

THE UTRECHT HEALTHY SCHOOL PROJECT:

Connecting adolescent health behavior, academic achievement and Health Promoting Schools.



Vincent Busch

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Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht.

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Author: Vincent Busch

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**The Utrecht Healthy School Project:
Connecting adolescent health behavior, academic achievement and Health
Promoting Schools**

Het Utrecht Gezonde School Project:

Het verbinden van gezondheidsgedrag van adolescenten, academische prestaties en
Health Promoting Schools.
(met een samenvatting in het Nederlands)

Proefschrift

Ter verkrijging van de graad van doctor aan de Universiteit Utrecht
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door

Vincent Busch

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te Naarden

Promotoren: Prof. dr. A.J.P. Schrijvers
Prof. dr. T.A. van Yperen

Copromotor: Dr. J.R.J. de Leeuw

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CHAPTER 1

GENERAL INTRODUCTION

General Introduction

Health-related behaviors such as smoking, peer bullying, alcohol use and unhealthy nutrition contribute significantly to the public health burden of major, contemporary diseases such as diabetes, cardiovascular disease and psychiatric and psychosocial disorders.^{1,2} Most often these health-related behaviors originate in adolescence and pose a gateway to poorer adult health.^{1,3} Since children spend much of their time at school, the World Health Organization (WHO) states this is the ideal place for health promotion.⁴⁻⁶ The Schools for Health in Europe (SHE) initiative was developed to promote the active crossover of education and health to create more effective, sustainable and feasible health promotion initiatives targeting children and adolescents: the Health Promoting School (HPS).⁷ SHE advocates to achieve this by promoting the integration of health promotion and education simultaneously into the school and social environment of children.⁷

This model of integrated health promotion at school is known as the Whole School Approach and should be viewed as a framework to shape health promoting initiatives and interventions.^{8,9} Rather than focusing on targeting students via professional intervention, via early detection interventions, or even via curriculum-wide health education, interventions that apply the Whole School Approach include the entire school community (parents, teachers, health services professionals and the neighborhood community) in a way that focuses mainly on a preventive approach to promote health and healthy behavior (Fig 1).

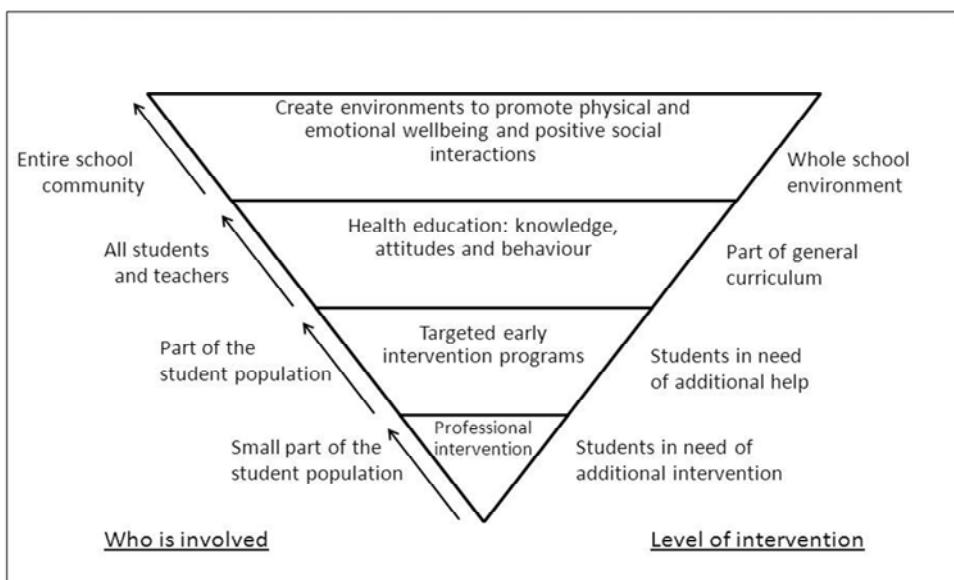


Figure 1 Whole School Approach model, adapted from Hendren, Birrell Weissen and Orley.¹⁶

