H., Hartman, C. A., Hogendoorn, S., de Haan, E., Prins, P. J. M., Reichart, C. G., Moorlag, H., & Nauta, M. H. (2013). Temperament and parenting predicting anxiety change in cognitive behavioral therapy: The role of mothers, fathers, and children. *Journal of Anxiety Disorders, 27*(3), 289–297. <https://doi.org/10.1016/j.janxdis.2013.03.001>
- Fishbein, D., Miller, S., Herman-Stahl, M., Williams, J., Lavery, B., Markovitz, L., Kluckman, M., Mosoriak, G., & Johnson, M. (2016). Behavioral and psychophysiological effects of a yoga intervention on high-risk adolescents: A randomized control trial. *Journal of Child and Family Studies, 25*(2), 518–529. <https://doi.org/10.1007/s10826-015-0231-6>
- Flett, G. L., Hewitt, P. L., Besser, A., Su, C., Vaillancourt, T., Boucher, D., Munro, Y., Davidson, L. A., & Gale, O. (2016). The Child-Adolescent Perfectionism Scale: Development, psychometric properties, and associations with stress, distress, and psychiatric symptoms. *Journal of Psychoeducational Assessment, 34*(7), 634–652. <https://doi.org/10.1177/0734282916651381>
- Flores, R. (1995). Dance for health: Improving fitness in African American and Hispanic adolescents. *Public Health Reports, 110*(2), 189–193.

- Flückiger, C., & Del Re, A. C. (2017). The sleeper effect between psychotherapy orientations: A strategic argument of sustainability of treatment effects at follow-up. *Epidemiology and Psychiatric Sciences*, 26(4), 442–444. <https://doi.org/10.1017/s2045796016000780>
- Fox, J. K., Halpern, L. F., Ryan, J. L., & Lowe, K. A. (2010). Stressful life events and the tripartite model: Relations to anxiety and depression in adolescent females. *Journal of Adolescence*, 33(1), 43–54. <https://doi.org/10.1016/j.adolescence.2009.05.009>
- Francisco, R., Pedro, M., Delvecchio, E., Espada, J. P., Morales, A., Mazzeschi, C., & Orgilés, M. (2020). Psychological symptoms and behavioral changes in children and adolescents during the early phase of COVID-19 quarantine in three European countries. *Frontiers in Psychiatry*, 11(December), 1–14. <https://doi.org/10.3389/fpsyt.2020.570164>
- Franck, E., De Raedt, R., Barbez, C., & Rosseel, Y. (2008). Psychometric properties of the Dutch Rosenberg Self-Esteem Scale. *Psychologica Belgica*, 48(1), 25–35. <https://doi.org/10.5334/pb-48-1-25>
- Frank, P., Iob, E., Steptoe, A., & Francourt, D. (2020). Trajectories of depressive symptoms among vulnerable groups in the UK during the COVID-19 pandemic. *JAMA Network Open*, 3(10), 1–13. <https://doi.org/https://doi.org/10.1101/2020.06.09.20126300>
- Fridrici, M., & Lohaus, A. (2009). Stress-prevention in secondary schools: Online- versus face-to-face-training. *Health Education*, 109(4), 299–313. <https://doi.org/10.1108/09654280910970884>
- Fuhrmann, D., Knoll, L. J., & Blakemore, S. J. (2015). Adolescence as a sensitive period of brain development. *Trends in Cognitive Sciences*, 19(10), 558–566. <https://doi.org/10.1016/j.tics.2015.07.008>
- Fung, J., Kim, J. J., Jin, J., Chen, G., Bear, L., & Lau, A. S. (2019). A randomized trial evaluating school-based mindfulness intervention for ethnic minority youth: Exploring mediators and moderators of intervention effects. *Journal of Abnormal Child Psychology*, 47(1), 1–19. <https://doi.org/10.1007/s10802-018-0425-7>
- G**
- García-Carmona, M., Marín, M. D., & Aguayo, R. (2019). Burnout syndrome in secondary school teachers: a systematic review and meta-analysis. *Social Psychology of Education*, 22(1), 189–208. <https://doi.org/10.1007/s11218-018-9471-9>
- Garcia, C., Pintor, J., Vazquez, G., & Alvarez-Zumarraga, E. (2013). Project Wings, a coping intervention for latina adolescents: A pilot study. *Western Journal of Nursing Research*, 35(4), 434–458. <https://doi.org/10.1177/0193945911407524>
- Garnefski, N., & Kraaij, V. (2006). Cognitive emotion regulation questionnaire - development of a short 18-item version (CERQ-short). *Personality and Individual Differences*, 41(6), 1045–1053. <https://doi.org/10.1016/j.paid.2006.04.010>
- Garnefski, N., Kraaij, V., & Spinhoven, P. (2001). Negative life events, cognitive emotion regulation and depression. *Personality and Individual Differences*, 30, 1311–1327. [https://doi.org/10.1016/S0191-8869\(00\)00113-6](https://doi.org/10.1016/S0191-8869(00)00113-6)
- Gaspar, T., Cerqueira, A., Branquinho, C., & Matos, M. G. (2018). The effect of a social-emotional school-based intervention upon social and personal skills in children and adolescents. *Journal of Education and Learning*, 7(6), 57. <https://doi.org/10.5539/jel.v7n6p57>
- Gee, B., Wilson, J., Clarke, T., Farthing, S., Carroll, B., Jackson, C., King, K., Murdoch, J., Fonagy, P., & Notley, C. (2021). Review: Delivering mental health support within schools and colleges – a thematic synthesis of barriers and facilitators to implementation of indicated psychological interventions for adolescents. *Child and Adolescent Mental Health*, 26(1), 34–46. <https://doi.org/10.1111/camh.12381>

- Goodman, R., & Newman, D. (2015). Testing a digital storytelling intervention to reduce stress in adolescent females. *Storytelling, Self, Society, 10*(2), 177–193. <https://doi.org/10.13110/storselsfoci.10.2.0177>
- Gregor, A. (2005). Examination anxiety: Live with it, control it or make it work for you? *School Psychology International, 26*(5), 617–635. <https://doi.org/10.1177/0143034305060802>
- Gregoski, M. J., Barnes, V. A., Tingen, M. S., Harshfield, G. A., & Treiber, F. A. (2011). Breathing awareness meditation and lifeskills training programs influence upon ambulatory blood pressure and sodium excretion among African American adolescents. *Journal of Adolescent Health, 48*(1), 59–64. <https://doi.org/10.1016/j.jadohealth.2010.05.019>
- H**
- Hafstad, G. S., Saetren, S. S., Wentzel-larsen, T., & Augusti, E. (2021). Adolescents' symptoms of anxiety and depression before and during the Covid-19 outbreak - A prospective population-based study of teenagers in Norway. *The Lancet Regional Health - Europe, 5*. <https://doi.org/10.1016/j.lanepe.2021.100093>
- Hagins, M., Haden, S. C., & Daly, L. A. (2013). A randomized controlled trial on the effects of yoga on stress reactivity in 6th grade students. *Evidence-Based Complementary and Alternative Medicine, 2013*. <https://doi.org/10.1155/2013/607134>
- Hampel, P., Meier, M., & Kümmel, U. (2008). School-based stress management training for adolescents: Longitudinal results from an experimental study. *Journal of Youth and Adolescence, 37*(8), 1009–1024. <https://doi.org/10.1007/s10964-007-9204-4>
- Hanrahan, K., McCarthy, A. M., Kleiber, C., Lutgendorf, S., & Tsalikian, E. (2006). Strategies for salivary cortisol collection and analysis in research with children. *Applied Nursing Research, 19*(2), 95–101. <https://doi.org/10.1016/j.apnr.2006.02.001>
- Harden, K. P., & Tucker-Drob, E. M. (2011). Individual differences in the development of sensation seeking and impulsivity during adolescence: Further evidence for a dual systems model. *Developmental Psychology, 47*(3), 739–746. <https://doi.org/10.1037/a0023279>
- Hariton, E., & Locascio, J. J. (2018). Randomised controlled trials—the gold standard for effectiveness research. *BJOG: An International Journal of Obstetrics & Gynaecology, 125*(13), 1–4. <https://doi.org/10.1111/1471-0528.15199>
- Harrell, A. W., Mercer, S. H., & DeRosier, M. E. (2009). Improving the social-behavioral adjustment of adolescents: The effectiveness of a social skills group intervention. *Journal of Child and Family Studies, 18*(4), 378–387. <https://doi.org/10.1007/s10826-008-9241-y>
- Harris, A., & Chapman, C. (2004). Improving schools in difficult contexts: Towards a differentiated approach. *British Journal of Educational Studies, 52*(4), 417–431. <https://doi.org/10.1111/j.1467-8527.2004.00276.x>
- Hawes, M. T., Szenczy, A. K., Olino, T. M., Nelson, B. D., & Klein, D. N. (2021). Trajectories of depression, anxiety and pandemic experiences; A longitudinal study of youth in New York during the Spring-Summer of 2020. *Psychiatry Research, 298*, 113778. <https://doi.org/10.1016/j.psychres.2021.113778>
- Heckenberg, R. A., Eddy, P., Kent, S., & Wright, B. J. (2018). Do workplace-based mindfulness meditation programs improve physiological indices of stress? A systematic review and meta-analysis. In *Journal of Psychosomatic Research* (Vol. 114, pp. 62–71). <https://doi.org/10.1016/j.jpsychores.2018.09.010>
- Henderson, C. E., Dakof, G. A., Greenbaum, P. E., & Liddle, H. A. (2010). Effectiveness of multidimensional family therapy with higher severity substance-abusing adolescents: Report from two randomized controlled trials. *Journal of Consulting and Clinical Psychology, 78*(6), 885–897. <https://doi.org/10.1037/a0020620>
- Hiebert, B., Kirby, B., & Jaknavorian, A. (1989). School-based relaxation: Attempting primary prevention. *Canadian Journal of Counselling, 23*(3), 273–287.

- Hofferth, S. L. (2009). Changes in American children's time - 1997 to 2003. *International Journal of Time Use Research*, 6(1), 26–47. <https://doi.org/10.13085/eijtur.6.1.26-47>
- Hollenstein, T., Colasante, T., & Loughed, J. P. (2021). Adolescent and maternal anxiety symptoms decreased but depressive symptoms increased before to during COVID-19 lockdown. *Journal of Research on Adolescence*, 31(3), 517–530. <https://doi.org/10.1111/jora.12663>
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Hussong, A. M., Midgette, A. J., Thomas, T. E., Coffman, J. L., & Cho, S. (2021). Coping and mental health in early adolescence during COVID-19. *Journal of Adolescence*. <https://doi.org/10.1006/jjado.1995.1033>

I

- Inchley, J., Currie, D., Budisavljevic, S., Torsheim, T., Jastad, A., Cosma, A., Kelly, C., & Arnarsson, A. M. (2020). Spotlight on adolescent health and well-being. Findings from the 2017/2018 Health Behaviour in School-aged Children (HBSC) survey in Europe and Canada. International report. *WHO Regional Office for Europe*, 1, 58.