General Introduction

The intervention that is subject of evaluation in this thesis, the Utrecht Healthy School, is an example of a Whole School Approach intervention that follows the five principles that form the core of the Whole School Approach:

1. Building a healthy school policy
Examples: a non-smoking policy or a zero tolerance-bullying policy.
2. Creating a supportive, healthy school environment
Examples: creating a healthy school canteen or hosting alcohol-free school parties.
3. Strengthening community action by involving the outside-of-school environment
Examples: actively involve parents in curricular activities (at home) or let them participate in designing the intervention.
4. Focusing on personal skill development
Examples: focus on handling peer pressure or on strengthening resiliency.
5. Reorienting health services
Example: Collaborate with local public health authorities/professionals to fine-tune educational content to evidence based methods.

The Whole School Approach introduces two important changes to health education and school health promotion. First, it does not focus on the one-way transfer of knowledge that is often used in health education, which is known not to lead to long term behavioral change. Instead, in the Whole School Approach health education focuses strongly on skill development and the development of self-esteem and self-efficacy to influence behavioral changes.^{4,10,11}

The second change that is introduced in this new paradigm is that health promotion initiatives should be comprehensive, with the school curriculum forming only a part of the total intervention. This means that health promotion initiatives, aside from curricular content changes, should include changes to the environment that are broadly embedded in students' school and personal lives through involvement of teachers, parents and the community.^{12,13} Examples that illustrate how the Whole School Approach can lead to health promotion initiatives to transcend and complement curricular health education classes are for example to have a zero tolerance on bullying policy, or to have a healthy school canteen as part of a healthy school environment. In the Whole School Approach view it is important to practice what is preached and put health education into practice so that learning and behavior change can continue outside the classroom.^{12,14,15}

These developments in health promotion through schools were evaluated in several previous studies.^{11,17,18} In 1999, Denman described these as an upcoming paradigm shift of school-based programs towards school-wide and community based programs. According to Denman these programs should be needs driven, skill-based classroom education programs that place the focus on shaping health attitudes and values instead of merely relaying health-related information. Denman concluded that school-

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wide health promotion should be an interdisciplinary, school community effort. Nowadays, these developments have increasingly shaped a new paradigm that is slowly but steadily accumulating empirical evidence showing its positive effects in comparison to past practices.^{9,14,15,19-22}

The following main research question will be answered by the three different parts of this thesis: How do health related behaviors cluster, how are they related to the psychosocial health, physical health and school performances of adolescents, and are they positively influenced by the Health Promoting School innovation the Utrecht Healthy School?

Part 1: Adolescent health, health behavior and multi-behavioral approaches to prevention

Studies increasingly show that many health behaviors in adolescents cluster, hereby complicating ideal preventive actions and the design of Health Promoting Schools.²³⁻²⁶ Evidence accumulates showing that clustered behaviors are most effectively tackled by interventions that address these behaviors simultaneously via a multi-behavioral approach instead of single-behavior initiatives.^{27,28} Such clustering has important implications due to the resulting synergistic effects, meaning that particular behaviors share a certain variance. The consequence of this is that changing one behavior affects the prevalence of another.^{29,30} Certain behaviors increase the likelihood of being involved in other risk behaviors³¹, e.g. alcohol users are more likely to partake in smoking than non-drinkers.²⁹ Such synergistic effects have been shown to increase disease risk to a level greater than either factor alone.^{29,30,32,33} Therefore, interventions that target associated behaviors are thought to be more effective than tackling these via separate interventions. The underlying hypothesis behind this is that on top of the health risks that come from a certain behavior, one's mindset and decision-making processes to be involved in certain behaviors are affected by partaking in certain other, related behaviors. This means that interventions that tackle a combination of behaviors might lead to an increased positive effect on one's health behavior in a synergistic manner, yielding additional benefit due to their clustered approach.^{23,32,34-36} This has significant implications for designing appropriate health promoting interventions and on which behaviors an intervention should focus. Since schools have limited time and opportunity to integrate health education and health promotion into their curriculum, they should prioritize topics to tackle. Therefore, some recent studies suggest that tailored Health Promoting School interventions are vital to ensure that addressed topics are relevant for the recipient school. Studies also show that this results in more appropriate practices and stronger feelings of psychological ownership among teachers, students and others involved than when a preset collection of topics would have been targeted. Such tailoring makes teachers relate more to 'their' project, which has, in turn, been shown to increase their motivation and commitment.³⁷⁻³⁹ Tailoring of an intervention is currently not common practice, although some promising examples

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exist, such as the Gatehouse Project³⁷ and the Irish Mind Out project.⁴⁰ In SHE's overview on recent Health Promoting School developments, and several other recent landmark publications, both these examples are mentioned as promising new inroads into school-health development, since they both effectively targeted multiple, tailored health outcomes in context of a coordinated Whole School Approach.^{9,22,41} Therefore, to elaborate on the relationships between different health behaviors and outcomes, the first part of this thesis is dedicated to answering research question 1:

How do different health-related behaviors relate to each other, and to adolescents' psychosocial and physical health?

In **chapter 2** an exploration is presented of the clustering of different adolescent health behaviors with each other and with certain sociodemographic factors (such as socioeconomic status and age). Their associations with being overweight and having psychosocial problems is also explored in this chapter. In **chapter 3**, the associations are studied between several health behaviors and psychosocial problems. In **chapters 4 and 5** the effects of respectively screen time behaviors (internet use, watching television and playing videogames) and bullying on adolescents' health are studied. These behaviors are especially highlighted due to their relative novelty in the context of health promotion; they are not commonly included in health promoting school interventions. Overall, in this first part of the thesis the aim is to study what behaviors should be included in Health Promoting School interventions and what multibehavioral approaches are likely to provide an added value over single-behavior approaches.

Part 2: Adolescent health behavior and academic achievement

Intervening via a Whole School Approach has been shown to be quite demanding for a school in terms of planning and organization.^{42,43} Studies that evaluate designing and implementing Whole School Approach initiatives from a practical perspective are therefore vital to understand previous successes and weaknesses.^{38,44-51} One of the most important lessons learned from such studies thus far is that many school-based interventions to date have been designed by health scientists and professionals from medicine and public health. This results in interventions with a strong focus on health promotion that disregard the main incentive that drives education professionals: improving students' school performances. As stated by Lawrence St Leger¹¹, and extensively advocated by Flay²² later, Health Promoting Schools should aim to make better schools (not health centers) that improve adolescents' health. Schools are first and foremost expected to educate adolescents and not primarily serve as a place for health promotion. When the relationship between health behavior and school performance would be better understood, it might get teachers more enthusiastic about the concept of a Health Promoting School and motivate them to invest in it. This is vital, since teachers are the main implementers of any school based intervention; it has to become their program.^{11,50,52,53} Health promoters and scientists should be more actively involved with this research topic, since the attitude change that this might

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stimulate among schools is important for the longevity of the Health Promoting School. Therefore, in the second part of this thesis the aim is to answer research question 2:

What are the effects of different health behaviors on the school performance of adolescents?

In **chapter 6** a systematic literature review is presented of the longitudinal evidence of the past 20 years about the effects of various health behaviors on adolescents' academic performances. **Chapter 7** adds to this with an empirical study on the topic. The secondary goal of this chapter is to better understand the underlying mechanisms of the associations of health-related behaviors and school performances. For this, a distinction was made between a direct route of association of a certain behavior and school performances, and an indirect route in which such a behavior could influence students' psychosocial problems, and through that effect school performance could subsequently be influenced. Overall, in this part of the thesis the aim is to study the relationship between health behavior and academic achievement in adolescents with special focus on underlying explanatory mechanisms, gender differences, and practical implications for Health Promoting Schools.