J

- Jamali, S., Sabokdast, S., Nia, H. S., Goudarzian, A. H., Beik, S., & Allen, K. A. (2016). The effect of life skills training on mental health of Iranian middle school students: A preliminary study. *Iranian Journal of Psychiatry*, 11(4), 269–273.
- Jayanthi, P., Thirunavukarasu, M., & Rajkumar, R. (2015). Academic stress and depression among adolescents: A cross-sectional study. *Indian Pediatrics*, 52, 217–219.
- Jellesma, F. C., & Cornelis, J. (2012). Mind Magic: A pilot study of preventive mind-body-based stress reduction in behaviorally inhibited and activated children. *Journal of Holistic Nursing*, 30(1), 55–62. <https://doi.org/10.1177/0898010111418117>
- Jezova, D., Makatsori, A., Duncko, R., Moncek, F., & Jakubek, M. (2004). High trait anxiety in healthy subjects is associated with low neuroendocrine activity during psychosocial stress. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, 28(8), 1331–1336. <https://doi.org/10.1016/j.pnpbp.2004.08.005>
- Jonsson, U., Bohman, H., Von Knorring, L., Olsson, G., Paaren, A., & Von Knorring, A. L. (2011). Mental health outcome of long-term and episodic adolescent depression: 15-year follow-up of a community sample. *Journal of Affective Disorders*, 130(3), 395–404. <https://doi.org/10.1016/j.jad.2010.10.046>
- Jose, B., & Sajeena. (2017). Effectiveness of yoga therapy on stress and concentration among students of selected schools in Kerala. *Asian Journal of Nursing Education and Research*, 7(3), 299–304. <https://doi.org/10.5958/2349-2996.2017.00062.3>
- Jose, P. E., & Ratcliffe, V. (2004). Stressor frequency and perceived intensity as predictors of internalizing problems: Gender and age differences in adolescence. *New Zealand Journal of Psychology*, 33(3), 145–154.
- Jung, T., & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass*, 2(1), 302–317. <https://doi.org/10.1111/j.1751-9004.2007.00054.x>
- Juth, V., & Dickerson, S. (2013). Social Stress. In M. D. Gellman & J. R. Turner (Eds.), *Encyclopedia of Behavioral Medicine* (pp. 1842–1843). Springer New York. https://doi.org/10.1007/978-1-4419-1005-9_283

K

- Kaplan, D. S., Liu, R. X., & Kaplan, H. B. (2005). School related stress in early adolescence and academic performance three years later: The conditional influence of self expectations. In *Social Psychology of Education* (Vol. 8).
- Kaplan, R. M., & Irvin, V. L. (2015). Likelihood of null effects of large NHLBI clinical trials has increased over time. *PLoS ONE*, *10*(8), 1–12. <https://doi.org/10.1371/journal.pone.0132382>
- Karlsson, P., & Bergmark, A. (2015). Compared with what? An analysis of control-group types in Cochrane and Campbell reviews of psychosocial treatment efficacy with substance use disorders. *Addiction*, *110*(3), 420–428. <https://doi.org/10.1111/add.12799>
- Kearney, C. A., & Graczyk, P. (2014). A Response to Intervention Model to promote school attendance and decrease school absenteeism. *Child and Youth Care Forum*, *43*(1), 1–25. <https://doi.org/10.1007/s10566-013-9222-1>
- Kempen, G. I. J. M., & van Eijk, L. M. (1995). The psychometric properties of the SSL12-I, a short scale for measuring social support in the elderly. *Social Indicators Research*, *35*(3), 303–312.
- Khalsa, S. B. S., Hickey-Schultz, L., Cohen, D., Steiner, N., & Cope, S. (2012). Evaluation of the mental health benefits of yoga in a secondary school: A preliminary randomized controlled trial. *Journal of Behavioral Health Services and Research*, *39*(1), 80–90. <https://doi.org/10.1007/s11414-011-9249-8>
- Kiang, L., & Buchanan, C. M. (2014). Daily stress and emotional well-being among Asian American adolescents: Same-day, lagged, and chronic associations. *Developmental Psychology*, *50*(2), 611–621. <https://doi.org/10.1037/a0033645>
- Kieling, C., Baker-Henningham, H., Belfer, M., Conti, G., Ertem, I., Omigbodun, O., Rohde, L. A., Srinath, S., Ulkuer, N., & Rahman, A. (2011). Child and adolescent mental health worldwide: Evidence for action. *The Lancet*, *378*(9801), 1515–1525. [https://doi.org/10.1016/S0140-6736\(11\)60827-1](https://doi.org/10.1016/S0140-6736(11)60827-1)
- Killen, J. D. (1988). Cardiovascular disease risk reduction for tenth graders. A multiple-factor school-based approach. *JAMA: The Journal of the American Medical Association*, *260*(12), 1728–1733. <https://doi.org/10.1001/jama.260.12.1728>
- Kim, H. G., Cheon, E. J., Bai, D. S., Lee, Y. H., & Koo, B. H. (2018). Stress and heart rate variability: A meta-analysis and review of the literature. *Psychiatry Investigation*, *15*(3), 235–245. <https://doi.org/10.30773/pi.2017.08.17>
- Kiselica, M. S., Baker, S. B., Thomas, R. N., & Reedy, S. (1994). Effects of stress inoculation training on anxiety, stress, and academic performance among adolescents. *Journal of Counseling Psychology*, *41*(3), 335–342.
- Kleinjan, M., Pieper, I., Stevens, G., van de Klundert, N., Rombouts, M., Boer, M., & Lammers, J. (2020). *Geluk onder druk? Onderzoek naar het mentaal welbevinden van jongeren in Nederland*.
- Klinger, D. A., Freeman, J. G., Bilz, L., Liiv, K., Ramelow, D., Sebok, S. S., Samdal, O., Dür, W., & Rasmussen, M. (2015). Cross-national trends in perceived school pressure by gender and age from 1994 to 2010. *European Journal of Public Health*, *25*(2), 51–56. <https://doi.org/10.1093/eurpub/ckv027>
- Knapp, G., & Hartung, J. (2003). Improved tests for a random effects meta-regression with a single covariate. *Statistics in Medicine*, *22*(17), 2693–2710. <https://doi.org/10.1002/sim.1482>
- Koehler, J. A., Lösel, F., Akoensi, T. D., & Humphreys, D. K. (2013). A systematic review and meta-analysis on the effects of young offender treatment programs in Europe. *Journal of Experimental Criminology*, *9*(1), 19–43. <https://doi.org/10.1007/s11292-012-9159-7>

- Kraag, G., Van Breukelen, G. J. P., Kok, G., & Hosman, C. (2009). "Learn young, learn fair", a stress management program for fifth and sixth graders: Longitudinal results from an experimental study. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *50*(9), 1185–1195. <https://doi.org/10.1111/j.1469-7610.2009.02088.x>
- Kraag, G., Zeegers, M. P., Kok, G., Hosman, C., & Abu-Saad, H. H. (2006). School programs targeting stress management in children and adolescents: A meta-analysis. *Journal of School Psychology*, *44*(6), 449–472. <https://doi.org/10.1016/j.jsp.2006.07.001>
- Kraemer, H. C., Wilson, G. T., Fairburn, C. G., & Agras, W. S. (2002). Mediators and moderators of treatment effects in randomized clinical trials. *Archives of General Psychiatry*, *59*(10), 877–883.
- Kratochwill, T. R., Albers, C. A., & Steele Shernoff, E. (2004). School-based interventions. *Child and Adolescent Psychiatric Clinics of North America*, *13*(4), 885–903. <https://doi.org/10.1016/j.chc.2004.05.003>
- Kudielka, B. M., Buske-Kirschbaum, A., Hellhammer, D. H., & Kirschbaum, C. (2004). Differential heart rate reactivity and recovery after psychosocial stress (TSST) in healthy children, younger adults, and elderly adults: The impact of age and gender. *International Journal of Behavioral Medicine*, *11*(2), 116–121.
- Kuyken, W., Weare, K., Ukoumunne, O. C., Vicary, R., Motton, N., Burnett, R., Cullen, C., Hennesly, S., & Huppert, F. (2013). Effectiveness of the Mindfulness in Schools Programme: Non-randomised controlled feasibility study. *British Journal of Psychiatry*, *203*(2), 126–131. <https://doi.org/10.1192/bjp.bp.113.126649>

L

- Lai, E. S. Y., Kwok, C. L., Wong, P. W. C., Fu, K. W., Law, Y. W., & Yip, P. S. F. (2016). The effectiveness and sustainability of a universal school-based programme for preventing depression in Chinese adolescents: A follow-up study using quasi-experimental design. *PLoS ONE*, *11*(2), 1–20. <https://doi.org/10.1371/journal.pone.0149854>
- Lane, K. L., Bocian, K. M., MacMillan, D. L., & Gresham, F. M. (2004). Treatment integrity: An essential—but often forgotten—component of school-based interventions. *Preventing School Failure: Alternative Education for Children and Youth*, *48*(3), 36–43. <https://doi.org/10.3200/psfl.48.3.36-43>
- Lang, C., Feldmeth, A. K., Brand, S., Holsboer-Trachsler, E., Pühse, U., & Gerber, M. (2017). Effects of a physical education-based coping training on adolescents' coping skills, stress perceptions and quality of sleep. *Physical Education and Sport Pedagogy*, *22*(3), 213–230. <https://doi.org/10.1080/17408989.2016.1176130>
- Larson, H. A., El Ramahi, M. K., Conn, S. R., Estes, L. A., & Ghibellini, A. B. (2010). Reducing test anxiety among third grade students through the implementation of relaxation techniques. *Journal of School Counseling*, *8*, 1–19.
- Lau, N. S., & Hue, M. T. (2011). Preliminary outcomes of a mindfulness-based programme for Hong Kong adolescents in schools: Well-being, stress and depressive symptoms. *International Journal of Children's Spirituality*, *16*(4), 315–330. <https://doi.org/10.1080/1364436X.2011.639747>
- Lazarus, R. S. (1966). Psychological stress and the coping process. In *New York: McGraw-Hill*.
- Lazarus, R. S., & Folkman, S. (1984). Coping and adaptation. In *The handbook of behavioral medicine*. New York: Guilford.
- Lee, M. J., Oh, W., Jang, J. S., & Lee, J. Y. (2018). A pilot study: Horticulture-related activities significantly reduce stress levels and salivary cortisol concentration of maladjusted elementary school children. *Complementary Therapies in Medicine*, *37*, 172–177. <https://doi.org/10.1016/j.ctim.2018.01.004>