Part 3: The Utrecht Healthy School

In line with the described developments in school-health promotion, the collaborative effort of the teachers, parents and students, together with several professionals from public health knowledge institutes and academics, led to the development of the Utrecht Healthy School Pilot on a Dutch high school. The intervention in this pilot adhered to the five earlier described Whole School Approach characteristics. In addition to these five characteristics, the multi-behavioral Utrecht Healthy School was tailored to fit the needs of the school. This was done via an annual assessment of students' health and health behavior via a self-report survey, based on the WHO's Health Behavior in School aged Children survey (HBSC).⁵⁴ The effects of this pilot study are presented in Part 3 of this thesis. Since this pilot did not include a control school (i.e. controlled experimental setup), a controlled prospective experiment study was set up to further study the intervention's effects. In this follow up study the intervention was implemented on two high schools in the Netherlands with two control schools to match. The schools in this study were relatively standard Dutch high schools that tailored, designed and integrated their own whole school Health Promoting School program and vision into their curriculum themselves without external financing or organizational aid. This provides possible insights into the feasibility and the generalization of effects when a whole school Health Promoting School approach would be applied by future schools in The Netherlands. Therefore, in the third part of this thesis the aim is to answer research question 3:

How feasible and effective is the Utrecht Healthy School intervention to improve adolescents' health and health behavior?

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To answer this comprehensive research question, three sub-questions are formulated:

1. How effective were previous multi-behavioral, Whole School Approach interventions in improving the health and health behavior of adolescents?
2. What lessons can be learned from the Utrecht Healthy School to aid future studies and interventions in terms of design, implementation and institutionalization?
3. How effective is the Utrecht Healthy School in improving the health and health behavior of adolescents?

In **chapter 8** the first sub-question is studied via a systematic literature review on the effectiveness of the Health Promoting School model. Thereafter, a qualitative lessons learned study of the Utrecht Healthy School Pilot's design and implementation is presented in **chapter 9** to answer the second sub-question. In **chapters 10-12** sub-question three is answered. Firstly, in **chapter 10** a quantitative evaluation is presented of the effects of the Utrecht Healthy School Pilot. After the study protocol for the controlled follow-up experiment study is presented in **chapter 11**, the effects of this controlled follow-up study are presented in **chapter 12**.

This thesis is finalized by the **General Discussion (chapter 13)**. There, the main findings are interpreted in lights of developments in the current literature with a special focus on discussing the value of the multi-behavioral approach as applied in the Utrecht Healthy School study. In addition, the mix of quantitative and qualitative assessments to evaluate the value of the Utrecht Healthy School method is discussed. Also, this chapter contains a discussion on whether tailoring schools in the Netherlands should be encouraged when endeavoring in comparable interventions as the Utrecht Healthy School. To conclude, recommendations for future research are provided.

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CHAPTER 2

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ABSTRACT

Background

Recent studies show several health-related behaviors to cluster in adolescents. This has important implications for public health. Interrelated behaviors have been shown to be most effectively targeted by multimodal interventions addressing wider-ranging improvements in lifestyle instead of via separate interventions targeting individual behaviors. However, few previous studies have taken into account a broad, multi-disciplinary range of health-related behaviors and connected these behavioral patterns to health-related outcomes. This paper presents an analysis of the clustering of a broad range of health-related behaviors with relevant demographic factors and several health-related outcomes in adolescents.

Methods

Self-report questionnaire data were collected from a sample of 2.690 Dutch high school adolescents. Behavioral patterns were deducted via Principal Components Analysis. Subsequently a Two-Step Cluster Analysis was used to identify groups of adolescents with similar behavioral patterns and health-related outcomes.

Results

Four distinct behavioral patterns describe the analyzed individual behaviors: 1- risk-prone behavior, 2- bully behavior, 3- problematic screen time use, and 4- sedentary behavior. Subsequent cluster analysis identified four clusters of adolescents. Multi-problem behavior was associated with problematic physical and psychosocial health outcomes, as opposed to those exerting relatively few unhealthy behaviors. These associations were relatively independent of demographics such as ethnicity, gender and socio-economic status.