- Liber, J. M., McLeod, B. D., Van Widenfelt, B. M., Goedhart, A. W., van der Leeden, A. J. M., Utens, E. M. W. J., & Treffers, P. D. A. (2010). Examining the relation between the therapeutic alliance, treatment adherence, and outcome of cognitive behavioral therapy for children with anxiety disorders. *Behavior Therapy, 41*(2), 172–186. <https://doi.org/10.1016/j.beth.2009.02.003>
- Limburg, K., Watson, H. J., Hagger, M. S., & Egan, S. J. (2017). The relationship between perfectionism and psychopathology: A meta-analysis. In *Journal of Clinical Psychology* (Vol. 73, Issue 10, pp. 1301–1326). Wiley Periodicals, Inc. <https://doi.org/10.1002/jclp.22435>
- Lindblad, F., Hogmark, Å., & Theorell, T. (2007). Music intervention for 5th and 6th grader - Effects on development and cortisol secretion. *Stress and Health, 23*(1), 9–14. <https://doi.org/10.1002/smi.1109>
- Linden, W., Earle, T. L., Gerin, W., & Christenfeld, N. (1997). Physiological stress reactivity and recovery: Conceptual siblings separated at birth? In *Journal of Psychosomatic Research* (Vol. 42, Issue 2, pp. 117–135). [https://doi.org/10.1016/S0022-3999\(96\)00240-1](https://doi.org/10.1016/S0022-3999(96)00240-1)
- Liu, Q., Jiang, M., Li, S., & Yang, Y. (2021). Social support, resilience, and self-esteem protect against common mental health problems in early adolescence. *Medicine, 100*(4), e24334. <https://doi.org/10.1097/md.00000000000024334>
- Liu, Y., & Merritt, D. H. (2018). Familial financial stress and child internalizing behaviors: The roles of caregivers' maltreating behaviors and social services. *Child Abuse and Neglect, 86*, 324–335. <https://doi.org/10.1016/j.chiabu.2018.09.002>
- Liu, Yangyang, & Lu, Z. (2011). The Chinese high school student's stress in the school and academic achievement. *Educational Psychology, 31*(1), 27–35. <https://doi.org/10.1080/01443410.2010.513959>
- Livheim, F., Hayes, L., Ghaderi, A., Magnusdottir, T., Högfeldt, A., Rowse, J., Turner, S., Hayes, S. C., & Tengström, A. (2015). The effectiveness of acceptance and commitment therapy for adolescent mental health: Swedish and Australian pilot outcomes. *Journal of Child and Family Studies, 24*(4), 1016–1030. <https://doi.org/10.1007/s10826-014-9912-9>
- Low, N. C. P., Dugas, E., O'Loughlin, E., Rodriguez, D., Contreras, G., Chaiton, M., & O'Loughlin, J. (2012). Common stressful life events and difficulties are associated with mental health symptoms and substance use in young adolescents. *BMC Psychiatry, 12*, 116. <http://www.biomedcentral.com/1471-244X/12/116>
- Lukmanji, A., Williams, J. V. A., Bulloch, A. G. M., & Patten, S. B. (2020). Seasonal variation in specific depressive symptoms: A population based study. *Journal of Affective Disorders, 261*(September 2019), 153–159. <https://doi.org/10.1016/j.jad.2019.10.003>
- Lupien, S. J., McEwen, B. S., Gunnar, M. R., & Heim, C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. In *Nature Reviews Neuroscience* (Vol. 10, Issue 6, pp. 434–445). <https://doi.org/10.1038/nrn2639>
- M**
- Magson, N. R., Freeman, J. Y. A., Rapee, R. M., Richardson, C. E., Oar, E. L., & Fardouly, J. (2020). Risk and protective factors for prospective changes in adolescent mental health during the COVID-19 pandemic. *Journal of Youth and Adolescence, 44*–57. <https://doi.org/10.1007/s10964-020-01332-9>
- Manjushambika, R., Prasanna, B., Vijayaraghavan, R., & Sushama, B. (2017). Effectiveness of Jacobson's Progressive Muscle Relaxation (JPMR) on educational stress among school going adolescents. *International Journal of Nursing Education, 9*(4), 110.

- Mantovani, A., Rinaldi, E., Zusi, C., Beatrice, G., Saccomani, M. D., & Dalbeni, A. (2021). Coronavirus disease 2019 (COVID-19) in children and/or adolescents: A meta-analysis. *Pediatric Research*, *89*(4), 733–737. <https://doi.org/10.1038/s41390-020-1015-2>
- Mariotti, A. (2015). The effects of chronic stress on health: New insights into the molecular mechanisms of brain-body communication. In *Future Science OA* (Vol. 1, Issue 3). <https://doi.org/10.4155/fso.15.21>
- Markham, T. (2004). *Effects of positive emotional refocusing on emotional intelligence and autonomic recovery from stress in high school students*.
- Marsland, A. L., Gentile, D., Hinze-Crout, A., von Stauffenberg, C., Rosen, R. K., Tavares, A., Votruba-Drzal, E., Cohen, S., McQuaid, E. L., & Ewing, L. J. (2019). A randomized pilot trial of a school-based psycho-educational intervention for children with asthma. *Clinical and Experimental Allergy*, *49*(5), 591–602. <https://doi.org/10.1111/cea.13337>
- Masten, A. S. (2007). Resilience in developing systems: Progress and promise as the fourth wave rises. *Development and Psychopathology*, *19*(3), 921–930. <https://doi.org/10.1017/S0954579407000442>
- McClendon, B. D. N., & Scott, J. (2018). Namaste to wellbeing? The effect of yoga on the health of African American high school students. *Journal of Emerging Investigators*.
- McCraty, R., Atkinson, M., Tomasino, D., & Bradley, R. T. (2009). The coherent heart: Heart-brain interactions, psychophysiological coherence, and the emergence of system-wide order. *Integral Review*, *5*(2), 10–115. <https://doi.org/Publication No. 06-022>
- McGorry, P. D., Purcell, R., Goldstone, S., & Amminger, G. P. (2011). Age of onset and timing of treatment for mental and substance use disorders: Implications for preventive intervention strategies and models of care. *Current Opinion in Psychiatry*, *24*(4), 301–306. <https://doi.org/10.1097/YCO.0b013e3283477a09>
- McMahon, E. M., Corcoran, P., O'Regan, G., Keeley, H., Cannon, M., Carli, V., Wasserman, C., Hadlaczky, G., Sarchiapone, M., Apter, A., Balazs, J., Balint, M., Bobes, J., Brunner, R., Cozman, D., Haring, C., Iosue, M., Kaess, M., Kahn, J. P., ... Wasserman, D. (2017). Physical activity in European adolescents and associations with anxiety, depression and well-being. *European Child and Adolescent Psychiatry*, *26*(1), 111–122. <https://doi.org/10.1007/s00787-016-0875-9>
- Meng, X. H., Tao, F. B., Wan, Y. H., Hu, Y., & Wang, R. X. (2011). Coping as a mechanism linking stressful life events and mental health problems in adolescents. *Biomedical and Environmental Sciences: BES*, *24*(6), 649–655. <https://doi.org/10.3967/0895-3988.2011.06.009>
- Menting, A. T. A., Orobio de Castro, B., & Matthys, W. (2013). Effectiveness of the Incredible Years parent training to modify disruptive and prosocial child behavior: A meta-analytic review. In *Clinical Psychology Review* (Vol. 33, Issue 8, pp. 901–913). <https://doi.org/10.1016/j.cpr.2013.07.006>
- Merikangas, K. R., He, J. P., Burstein, M., Swendsen, J., Avenevoli, S., Case, B., Georgiades, K., Heaton, L., Swanson, S., & Olfson, M. (2011). Service utilization for lifetime mental disorders in U.S. adolescents: Results of the National Comorbidity Survey-Adolescent supplement (NCS-A). *Journal of the American Academy of Child and Adolescent Psychiatry*, *50*(1), 32–45. <https://doi.org/10.1016/j.jaac.2010.10.006>
- Mertens, E., Deković, M., Leijten, P., Van Londen, M., & Reitz, E. (2020). Components of school-based interventions stimulating students' intrapersonal and interpersonal domains: A meta-analysis. *Clinical Child and Family Psychology Review*, *23*(4), 605–631. <https://doi.org/10.1007/s10567-020-00328-y>
- Metz, S. M., Frank, J. L., Reibel, D., Cantrell, T., Sanders, R., & Broderick, P. C. (2013). The effectiveness of the Learning to BREATHE Program on adolescent emotion regulation. *Research in Human Development*, *10*(3), 252–272. <https://doi.org/10.1080/15427609.2013.818488>

- Miller, D. B., & O'Callaghan, J. P. (2002). Neuroendocrine aspects of the response to stress. *Metabolism: Clinical and Experimental*, 51(6), 5–10. <https://doi.org/10.1053/meta.2002.33184>
- Mitchell, J. H., Newall, C., Broeren, S., & Hudson, J. L. (2013). The role of perfectionism in cognitive behaviour therapy outcomes for clinically anxious children. *Behaviour Research and Therapy*, 51(9), 547–554. <https://doi.org/10.1016/j.brat.2013.05.015>
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Altman, D., Antes, G., Atkins, D., Barbour, V., Barrowman, N., Berlin, J. A., Clark, J., Clarke, M., Cook, D., D'Amico, R., Deeks, J. J., Devereaux, P. J., Dickersin, K., Egger, M., Ernst, E., ... Tugwell, P. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. In *PLoS Medicine* (Vol. 6, Issue 7). <https://doi.org/10.1371/journal.pmed.1000097>
- Montori, V. M., & Guyatt, G. H. (2001). Intention-to-treat principle. *Canadian Medical Association Journal*, 165(10), 1339–1341.
- Mulraney, M., Coghill, D., Bishop, C., Mehmed, Y., Sciberras, E., Sawyer, M., Efron, D., & Hiscock, H. (2021). A systematic review of the persistence of childhood mental health problems into adulthood. *Neuroscience and Biobehavioral Reviews*, 129(July), 182–205. <https://doi.org/10.1016/j.neubiorev.2021.07.030>
- Munasinghe, S., Sperandei, S., Freebairn, L., Conroy, E., Jani, H., Marjanovic, S., & Page, A. (2020). The impact of physical distancing policies during the COVID-19 pandemic on health and well-being among Australian adolescents. *Journal of Adolescent Health*, 67(5), 653–661. <https://doi.org/10.1016/j.jadohealth.2020.08.008>
- Muñoz-Fernández, N., & Rodríguez-Meirinhos, A. (2021). Adolescents' concerns, routines, peer activities, frustration, and optimism in the time of COVID-19 confinement in Spain. *Journal of Clinical Medicine*, 10(4). <https://doi.org/10.3390/jcm10040798>
- N**
- Nanni, V., Uher, R., & Danese, A. (2012). Childhood maltreatment predicts unfavorable course of illness and treatment outcome in depression: A meta-analysis. *American Journal of Psychiatry*, 169, 141–151. <https://doi.org/10.3969/j.issn.1000-1093.2014.11.006>
- Nesse, R. M., Bhatnagar, S., & Ellis, B. (2016). Evolutionary origins and functions of the stress response system. In *Stress: Concepts, Cognition, Emotion, and Behavior: Handbook of Stress* (pp. 95–101). <https://doi.org/10.1016/B978-0-12-800951-2.00011-X>
- Nicolai, K. A., Laney, T., & Mezulis, A. H. (2013). Different stressors, different strategies, different outcomes: How domain-specific stress responses differentially predict depressive symptoms among adolescents. *Journal of Youth and Adolescence*, 42(8), 1183–1193. <https://doi.org/10.1007/s10964-012-9866-4>
- Nobel, R., Manassis, K., & Wilansky-Traynor, P. (2012). The role of perfectionism in relation to an intervention to reduce anxious and depressive symptoms in children. *Journal of Rational - Emotive and Cognitive - Behavior Therapy*, 30(2), 77–90. <https://doi.org/10.1007/s10942-011-0133-5>
- Noggle, J. J., Steiner, N. J., Minami, T., & Khalsa, S. B. S. (2012). Benefits of yoga for psychosocial well-being in a US high school curriculum. *Journal of Developmental & Behavioral Pediatrics*, 33(3), 193–201. <https://doi.org/10.1097/dbp.0b013e31824afdc4>
- Norlander, T., Moães, L., & Archer, T. (2005). Noise and stress in primary and secondary school children: Noise reduction and increased concentration ability through a short but regular exercise and relaxation program. *School Effectiveness and School Improvement*, 16(1), 91–99. <https://doi.org/10.1080/092434505000114173>

Núñez-Regueiro, F., & Núñez-Regueiro, S. (2021). Identifying salient stressors of adolescence: A systematic review and content analysis. *Journal of Youth and Adolescence*, *50*, 2533–2556. <https://doi.org/10.1007/s10964-021-01492-2>

O

O'Connor, R. C., Dixon, D., & Rasmussen, S. (2009). The structure and temporal stability of the Child and Adolescent Perfectionism Scale. *Psychological Assessment*, *21*(3), 437–443. <https://doi.org/10.1037/a0016264>

O'Connor, R. C., Rasmussen, S., & Hawton, K. (2010). Predicting depression, anxiety and self-harm in adolescents: The role of perfectionism and acute life stress. *Behaviour Research and Therapy*, *48*(1), 52–59. <https://doi.org/10.1016/j.brat.2009.09.008>

O'Driscoll, D., & McAleese, M. (2021). The feasibility and effectiveness of compassionate mind training as a test anxiety intervention for adolescents: A preliminary investigation. *Counselling and Psychotherapy Research*. <https://doi.org/https://doi.org/10.1002/capr.12447>

O'Rourke, D. J., Smith, R. E., Smoll, F. L., & Cumming, S. P. (2011). Trait anxiety in young athletes as a function of parental pressure and motivational climate: Is parental pressure always harmful? *Journal of Applied Sport Psychology*, *23*(4), 398–412. <https://doi.org/10.1080/10413200.2011.552089>

Offord, D. R. (2000). Selection of levels of prevention. *Addictive Behaviors*, *25*(6), 833–842. [https://doi.org/10.1016/S0306-4603\(00\)00132-5](https://doi.org/10.1016/S0306-4603(00)00132-5)

Oldehinkel, A. J., Ormel, J., Bosch, N. M., Bouma, E. M. C., Van Roon, A. M., Rosmalen, J. G. M., & Riese, H. (2011). Stressed out? Associations between perceived and physiological stress responses in adolescents: The TRAILS study. *Psychophysiology*, *48*(4), 441–452. <https://doi.org/10.1111/j.1469-8986.2010.01118.x>

Orben, A., Tomova, L., & Blakemore, S. J. (2020). The effects of social deprivation on adolescent development and mental health. *The Lancet Child and Adolescent Health*, *4*(8), 634–640. [https://doi.org/10.1016/S2352-4642\(20\)30186-3](https://doi.org/10.1016/S2352-4642(20)30186-3)

Ormhaug, S. M., Shirk, S. R., & Wentzel-Larsen, T. (2015). Therapist and client perspectives on the alliance in the treatment of traumatized adolescents. *European Journal of Psychotraumatology*, *6*, 27705. <https://doi.org/10.3402/ejpt.v6.27705>

Ørntoft, C., Fuller, C. W., Larsen, M. N., Bangsbo, J., Dvorak, J., & Krstrup, P. (2016). “FIFA 11 for Health” for Europe. II: Effect on health markers and physical fitness in Danish schoolchildren aged 10–12 years. *British Journal of Sports Medicine*, *50*(22), 1394–1399. <https://doi.org/10.1136/bjsports-2016-096124>

Osborne, M. S., Kenny, D. T., & Cooksey, J. (2007). Impact of a cognitive-behavioural treatment program on music performance anxiety in secondary school music students: A pilot study. *Musicae Scientiae*, *11*(SPEC. ISS.), 53–84. <https://doi.org/10.1177/10298649070110s204>

P

Parray, W. M., & Kumar, S. (2017). Impact of assertiveness training on the level of assertiveness, self-esteem, stress, psychological well-being and academic achievement of adolescents. *Indian Journal of Health & Wellbeing*, *8*(12), 1476–1480.

Pascoe, M. C., & Bauer, I. E. (2015). A systematic review of randomised control trials on the effects of yoga on stress measures and mood. *Journal of Psychiatric Research*, *68*, 270–282. <https://doi.org/10.1016/j.jpsychires.2015.07.013>

Pascoe, M. C., & Crewther, S. (2016). A systematic review of randomised control trials examining the effects of mindfulness on stress and anxious symptomatology. In *Anxiety Disorders* (pp. 1–23).

- Pascoe, M. C., Thompson, D. R., Jenkins, Z. M., & Ski, C. F. (2017). Mindfulness mediates the physiological markers of stress: Systematic review and meta-analysis. *Journal of Psychiatric Research, 95*, 156–178. <https://doi.org/10.1016/j.jpsychires.2017.08.004>
- Pascoe, M. C., Thompson, D. R., & Ski, C. F. (2017). Yoga, mindfulness-based stress reduction and stress-related physiological measures: A meta-analysis. In *Psychoneuroendocrinology* (Vol. 86, pp. 152–168). <https://doi.org/10.1016/j.psyneuen.2017.08.008>
- Perepletchikova, F., Treat, T. A., & Kazdin, A. E. (2007). Treatment integrity in psychotherapy research: Analysis of the studies and examination of the associated factors. *Journal of Consulting and Clinical Psychology, 75*(6), 829–841. <https://doi.org/10.1037/0022-006X.75.6.829>
- Petrosino, A., & Soydan, H. (2005). The impact of program developers as evaluators on criminal recidivism: Results from meta-analyses of experimental and quasi-experimental research. *Journal of Experimental Criminology, 1*(4), 435–450. <https://doi.org/10.1007/s11292-005-3540-8>
- Philipp, J., Zeiler, M., Waldherr, K., Truttmann, S., Dür, W., Karwautz, A. F. K., & Wagner, G. (2018). Prevalence of emotional and behavioral problems and subthreshold psychiatric disorders in Austrian adolescents and the need for prevention. *Social Psychiatry and Psychiatric Epidemiology, 53*, 1325–1337. <https://doi.org/10.1007/s00127-018-1586-y>
- Piferi, R. L., Kline, K. A., Younger, J., & Lawler, K. A. (2000). An alternative approach for achieving cardiovascular baseline: Viewing an aquatic video. *International Journal of Psychophysiology, 37*(2), 207–217. [https://doi.org/10.1016/S0167-8760\(00\)00102-1](https://doi.org/10.1016/S0167-8760(00)00102-1)
- Pinquart, M. (2013). Do the parent-child relationship and parenting behaviors differ between families with a child with and without chronic illness? A meta-analysis. In *Journal of Pediatric Psychology* (Vol. 38, Issue 7, pp. 708–721). <https://doi.org/10.1093/jpepsy/jst020>
- Pramanik, T., Sharma, H. O., Mishra, S., Mishra, A., Prajapati, R., & Singh, S. (2009). Immediate effect of slow pace bhastrika pranayama on blood pressure and heart rate. *Journal of Alternative and Complementary Medicine, 15*(3), 293–295. <https://doi.org/10.1089/acm.2008.0440>
- Prinz, J. R., Smith, E. P., Dumas, J. E., Laughlin, J. E., White, D. W., & Barron, R. (2001). Recruitment and retention of participants in prevention trials. *American Journal of Preventive Medicine, 20*(00), 31–37.
- Puolakanaho, A., Lappalainen, R., Lappalainen, P., Muotka, J. S., Hirvonen, R., Eklund, K. M., Ahonen, T. P. S., & Kiuru, N. (2019). Reducing stress and enhancing academic buoyancy among adolescents using a brief web-based program based on acceptance and commitment therapy: A randomized controlled trial. *Journal of Youth and Adolescence, 48*(2), 287–305. <https://doi.org/10.1007/s10964-018-0973-8>
- Putwain, D. W., & Pescod, M. (2018). Is reducing uncertain control the key to successful test anxiety intervention for secondary school students? Findings from a randomized control trial. *School Psychology Quarterly, 33*(2), 283–292. <https://doi.org/10.1037/spq0000228>
- Putwain, D. W., & von der Embse, N. P. (2021). Cognitive-behavioral intervention for test anxiety in adolescent students: do benefits extend to school-related wellbeing and clinical anxiety. *Anxiety, Stress and Coping, 34*(1), 22–36. <https://doi.org/10.1080/10615806.2020.1800656>
- Q**
- Qi, M., Zhou, S. J., Guo, Z. C., Zhang, L. G., Min, H. J., Li, X. M., & Chen, J. X. (2020). The effect of social support on mental health in Chinese adolescents during the outbreak of COVID-19. *Journal of Adolescent Health, 67*(4), 514–518. <https://doi.org/10.1016/j.jadohealth.2020.07.001>

Quach, A. S., Epstein, N. B., Riley, P. J., Falconier, M. K., & Fang, X. (2013). Effects of parental warmth and academic pressure on anxiety and depression symptoms in Chinese adolescents. *Journal of Child and Family Studies*, 24(1), 106–116. <https://doi.org/10.1007/s10826-013-9818-y>

Quach, D., Jastrowski Mano, K. E., & Alexander, K. (2016). A randomized controlled trial examining the effect of mindfulness meditation on working memory capacity in adolescents. *Journal of Adolescent Health*, 58(5), 489–496. <https://doi.org/10.1016/j.jadohealth.2015.09.024>

R

Racine, N., Cooke, J. E., Eirich, R., Korczak, D. J., McArthur, B., & Madigan, S. (2020). Child and adolescent mental illness during COVID-19: A rapid review. *Psychiatry Research*.

Ram, N., & Grimm, K. J. (2009). Growth mixture modeling: A method for identifying differences in longitudinal change among unobserved groups. *International Journal of Behavioral Development*, 33(6), 565–576. <https://doi.org/10.1177/0165025409343765>

Ran, L., Wang, W., Ai, M., Kong, Y., Chen, J., & Kuang, L. (2020). Psychological resilience, depression, anxiety, and somatization symptoms in response to COVID-19: A study of the general population in China at the peak of its epidemic. *Social Science and Medicine*, 262(July), 113261. <https://doi.org/10.1016/j.socscimed.2020.113261>

Ravens-Sieberer, U., Kaman, A., Erhart, M., Devine, J., Schlack, R., & Otto, C. (2021). Impact of the COVID-19 pandemic on quality of life and mental health in children and adolescents in Germany. *European Child and Adolescent Psychiatry*. <https://doi.org/10.1007/s00787-021-01726-5>

Regehr, C., Glancy, D., & Pitts, A. (2013). Interventions to reduce stress in university students: A review and meta-analysis. In *Journal of Affective Disorders* (Vol. 148, Issue 1, pp. 1–11). <https://doi.org/10.1016/j.jad.2012.11.026>

Reiss, V. (2013). Effectiveness of mindfulness training on ratings of perceived stress, mindfulness and well-being of adolescents enrolled in an international Baccalaureate diploma program. *ProQuest Dissertations and Theses*, 1–183.

Rens, E., Smith, P., Nicaise, P., Lorant, V., & Van den Broeck, K. (2021). Mental distress and its contributing factors among young people during the first wave of COVID-19: A Belgian survey study. *Frontiers in Psychiatry*, 12, 1–9. <https://doi.org/10.3389/fpsy.2021.575553>

Rental, S., Lau, B. H. P., Aladakatti, R., & Thimmajja, S. G. (2017). Effectiveness of holistic group health promotion program on educational stress, anxiety, and depression among adolescent girls - A pilot study. *Journal of Family Medicine and Primary Care*, 6(2), 169–170.