Conclusions

The results show that health-related behaviors tend to cluster, indicating that specific behavioral patterns underlie individual health behaviors. In addition, specific patterns of health-related behaviors were associated with specific health outcomes and demographic factors. In general, unhealthy behavior on account of multiple health-related behaviors was associated with both poor psychosocial and physical health. These findings have significant meaning for future public health programs, which should be more tailored with use of such knowledge on behavioral clustering via e.g. Transfer-oriented Learning.

Background

Health-related behaviors such as smoking, peer bullying, alcohol use and unhealthy nutritional habits contribute significantly to the public health burden of major, contemporary diseases such as diabetes, cardiovascular disease and psychiatric and psychosocial disorders. Many of such behaviors originate during adolescence and frequently lead to impaired adult health.^{1,2} Recent studies show that several of such health-related behaviors influence each other in a clustered fashion instead of acting independently on one's health.³⁻⁷ Such clustering has important implications for research and practice due to the resulting synergistic effects, meaning that particular behaviors share a certain variance, resulting in the fact that changing one behavior affects prevalence of another.^{8,9} Certain behaviors increase the likelihood of being involved in other risk behaviors¹⁰, e.g. alcohol users are more likely to partake in smoking use than non-drinkers.⁹ Such synergistic effects have been shown to increase disease risk to a level greater than either factor alone.^{3-5,8,9} The underlying hypothesis behind this is that on top of the health risks that come from a certain behavior, one's mindset and decision-making processes are affected by partaking in a certain behavior.⁹

This has important implications for preventive interventions, because "if there is covariance between these behaviors, then programs that fail to engage multiple risk behaviors are unlikely to be successful or to generate lasting effects."¹¹ When behavior A and B cluster, then intervention on behavior A might affect behavior B, even though that was not directly targeted. Conversely, when behavior B is left out, intervening on behavior A might be less effective than a combined approach. Interventions that simultaneously tackled clustered health behaviors have been shown to be more effective as well as less costly.^{6,10,12}

Such intervention tailoring requires knowledge on the clustering characteristics of a broad scope of health behaviors. However, most past studies on health behavioral clustering focused on a relative small range of health behaviors. They mostly focused on the clustering of nutrition, smoking and exercise^{8,13} while some additionally included alcohol use^{11,14}, safe sex^{9,15} or sedentary time.¹⁶⁻¹⁸ However, few studies thus far included behaviors such as bullying/being bullied and/or screen time use (watching TV, playing videogames, using the internet/PC), while their relevance to adolescent health has become increasingly evident.¹⁹⁻²⁶ Especially the "compulsive aspect" of screen time use has been overlooked thus far, while this is increasingly shown to affect both adolescents' physical and psychosocial health.^{19-22,27,28} Therefore, a better understanding of the interrelations of a broad, comprehensive scope of health behaviors is needed.¹² In addition, despite evidence that several health-related behaviors can negatively affect one's physical and mental health, thus far studies have generally focused only on the associations of such clusters of health behaviors with physical health (mostly on overweight). The relations with psychosocial factors (e.g. self-efficacy or resilience) are underexposed, while they are often targets of health

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promoting interventions.^{29,30} Also, only few studies have focused on adolescents as the population of interest, while they form such a unique population in which many health related behavior habits find their origin.^{1,2,31}

Therefore, this study aimed to identify clustering of a comprehensive number of health-related behaviors in adolescents, and, subsequently, to identify groups of adolescents with similar behavior and health outcomes.

Methods

Sample and procedures

Students from different educational levels, ethnic backgrounds and ages of five middle-large Dutch high schools (adolescents, 11–18 years old) received an online questionnaire in September 2012. These schools form a convenience sample with all schools participating out of intrinsic motivation, without being provided with funds or other incentives to participate. All schools were assisted with the questionnaire procedures by the research team. All schools are situated in suburban areas of middle to large cities in the Netherlands, are categorized as in-between rural and urban, and include students from both urban and rural background. Students completed the survey individually during class. Survey procedures were designed to allow students to participate voluntarily and anonymously. Students were made aware that all data were collected confidentially and stored under a password protected website, only to be assessed by the direct researchers and to be processed anonymously. Students and parents were informed on the nature and format of the survey in timely fashion and were made explicitly clear that participation was voluntary. Approximately 80% of the eligible students completed the survey. Only students with conflicting course schedules (according to their teachers) or those that were ill / absent on the day of the survey did not participate. Since the actual day and timing of the surveys was unannounced, selection bias was prevented in this step. This study has been approved by the Medical Ethics Committee of the University Medical Center Utrecht (UMCU), The Netherlands. METC-protocol number 11-397 / C. For this study the UMCU's Medical Ethics Committee decided no informed consent procedure was necessary, due to the coded data.