Resurrección, D. M., Salguero, J. M., & Ruiz-Aranda, D. (2014). Emotional intelligence and psychological maladjustment in adolescence: A systematic review. *Journal of Adolescence*, 37(4), 461–472. <https://doi.org/10.1016/j.adolescence.2014.03.012>

Rew, L., Johnson, K., & Young, C. (2014). A systematic review of interventions to reduce stress in adolescence. *Issues in Mental Health Nursing*, 35(11), 851–863. <https://doi.org/10.3109/01612840.2014.924044>

RIVM. (2021a). <https://www.rivm.nl/coronavirus-covid-19/grafieken>.

RIVM. (2021b). <https://www.rivm.nl/gedragsonderzoek/tijdlijn-maatregelen-covid>.

Roeser, R. W., Eccles, J. S., & Sameroff, A. J. (2000). School as a context of early adolescents' academic and social-emotional development: A summary of research findings. *The Elementary School Journal*, 100(5), 443–471. <https://doi.org/https://doi.org/10.1086/499650>

- Rogers, A. A., Ha, T., & Ockey, S. (2021). Adolescents' perceived socio-emotional impact of COVID-19 and implications for mental health: Results from a U.S.-based mixed-methods study. *Journal of Adolescent Health, 68*(1), 43–52. <https://doi.org/10.1016/j.jadohealth.2020.09.039>
- Romeo, R. D. (2010). Adolescence: A central event in shaping stress reactivity. *Developmental Psychobiology, 52*(3), 244–253. <https://doi.org/10.1002/dev.20437>
- Romeo, R. D. (2013). The teenage brain: The stress response and the adolescent brain. *Current Directions in Psychological Science, 22*(2), 140–145. <https://doi.org/10.1177/0963721413475445>
- Rosenberg, M. (1965). Society and the adolescent self-image. *Princeton University Press, Princeton, NJ.*
- Rosenthal, R. (1979). The file drawer problem and tolerance for null results. *Psychological Bulletin, 86*(3), 638–641.
- Rothon, C., Head, J., Klineberg, E., & Stansfeld, S. (2011). Can social support protect bullied adolescents from adverse outcomes? A prospective study on the effects of bullying on the educational achievement and mental health of adolescents at secondary schools in East London. *Journal of Adolescence, 34*(3), 579–588. <https://doi.org/10.1016/j.adolescence.2010.02.007>
- Ruiz-Aranda, D., Salguero, J. M., Cabello, R., Palomera, R., & Berrocal, P. F. (2012). Can an emotional intelligence program improve adolescents' psychosocial adjustment? Results from the intemo project. *Social Behavior and Personality: An International Journal, 40*(8), 1373–1379. <https://doi.org/10.2224/sbp.2012.40.8.1373>
- S**
- Sagone, E., & Caroli, M. E. De. (2014). Relationships between psychological well-being and resilience in middle and late adolescents. *Procedia - Social and Behavioral Sciences, 141*, 881–887. <https://doi.org/10.1016/j.sbspro.2014.05.154>
- Salazar, A. L. (2017). *Improving adolescent's working memory through a long-term MBSR curriculum.*
- Sanada, K., Montero-Marín, J., Díez, M. A., Salas-Valero, M., Pérez-Yus, M. C., Morillo, H., Demarzo, M. M. P., García-Toro, M., & García-Campayo, J. (2016). Effects of mindfulness-based interventions on salivary cortisol in healthy adults: A meta-analytical review. *Frontiers in Physiology, 7*(OCT). <https://doi.org/10.3389/fphys.2016.00471>
- Sarkova, M., Bacikova-Sleskova, M., Orosova, O., Madarasova Geckova, A., Katreniakova, Z., Klein, D., Van den Heuvel, W., & Van Dijk, J. P. (2013). Associations between assertiveness, psychological well-being, and self-esteem in adolescents. *Journal of Applied Social Psychology, 43*(1), 147–154. <https://doi.org/10.1111/j.1559-1816.2012.00988.x>
- Saunders, R., Buckman, J. E. J., Fonagy, P., & Fancourt, D. (2020). Understanding different trajectories of mental health across the general population during the COVID-19 pandemic. *Psychological Medicine, May*. <https://doi.org/10.1017/S0033291721000957>
- Saunders, T., Driskell, J. E., Johnston, J. H., & Salas, E. (1996). The effect of stress inoculation training on anxiety and performance. *Journal of Occupational Health Psychology, 1*(2), 170–186. <https://doi.org/10.1037/1076-8998.1.2.170>
- Sawyer, S. M., Azzopardi, P. S., Wickremaratne, D., & Patton, G. C. (2018). The age of adolescence. *The Lancet Child and Adolescent Health, 2*(3), 223–228. [https://doi.org/10.1016/S2352-4642\(18\)30022-1](https://doi.org/10.1016/S2352-4642(18)30022-1)
- Schaufeli, W. B., Leiter, M. P., & Maslach, C. (2009). Burnout: 35 years of research and practice. *Career Development International, 14*(3), 204–220. <https://doi.org/10.1108/13620430910966406>

- Schonert-Reichl, K. A., & Lawlor, M. S. (2010). The effects of a mindfulness-based education program on pre- and early adolescents' well-being and social and emotional competence. *Mindfulness, 1*(3), 137–151. <https://doi.org/10.1007/s12671-010-0011-8>
- Schonert-Reichl, K. A., Oberle, E., Lawlor, M. S., Abbott, D., Thomson, K., Oberlander, T. F., & Diamond, A. (2015). Enhancing cognitive and social-emotional development through a simple-to-administer mindfulness-based school program for elementary school children: A randomized controlled trial. *Developmental Psychology, 51*(1), 52–66. <https://doi.org/10.1037/a0038454>
- Schraml, K., Perski, A., Grossi, G., & Simonsson-Sarnecki Margareta, M. (2011). Stress symptoms among adolescents: The role of subjective psychosocial conditions, lifestyle, and self-esteem. *Journal of Adolescence, 34*(5), 987–996. <https://doi.org/10.1016/j.adolescence.2010.11.010>
- Shimmer3 GSR+. (n.d.). *Shimmer Research Ltd, Dublin Ireland*. <http://www.shimmersensing.com/products/shimmer3-wireless-gsr-sensor>
- Shirk, S. R., & Saiz, Christopher, C. (1992). Clinical, empirical, and developmental perspectives on the therapeutic relationship in child psychotherapy. *Development and Psychopathology, 4*(4), 713–728.
- Sibinga, E. M. S., Kerrigan, D., Stewart, M., Johnson, K., Magyari, T., & Ellen, J. M. (2011). Mindfulness-Based Stress Reduction for urban youth. *The Journal of Alternative and Complementary Medicine, 17*(3), 213–218. <https://doi.org/10.1089/acm.2009.0605>
- Sibinga, E. M. S., Perry-Parrish, C., Chung, S. en, Johnson, S. B., Smith, M., & Ellen, J. M. (2013). School-based mindfulness instruction for urban male youth: A small randomized controlled trial. *Preventive Medicine, 57*(6), 799–801. <https://doi.org/10.1016/j.ypmed.2013.08.027>
- Sibinga, E. M. S., Webb, L., Ghazarian, S. R., & Ellen, J. M. (2016). School-based mindfulness instruction: An RCT. *Pediatrics, 137*(1), 1–8. <https://doi.org/10.1542/peds.2015-2532>
- Sibnath, D., Esben, S., & Jiandong, S. (2015). Academic stress, parental pressure, anxiety and mental health among Indian high school students. *International Journal of Psychology and Behavioral Sciences, 5*(1), 26–34. <https://doi.org/10.5923/j.ijpbs.20150501.04>
- Sieverdes, J. C., Mueller, M., Gregoski, M. J., Brunner-Jackson, B., McQuade, L., Matthews, C., & Treiber, F. A. (2014). Effects of hatha yoga on blood pressure, salivary α -amylase, and cortisol function among normotensive and prehypertensive youth. *Journal of Alternative and Complementary Medicine, 20*(4), 241–250. <https://doi.org/10.1089/acm.2013.0139>
- Silbert, K. L., & Berry, G. L. (1991). Psychological effects of a suicide prevention unit on adolescents' level of stress, anxiety and hopelessness: Implications for counselling psychologists. *Counselling Psychology Quarterly, 4*(1), 45–58.
- Silk, J. S., Scott, L. N., Hutchinson, E. A., Lu, C., Sequeira, S. L., Mckone, K. M. P., Do, Q. B., & Ladouceur, C. D. (2022). Storm clouds and silver linings: Day-to-day life in COVID-19 lockdown and emotional health in adolescent girls. *Journal of Pediatric Psychology, 47*(1), 37–48. <https://doi.org/10.1093/jpepsy/jsab107>
- Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of Clinical Psychology, 65*(4), 467–487. <https://doi.org/10.1002/jclp.20593>
- Singh, S., Roy, D., Sinha, K., Parveen, S., Sharma, G., & Joshi, G. (2020). Impact of COVID-19 and lockdown on mental health of children and adolescents: A narrative review with recommendations. *Psychiatry Research, 293*, 113429. <https://doi.org/10.1016/j.psychres.2020.113429>

- Singhal, M., Manjula, M., & Vijay Sagar, K. J. (2014). Development of a school-based program for adolescents at-risk for depression in India: Results from a pilot study. *Asian Journal of Psychiatry, 10*, 56–61. <https://doi.org/10.1016/j.ajp.2014.03.011>
- Singhal, M., Munivenkatappa, M., Kommu, J. V. S., & Philip, M. (2018). Efficacy of an indicated intervention program for Indian adolescents with subclinical depression. *Asian Journal of Psychiatry, 33*, 99–104. <https://doi.org/10.1016/j.ajp.2018.03.007>
- Skoradal, M.-B., Purkhús, E., Steinholm, H., Olsen, M. H., Ørntoft, C., Larsen, M. N., Dvorak, J., Mohr, M., & Krustруп, P. (2018). “FIFA 11 for Health” for Europe in the Faroe Islands: Effects on health markers and physical fitness in 10- to 12-year-old schoolchildren. *Scandinavian Journal of Medicine & Science in Sports, 28*, 8–17. <https://doi.org/10.1111/sms.13209>
- Snyder, H. R., Young, J. F., & Hankin, B. L. (2017). Chronic stress exposure and generation are related to the P-factor and externalizing specific psychopathology in youth. *Journal of Clinical Child and Adolescent Psychology, 00*(00), 1–10. <https://doi.org/10.1080/15374416.2017.1321002>
- Soares, D., & Woods, K. (2020). An international systematic literature review of test anxiety interventions 2011–2018. *Pastoral Care in Education, 38*(4), 311–334. <https://doi.org/10.1080/02643944.2020.1725909>
- Solar II, E. L. (2013). The effects of mindfulness meditation on adolescents with high-incidence disabilities. In *ProQuest Dissertations and Theses*.
- Spence, S. H., & Shortt, A. L. (2007). Research review: Can we justify the widespread dissemination of universal, school-based interventions for the prevention of depression among children and adolescents? *Journal of Child Psychology and Psychiatry and Allied Disciplines, 48*(6), 526–542. <https://doi.org/10.1111/j.1469-7610.2007.01738.x>
- Spielberger, C. D. (1980). Test Anxiety Inventory: Sampler Set: Manual, Test Scoring:” test Attitude Inventory”: Preliminary Professional Manual. *Mind Garden*.
- Spielberger, C. D., Gonzalez, H. P., Taylor, C. J., Algaze, B., & Anton, W. D. (1978). Examination stress and test anxiety. *Stress and Anxiety, 5*, 167–191.
- Spruit, A., Goos, L., Weenink, N., Rodenburg, R., Niemeyer, H., Stams, G. J., & Colonna, C. (2020). The relation between attachment and depression in children and adolescents: A multilevel meta-analysis. In *Clinical Child and Family Psychology Review* (Vol. 23, Issue 1, pp. 54–69). <https://doi.org/10.1007/s10567-019-00299-9>
- Stephan, S. H., Weist, M., Kataoka, S., Adelsheim, S., & Mills, C. (2007). Transformation of children’s mental health services: The role of school mental health. *Psychiatric Services, 58*(10), 1330–1338.
- Stern, R. A., Arruda, J. E., Hooper, C. R., Wolfner, G. D., & Morey, C. E. (1997). Visual analogue mood scales to measure internal mood state in neurologically impaired patients: Description and initial validity evidence. *Aphasiology, 11*(1), 59–71. <https://doi.org/10.1080/02687039708248455>
- Stevens, G., van Dorsselaer, S. Van, Boer, M., Roos, S. De, Duinhof, E., ter Bogt, T., van den Eijnden, R. Van Den, Kuyper, L., Visser, D., Vollebergh, W., & de Looze, M. (2018). *HBSC 2017: Gezondheid en welzijn van jongeren in Nederland*.
- Stice, E., & Shaw, H. (2004). Eating disorder prevention programs: A meta-analytic review. In *Psychological Bulletin* (Vol. 130, Issue 2, pp. 206–227). <https://doi.org/10.1037/0033-2909.130.2.206>
- Stice, E., Shaw, H., Bohon, C., Marti, C. N., & Rohde, P. (2009). A meta-analytic review of depression prevention programs for children and adolescents: Factors that predict magnitude of intervention effects. *Journal of Consulting and Clinical Psychology, 77*(3), 486–503. <https://doi.org/10.1037/a0015168>

- Stjerneklar, S., Hougaard, E., & Thastum, M. (2019). Guided internet-based cognitive behavioral therapy for adolescent anxiety: Predictors of treatment response. *Internet Interventions, 15*(January), 116–125. <https://doi.org/10.1016/j.invent.2019.01.003>
- Stoeber, J., Otto, K., & Stoll, O. (2006). Multidimensional Inventory of Perfectionism in Sport (MIPS): English version. *School of Psychology, University of Kent (Unpublished)*. <https://core.ac.uk/download/pdf/20524039.pdf>
- Stoeber, J., & Rambow, A. (2007). Perfectionism in adolescent school students: Relations with motivation, achievement, and well-being. *Personality and Individual Differences, 42*(7), 1379–1389. <https://doi.org/10.1016/j.paid.2006.10.015>
- Suldo, S., Thalji, A., & Ferron, J. (2011). Longitudinal academic outcomes predicted by early adolescents' subjective well-being, psychopathology, and mental health status yielded from a dual factor model. *Journal of Positive Psychology, 6*(1), 17–30. <https://doi.org/10.1080/17439760.2010.536774>
- Suter, J. C., & Bruns, E. J. (2009). Effectiveness of the wraparound process for children with emotional and behavioral disorders: A meta-analysis. *Clinical Child and Family Psychology Review, 12*(4), 336–351. <https://doi.org/10.1007/s10567-009-0059-y>

T

- Tang, S., Xiang, M., Cheung, T., & Xiang, Y. T. (2021). Mental health and its correlates among children and adolescents during COVID-19 school closure: The importance of parent-child discussion. *Journal of Affective Disorders, 279*, 353–360. <https://doi.org/10.1016/j.jad.2020.10.016>
- Taylor, Z. E., Conger, R. D., Robins, R. W., & Widaman, K. F. (2016). Parenting practices and perceived social support: Longitudinal relations with the social competence of Mexican-origin children. *J Lat Psychol, 3*(4), 193–208. <https://doi.org/10.1037/lat0000038>
- Telles, S., & Srinivas, R. B. (1998). Autonomic and respiratory measures in children with impaired vision following yoga and physical activity programs. *International Journal of Rehabilitation and Health, 4*(2), 117–122. <https://doi.org/10.1023/A:1022912626238>
- Terjestam, Y. (2011). Stillness at school: Well-being after eight weeks of meditation-based practice in secondary school. *Psyke & Logos, 32*, 105–116.
- Terjestam, Y., Bengtsson, H., & Jansson, A. (2016). Cultivating awareness at school. Effects on effortful control, peer relations and well-being at school in grades 5, 7, and 8. *School Psychology International, 37*(5), 456–469. <https://doi.org/10.1177/0143034316658321>
- Terjestam, Y., Jouper, J., & Johansson, C. (2010). Effects of scheduled qigong exercise on pupils' well-being, self-image, distress, and stress. *The Journal of Alternative and Complementary Medicine, 16*(9), 939–944. <https://doi.org/10.1089/acm.2009.0405>
- Thomas, B. H., Ciliska, D., Dobbins, M., & Micucci, S. (2004). A process for systematically reviewing the literature: Providing the research evidence for public health nursing interventions. *Worldviews on Evidence-Based Nursing, 1*(3), 176–184. <https://doi.org/10.1111/j.1524-475X.2004.04006.x>
- Thomas, K., Nilsson, E., Festin, K., Henriksson, P., Lowén, M., Löf, M., & Kristenson, M. (2020). Associations of psychosocial factors with multiple health behaviors: A population-based study of middle-aged men and women. *International Journal of Environmental Research and Public Health, 17*(4). <https://doi.org/10.3390/ijerph17041239>

- Thrasher, S., Power, M., Morant, N., Marks, I., & Dalgleish, T. (2010). Social support moderates outcome in a randomized controlled trial of exposure therapy and (or) cognitive restructuring for chronic post-traumatic stress disorder. In *Canadian Journal of Psychiatry* (Vol. 55, Issue 3, pp. 187–190). <https://doi.org/10.1177/070674371005500311>
- Tobbell, J., & O'Donnell, V. L. (2013). The formation of interpersonal and learning relationships in the transition from primary to secondary school: Students, teachers and school context. *International Journal of Educational Research*, 59, 11–23. <https://doi.org/10.1016/j.ijer.2013.02.003>
- Tomette, A. (2015). *Stress reduction among adolescents: A biopsychosocial approach to high school health education*. <http://dx.doi.org/10.3923/ijss.2016.1.8%0Ahttp://dx.doi.org/10.3923/ijss.2015.142.152>
- Tsigos, C., & Chrousos, G. P. (2002). Hypothalamic-pituitary-adrenal axis, neuroendocrine factors and stress. *Journal of Psychosomatic Research*, 53(4), 865–871. [https://doi.org/10.1016/S0022-3999\(02\)00429-4](https://doi.org/10.1016/S0022-3999(02)00429-4)
- U**
- Umscheid, C. A., Margolis, D. J., & Grossman, C. E. (2011). Key concepts of clinical trials: A narrative review. *Postgraduate Medicine*, 123(5), 194–204. <https://doi.org/10.3810/pgm.2011.09.2475>
- V**
- Valizadeh, L., Farnam, A., & Rahkar Farshi, M. (2012). Investigation of stress symptoms among primary school children. *Journal of Caring Sciences*, 1(1), 25–30. <https://doi.org/10.5681/jcs.2012.004>
- van 't Veer, A. E., & Giner-Sorolla, R. (2016). Pre-registration in social psychology—A discussion and suggested template. *Journal of Experimental Social Psychology*, 67, 2–12. <https://doi.org/10.1016/j.jesp.2016.03.004>
- van de Schoot, R., Sijbrandij, M., Winter, S. D., Depaoli, S., & Vermunt, J. K. (2017). The GRoLTS-checklist: Guidelines for reporting on latent trajectory studies. *Structural Equation Modeling*, 24(3), 451–467. <https://doi.org/10.1080/10705511.2016.1247646>
- van den Bos, E., de Rooij, M., Miers, A. C., Bokhorst, C. L., & Westenberg, P. M. (2014). Adolescents' increasing stress response to social evaluation: Pubertal effects on cortisol and alpha-amylase during public speaking. *Child Development*, 85(1), 220–236. <https://doi.org/10.1111/cdev.12118>
- van den Noortgate, W., López-López, J. A., Marín-Martínez, F., & Sánchez-Meca, J. (2013). Three-level meta-analysis of dependent effect sizes. *Behavior Research Methods*, 45(2), 576–594. <https://doi.org/10.3758/s13428-012-0261-6>
- van der Gucht, K., Takano, K., Raes, F., & Kuppens, P. (2018). Processes of change in a school-based mindfulness programme: Cognitive reactivity and self-coldness as mediators. *Cognition and Emotion*, 32(3), 658–665. <https://doi.org/10.1080/02699931.2017.1310716>
- van der Ploeg, H. M. (1983). The validation of the Dutch form of Test Anxiety Inventory. *Advances in Test Anxiety Research*. Lisse, The Netherlands, 2, 191–202.
- van der Ploeg, Henk M. (1984). The development and validation of the Dutch form of the Test Anxiety Inventory. *Applied Psychology*, 33(2), 243–254. <https://doi.org/10.1111/j.1464-0597.1984.tb01432.x>
- van der Put, C. E., Assink, M., Gubbels, J., & Boekhout van Solinge, N. F. (2018). Identifying effective components of child maltreatment interventions: A meta-analysis. In *Clinical Child and Family Psychology Review* (Vol. 21, Issue 2). Springer US. <https://doi.org/10.1007/s10567-017-0250-5>
- van der Stouwe, T., Asscher, J. J., Stams, G. J. J. M., Deković, M., & van der Laan, P. H. (2014). The effectiveness of multisystemic therapy (MST): A meta-analysis. In *Clinical Psychology Review* (Vol. 34, Issue 6, pp. 468–481). <https://doi.org/10.1016/j.cpr.2014.06.006>

- van Eijk, L. M., Kempen, G. I. J. M., & van Sonderen, F. L. P. (1994). A short scale for measuring social support in the elderly: The SSL12-I. *Tijdschrift Voor Gerontologie En Geriatrie*, 25(5), 192–196.
- van Leeuwen, K., Vermulst, A., Kroes, G., De Meyer, G., & Veerman, J. (2011). De verkorte schaal voor ouderlijk gedrag. VSOG voor ouders van jeugdigen van 4 t/m 18 jaar. *Nijmegen, The Netherlands: Katholieke Universiteit Leuven/Praktikon Bv*.
- van Loon, A. W. G., Creemers, H. E., Beumer, W. Y., Okorn, A., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2020). Can schools reduce adolescent psychological stress? A multilevel meta-analysis of the effectiveness of school-based intervention programs. *Journal of youth and adolescence*, 49(6), 1127–1145.
- van Loon, A. W. G., Creemers, H. E., Okorn, A., Vogelaar, S., Miers, A. C., Saab, N., Westenberg, P. M., & Asscher, J. J. (2022). The effects of school-based interventions on physiological stress in adolescents: A meta-analysis. *Stress and Health*, 38(2), 187–209.
- van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Miers, A. C., Saab, N., Westenberg, P. M., & Asscher, J. J. (2022). The effectiveness of school-based skills-training programs promoting adolescent mental health: A randomized controlled study (under review). *Manuscript Submitted for Publication*.
- van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2019). The effectiveness of school-based skills-training programs promoting mental health in adolescents: A study protocol for a randomized controlled study. *BMC Public Health*, 19(1), 1–12. <https://doi.org/10.1186/s12889-019-6999-3>
- van Loon, Amanda W. G., Creemers, H. E., Vogelaar, S., Miers, A. C., Saab, N., Westenberg, P. M., & Asscher, J. J. (2021). Prepandemic risk factors of COVID-19-related concerns in adolescents during the COVID-19 pandemic. *Journal of Research on Adolescence*, 31(3), 531–545. <https://doi.org/10.1111/jora.12651>
- van Ryzin, M. J., & Roseth, C. J. (2018). Cooperative learning in middle school: A means to improve peer relations and reduce victimization, bullying, and related outcomes. *Journal of Educational Psychology*, 110(8), 1192–1201. <https://doi.org/10.1037/edu0000265>
- Verzeletti, C., Zammuner, V. L., Galli, C., & Agnoli, S. (2016). Emotion regulation strategies and psychosocial well-being in adolescence. *Cogent Psychology*, 3(1). <https://doi.org/10.1080/23311908.2016.1199294>
- Vogelaar, S., Miers, A. C., Saab, N., van Loon, A. W. G., Creemers, H. E., Asscher, J. J., & Westenberg, P. M. (2022). Self-reported salient stressors in early adolescence: Findings from a large representative sample from different educational levels and ethnic identities (under review). *Manuscript Submitted for Publication*.
- Vollebergh, W. A. M., ten Have, M., Dekovic, M., Oosterwegel, A., Pels, T., Veenstra, R., de Winter, A., Ormel, H., & Verhulst, F. (2005). Mental health in immigrant children in the Netherlands. *Social Psychiatry and Psychiatric Epidemiology*, 40(6), 489–496. <https://doi.org/10.1007/s00127-005-0906-1>
- von der Embse, N., Barterian, J., & Segool, N. (2013). Test anxiety interventions for children and adolescents: A systematic review of treatment studies from 2000-2010. *Psychology in the Schools*, 50(1), 57–71. <https://doi.org/10.1002/pits>
- von der Embse, N., Jester, D., Roy, D., & Post, J. (2017). Test anxiety effects, predictors, and correlates: A 30-year meta-analytic review. *Journal of Affective Disorders*, 227, 483–493. <https://doi.org/10.1016/j.jad.2017.11.048>

W

- Wade, M., Prime, H., & Browne, D. T. (2020). Why we need longitudinal mental health research with children and youth during (and after) the COVID-19 pandemic. *Psychiatry Research*, 19–21.
- Wagner, E. F., Tubman, J. G., & Gil, A. G. (2004). Implementing school-based substance abuse interventions: Methodological dilemmas and recommended solutions. *Addiction*, 99(s2), 106–119. <https://doi.org/10.1111/j.1360-0443.2004.00858.x>
- Walburg, V. (2014). Burnout among high school students: A literature review. *Children and Youth Services Review*, 42, 28–33. <https://doi.org/10.1016/j.childyouth.2014.03.020>
- Weems, C. F., Scott, B. G., Graham, R. A., Banks, D. M., Russell, J. D., Taylor, L. K., Cannon, M. F., Varela, R. E., Scheeringa, M. A., Perry, A. M., & Marino, R. C. (2014). Fitting anxious emotion-focused intervention into the ecology of schools: Results from a test anxiety program evaluation. *Prevention Science*, 16(2), 200–210. <https://doi.org/10.1007/s11121-014-0491-1>
- Weigensberg, M. J., Joy Lane, C., Winners, O., Wright, T., Nguyen-Rodriguez, S., Goran, M. I., & Spruijt-Metz, D. (2009). Acute effects of stress-reduction interactive guided imagerySM on salivary cortisol in overweight latino adolescents. *The Journal of Alternative and Complementary Medicine*, 15(3), 297–303. <https://doi.org/10.1089/acm.2008.0156>
- Weisz, J. R., Jensen-Doss, A., & Hawley, K. M. (2006). Evidence-based youth psychotherapies versus usual clinical care: A meta-analysis of direct comparisons. *American Psychologist*, 61(7), 671–689. <https://doi.org/10.1037/0003-066X.61.7.671>
- Werner-Seidler, A., Perry, Y., Calear, A. L., Newby, J. M., & Christensen, H. (2017). School-based depression and anxiety prevention programs for young people: A systematic review and meta-analysis. *Clinical Psychology Review*, 51, 30–47. <https://doi.org/10.1016/j.cpr.2016.10.005>
- White, L. S. (2012). Reducing stress in school-age girls through mindful yoga. *Journal of Pediatric Health Care*, 26(1), 45–56. <https://doi.org/10.1016/j.pedhc.2011.01.002>
- WHO. (1998). Wellbeing measures in primary health care/The Depcare Project. *WHO Regional Office for Europe: Copenhagen*.
- WHO. (2001). Strengthening mental health promotion. *Geneva: World Health Organization*, Fact sheet, No. 220.
- Wills, T. A., McNamara, G., Vaccaro, D., & Hirky, A. E. (1996). Escalated substance use: A longitudinal grouping analysis from early to middle adolescence. *Journal of Abnormal Psychology*, 105(2), 166–180. <https://doi.org/10.1037/0021-843X.105.2.166>
- Wills, Thomas A., Cleary, S., Filer, M., Shinar, O., Mariani, J., & Spera, K. (2001). Temperament related to early-onset substance use: test of a developmental model. *Prevention Science*, 2(3), 145–163.
- Wilson, D. B. (n.d.). *Practical Meta-Analysis Effect Size Calculator [Online calculator]*. <https://campbellcollaboration.org/research-resources/effect-size-calculator.html>
- Wright, L. B., Gregoski, M. J., Tinggen, M. S., Barnes, V. A., & Treiber, F. A. (2011). Impact of stress reduction interventions on hostility and ambulatory systolic blood pressure in African American adolescents. *Journal of Black Psychology*, 37(2), 210–233. <https://doi.org/10.1177/0095798410380203>

X

- Xie, X., Xue, Q., Zhou, Y., Zhu, K., Liu, Q., Zhang, J., & Song, R. (2020). Mental health status among children in home confinement during the coronavirus disease 2019 outbreak in Hubei province, China. *Demography*, 174(9), 898–900. <https://doi.org/10.1353/dem.2008.0004>

Y

- Yahav, R., & Cohen, M. (2008). Evaluation of a cognitive-behavioral intervention for adolescents. *International Journal of Stress Management, 15*(2), 173–188. <https://doi.org/10.1037/1072-5245.15.2.173>
- Yeo, L. S., Goh, V. G., & Liem, G. A. D. (2016). School-based intervention for test anxiety. *Child and Youth Care Forum, 45*(1), 1–17. <https://doi.org/10.1007/s10566-015-9314-1>
- Yoo, Y. G., Lee, D. J., Lee, I. S., Shin, N., Park, J. Y., Yoon, M. R., & Yu, B. (2016). The effects of mind subtraction meditation on depression, social anxiety, aggression, and salivary cortisol levels of elementary school children in South Korea. *Journal of Pediatric Nursing, 31*(3), e185–e197. <https://doi.org/10.1016/j.pedn.2015.12.001>

Z

- Zafar, H., & T. Khalily, M. (2015). Didactic therapy for management of stress and co-morbid symptoms of depression and anxiety in Pakistani adolescents. *Pakistan Journal of Psychological Research, 30*(1), 131–149.
- Zhou, S. J., Zhang, L. G., Wang, L. L., Guo, Z. C., Wang, J. Q., Chen, J. C., Liu, M., Chen, X., & Chen, J. X. (2020). Prevalence and socio-demographic correlates of psychological health problems in Chinese adolescents during the outbreak of COVID-19. *European Child and Adolescent Psychiatry, 29*(6), 749–758. <https://doi.org/10.1007/s00787-020-01541-4>
- Zins, J. E., Bloodworth, M. R., Weissberg, R. P., & Walberg, H. J. (2007). The scientific base linking social and emotional learning to school success. *Journal of Educational and Psychological Consultation, 17*(2–3), 191–210. <https://doi.org/10.1080/10474410701413145>
- Zoogman, S., Goldberg, S. B., Hoyt, W. T., & Miller, L. (2015). Mindfulness interventions with youth: A meta-analysis. *Mindfulness, 6*(2), 290–302. <https://doi.org/10.1007/s12671-013-0260-4>
- Zuroff, D. C., Blatt, S. J., Sotsky, S. M., Krupnick, J. L., Martin, D. J., Sanislow, C. A., & Simmens, S. (2000). Relation of therapeutic alliance and perfectionism to outcome in brief outpatient treatment of depression. *Journal of Consulting and Clinical Psychology, 68*(1), 114–124. <https://doi.org/10.1037/0022-006x.68.1.114>

PUBLICATION LIST

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Miers, A. C., Saab, N., Westenberg, P. M., & Asscher, J. J. (under review). Promoting adolescent mental health: Recommendations for successful implementation and evaluation of school-based intervention programs.

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Miers, A. C., Saab, N., Westenberg, P. M., & Asscher, J. J. (under review). The effectiveness of school-based skills-training programs promoting adolescent mental health: A randomized controlled study.

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2022). Trajectories of adolescent perceived stress and symptoms of depression and anxiety during the COVID-19 pandemic. *Scientific Reports*, *12*(1), 1-12.

Vogelaar, S., Miers, A. C., Saab, N., van Loon, A. W. G., Creemers, H. E., Asscher, J. J., & Westenberg, P. M. (in preparation). Self-referral to skills-training programs after a universal school-based prevention program.

Vogelaar, S., Miers, A. C., Saab, N., Dusseldorp, E. M. L., **van Loon, A. W. G.**, Creemers, H. E., Asscher, J. J., & Westenberg, P. M. (in preparation). Teaching adolescents about stress using a universal school-based psychoeducation program: A cluster randomized controlled trial.

Vogelaar, S., Miers, A. C., Saab, N., **van Loon, A. W. G.**, Creemers, H. E., Asscher, J. J., & Westenberg, P. M. (under review). Self-reported salient stressors in early adolescence: Findings from a large representative sample from different educational levels and ethnic identities.

Vogelaar, S., Miers, A. C., Saab, N., **van Loon, A. W. G.**, Creemers, H. E., Asscher, J. J., & Westenberg, P. M. (in preparation). Measurement invariance of the Adolescent Stress Questionnaire-Short Form in a mixed gender, educational level, and ethnic identity sample.

van Loon, A. W. G., Creemers, H. E., Okorn, A., Vogelaar, S., Miers, A., Saab, N., Westenberg, P. M., & Asscher, J. J. (2021). The effects of school-based interventions on physiological stress in adolescents: A meta-analysis. *Stress and Health, 38*(2), 187-209. <https://doi.org/10.1002/smi.3081>

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Miers, A., Saab, N., Westenberg, P. M., & Asscher, J. J. (2021). Prepandemic risk factors of COVID-19-related concerns in adolescents during the COVID-19 pandemic. *Journal of Research on Adolescence, 31*(3), 531-545. <https://doi.org/10.1111/jora.12651>

van Loon, A. W. G., Creemers, H. E., Beumer, W. Y., Okorn, A., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2020). Can schools reduce adolescent psychological stress? A multilevel meta-analysis of the effectiveness of school-based intervention programs. *Journal of Youth and Adolescence, 49*, 1127-1145. <https://doi.org/10.1007/s10964-020-01201-5>

van Loon, A. W. G., Creemers, H. E., Vogelaar, S., Saab, N., Miers, A. C., Westenberg, P. M., & Asscher, J. J. (2019). The effectiveness of school-based skills-training programs promoting mental health in adolescents: A study protocol for a randomized controlled study. *BMC Public Health, 19*(1), 1-12. <https://doi.org/10.1186/s12889-019-6999-3>

van Lith, K., Veltman, D. J., Cohn, M. D., Pape, L. E., van den Akker-Nijdam, M. E., **van Loon, A. W. G.**, Bet, P., van Wingen, G. A., van den Brink, W., Doreleijers, T., & Popma, A. (2018). Effects of methylphenidate during fear learning in antisocial adolescents: A randomized controlled fMRI trial. *Journal of the American Academy of Child and Adolescent Psychiatry, 57*(12), 934-943. <https://doi.org/10.1016/j.jaac.2018.06.026>

ABOUT THE AUTHOR

Amanda van Loon was born on the 25th of November 1991 in Utrecht, the Netherlands. In 2010, she graduated high school at the Grifland College in Soest. She obtained her bachelor degree in Psychobiology in 2013 at the University of Amsterdam. After the bachelor program, Amanda completed the research master Biomedical Sciences, cluster Neurobiology, track Cognitive Neurobiology and Clinical Neurophysiology in 2015 at the University of Amsterdam. During her master program, Amanda completed two internships. The first internship was at the Vrije Universiteit Medical Center, where she analyzed fMRI data of OCD patients. The second internship was at the department of Child and Youth Psychiatry at de Bascule, where she worked on a project that examined the effects of methylphenidate on neural processing in antisocial adolescents. After the master program, Amanda worked as a data-analyst at Stichting Kijkonderzoek (SKO) in Amsterdam. In 2018, Amanda started her PhD project at the department of Clinical Child and Family Studies at Utrecht University, to investigate the effectiveness of school-based intervention programs in adolescents, a project that combines many of her interests: Intervention research, youth mental health, and helping vulnerable, at-risk populations. At the moment, Amanda works as a teacher at Utrecht University. From November 2022, Amanda will combine her work as a teacher with a postdoc position focusing on intervention research.

DANKWOORD (ACKNOWLEDGEMENTS)

Dit proefschrift zou er niet zijn geweest dankzij de inzet, het werk en de steun van vele anderen! Al deze mensen wil ik hierbij graag persoonlijk bedanken.

Allereerst wil ik al mijn begeleiders bedanken voor hun steun, tijd en geduld. *Jessica* en *Hanneke* – het UvA/UU team zoals we onszelf noemen – ik ben erg blij en dankbaar dat jullie mijn (dagelijkse) begeleiders zijn (geweest). Jullie hebben me altijd flink aangespoord en (uiteindelijk) het beste uit mezelf gehaald! Niet alleen met het schrijven van papers, maar ook tijdens de dataverzameling met het bedenken van allerlei oplossingen op de (vele) uitdagingen. *Jessica*, bedankt dat je altijd achter me stond, me geholpen hebt met prioriteiten stellen en mijn interesse in onderwijs hebt aangewakkerd. *Hanneke*, bedankt voor je geduld, je betrokkenheid en je kritische en scherpe vragen, dat mede zorgde voor iets meer orde in mijn soms wat chaotische brein en dwong me naar de kern te gaan.

Dan de rest van het projectteam – Team Leiden – ik vond het erg leuk om onderdeel te zijn van een groot onderzoeksteam en vond het fijn om met jullie samen te werken! *Michiel*, bedankt voor je kritische blik, enthousiasme en vertrouwen in mij de afgelopen jaren. *Anne*, bedankt voor je sympathieke en vakkundige feedback en *Nadira*, bedankt voor je positiviteit en goede adviezen. *Anthea*, wat fijn dat jij betrokken was bij de eerste jaren van het onderzoek als coördinator, voorzitter, logo-ontwerper en nog veel meer. Ik vond het plezierig om te werken aan het Stress Less Project en ben trots op wat we hebben opgezet (en uitgevoerd).

De andere coauteurs, *Ana* en *Wieke*, wil ik bedanken voor de prettige samenwerking en hulp bij het uitvoeren van de meta-analyses.

Natuurlijk wil ik mijn paranimfen ook heel erg bedanken! *Simone*, we zijn tegelijkertijd aan dit avontuur begonnen en hebben leed (lange dagen, dataverzamelingsuitdagingen), maar ook veel leuke dingen meegemaakt (borrelen, taartjes eten, tochten door Den Haag, strandbezoekjes). Erg fijn om te kunnen sparren over van alles en nog wat. Ik ben blij dat we dit samen konden delen! *Natasha*, we zijn ook bijna gelijktijdig gestart, toevallig beide op zowel de UU als de UvA. Onze (bijna) wekelijkse wandeltochten zijn heel erg waardevol! Bedankt voor het spuien en sparren, het vieren van (kleine) mijlpalen, het meedenken en je enthousiasme. Laten we nog veel wandeltochten maken (en congressen bezoeken) in de toekomst!

Zonder onderzoek natuurlijk geen proefschrift. Ik wil alle jongeren, ouders, scholen, leerkrachten, aanbieders, trainers en de gemeente Den Haag van harte bedanken voor hun enthousiasme, inzet en betrokkenheid bij het project! Met name de scholen en aanbieders met wie ik zoveel contact heb gehad. *Astrid* en *Harriët*, ik ben jullie heel dankbaar voor jullie oprechte interesse in mij en het project, en dat ik altijd welkom was bij jullie op school! *Joëlle*, ik vond het erg leuk om bij jullie school langs te komen (heerlijk in het groen) en fijn dat je zo benader- en bereikbaar was. *Marian*, *Agnes*, *Maroesja*, *Debby*, *Marca* en *Annieck*, dank voor jullie gastvrijheid en de prettige samenwerking. *Brahim*, *Hanane*, *Floris*, *Eefje*, *Evelyn*, *Ellen* en alle trainers, wat fijn dat jullie je zo inzetten voor alle jongeren in de omgeving Den Haag en met veel plezier en motivatie de trainingen hebben gegeven en hebben meegewerkt aan het project. Ik ben blij dat ik met jullie heb mogen samenwerken!

Ik ben ook alle student-assistenten, master- en bachelorstudenten dankbaar voor hun hulp bij het verzamelen van alle data. Zonder jullie was het nooit gelukt!

Daarnaast wil ik alle (oud-) OPP-collega's bedanken, ik heb me vanaf het begin af aan erg welkom gevoeld (en voel ik me nog steeds!). Ik ben blij dat ik velen van jullie beter heb leren kennen tijdens de lunch of bij een van de leuke uitjes. Ook de collega's van JC&JB wil ik bedanken voor de gezelligheid, in het bijzonder *Coralijn*, ik heb heel fijn met je samengewerkt. Erg leuk dat we allebei met iets nieuws startte waardoor we veel aan elkaar hebben gehad (we hadden genoeg te bespreken)! *Hanne*, super leuk om je nu ook als collega te hebben bij de UU. Heel erg jammer (maar natuurlijk super voor jou) dat je twee jaar naar het buitenland gaat, ik ga onze mini-breaks en gesprekken missen. Natuurlijk kom ik je snel een keer opzoeken!

Verder wil ik de leukste (oud-) OPP PhD Collega's - *Lilly*, *Esther*, *Rianne*, *Marissa*, *Janna*, *Christel*, *Lisa*, *Marjolein* en *Jessica* - bedanken voor de wandelingen, de uitjes, de openheid, het delen van (on)zekerheden, het brainstormen, het luisteren en bovenal de gezelligheid! *Lilly* en *Esther*, helaas veel te kort kamergenoten, maar bedankt voor jullie warme ontvangst. *Rianne*, we hebben de laatste maanden intens beleefd met (de stress van) het inleveren van onze proefschriften, fijn dat we dit konden delen. Ook de PhD collega's van de UvA wil ik bedanken voor de gezelligheid en gastvrijheid wanneer ik (vooral in het begin van mijn PhD) in Amsterdam kwam werken. Als laatst wil ik alle andere PhD lotgenoten bedanken die ik de afgelopen vier jaar heb ontmoet, met leuke samenwerkingen (VNOP-CAS, dataverzamelingscursus), lunches, wandelingen en congressen.

Uiteraard wil ik ook mijn vrienden bedanken voor hun steun, ontspanning en afleiding van de afgelopen jaren. *Malon*, heel erg bedankt voor je betrokkenheid, interesse, het meedenken, de interessante discussies, het helpen reflecteren en natuurlijk je super lieve kaartjes! Ik ben blij dat je altijd voor me klaar staat. Samen met *Rutger* en *Martijn* geniet ik erg van onze uitjes, van lekkere etentjes en borrels tot spelletjes- en horrorfilmavonden!

Lieke, *Claudia* en *Leonie*, onze (sportieve) dagjes uit zijn altijd erg gezellig en heeft zeker voor de nodige afleiding en ontspanning gezorgd! Op naar nog veel meer mooie momenten. *Lieke*, bedankt voor de fijne gesprekken tijdens de autoritjes naar handbal (al weer lang geleden), onze wandelingen en natuurlijk de borrels en etentjes.

Meiden van psychobiologie, *Annemarie*, *Bianca*, *Inge*, *Iris*, *Naomi* en *Susanne*, ondanks dat we elkaar niet zo regelmatig meer zien ben ik blij dat we nog steeds contact hebben na zoveel jaar. Bedankt voor de (online) escaperooms, etentjes en feestjes! *Bianca*, bedankt voor het sparren, meelevens en klagen over het PhD leven! *Inge*, m'n shopmaatje, bedankt voor je steun en gezelligheid! Ik ben blij dat we elkaar nog veel zien en spreken, en samen met *Femke* nog veel leuke dingen ondernemen.

Handbalmeiden, heel erg bedankt voor de (bijna) wekelijkse ontspanning op het handbalveld, en ook vaak daarbuiten. Carnaval is altijd een feestje! Ik wil ook mijn frisbee teamgenoten bedanken voor de leuke tijden op en buiten het veld. *Annabelle*, ik ben heel blij dat we samen zijn begonnen met frisbee, het is niet meer weg te denken. Op naar nog veel meer (fiets)tochten naar de trainingen, wedstrijden en andere leuke evenementen!

Tot slot wil ik mijn familie bedanken voor hun steun, interesse en aanmoediging, ook al weten jullie misschien nog steeds niet helemaal wat ik precies heb gedaan de afgelopen vier jaar. Heel veel dank!

Lieve *Thirza*, bedankt dat je altijd achter me staat, ook al ben je het misschien niet altijd met me eens. Heel erg leuk dat we al zoveel hebben gezien en gedaan – verre vakanties, festivals, handbaltripjes en nog veel meer – op naar de volgende avonturen! Lieve *pap* en *mam*, wat ben ik blij met jullie betrokkenheid, ondersteuning en vertrouwen in mij! Heel erg veel dank voor het warme ontvangst als ik weer thuis kom, de vele uitjes en tripjes (sportwedstrijden, etentjes, dierentuinen) die we ondernemen en vooral dat jullie er altijd voor me zijn!