Measures

Data consisted of self-report data from a sample of Dutch high school adolescents on their relevant demographics, a range of health behaviors and several health outcomes. All outcomes concerned the individual students as the primary sampling unit of the study. The questionnaire was based on the Dutch version of the WHO's Health Behavior in School-Aged Children (HBSC) questionnaire.^{32,33} Table 1 shows the operationalization of all main measures. All behaviors that were included regarded "Recent behaviors", meaning that one indicated to partake in a certain behavior in the month prior to filling out the questionnaire. With regard to bullying this concerned three months prior to filling in the survey. The questions regarding psychosocial problems and self-efficacy were more general, without indicating a certain period of time in

which the behaviors had to have taken place. The included health-related behaviors were alcohol use, drug use, smoking, physical exercise, nutrition, sexual behavior, screen time (watching television, (online) gaming and internet use) and peer bullying. Most items were surveyed in similar fashion to those of the Dutch HBSC questionnaire; these are summarized in Table 1. The items that differed from the HBSC questionnaire format are discussed in more detail below.

Bullying. The measurement of bully behavior was based on the Olweus Bully Score and the Olweus Bully Victim Score.³⁴ These scores distinguish bullies and bullied children from non-bullies and non-bullied children with a cut-off of “*2 to 3 times a month*”. These measures’ validity and reliability were demonstrated in previous research, stating that these scores allow for prevalence estimates of bullying and being bullied to be obtained conveniently, that they have a reasonably well-defined meaning and that they are easily and unambiguously understood by users and researchers.³⁵

Physical exercise and nutrition. Healthy physical exercise was defined as at least one hour of moderately intensive physical exercise every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness. Healthy eating habits were defined as a composite score of having breakfast, eating fruits and vegetables, all at least five times per week. Both are commonly used measures in The Netherlands and the Dutch HBSC.³²

Screen time: watching television, internet use and videogame playing. Internet use was defined as use of the computer/internet for non-school-related purposes. Videogame playing was defined as (online) gaming on a game console. Spending more than two hours/day on a screen time behavior was defined as “*excessive*” use.²³ The compulsionness of someone’s screen time behavior was measured by the Compulsive Internet Use Scale (CIUS) for compulsive internet use²³ and by the Videogame Addiction Test (VAT) for compulsive videogame playing.²² The CIUS and VAT both represent a measurement of the core elements of compulsive or addictive behavior that are applicable to Internet use (e.g. loss of control, withdrawal symptoms, coping).²³ These measures focus particularly on the compulsive and impulse control elements of Internet use and video game playing. To illustrate, issues such as whether one finds it difficult to stop using the Internet/playing video games, whether one rushes through homework to get to using the Internet/video games or whether others say one should spend less time on the Internet/playing video games are questioned by both surveys.^{22,23} Both the VAT and CIUS consist of 14 questions with a five-point Likert scale, used to evaluate compulsive behavior, respectively for compulsive videogame playing (CVP) and compulsive internet use (CIU). A mean score higher than 3.0 points indicates compulsive behavior.

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Table 1 The operationalization of the studied health behaviors and health indicators (N=2.690).

Variable	Item	Operationalization
Cannabis Use ³²	Have you ever used cannabis? Have you recently (in the last 4 weeks) used cannabis?	0) No, 1) Yes 0) No, 1) Yes
Alcohol use ³²	Have you ever drunk alcohol? Have you recently drunk alcohol? How many days a week do you drink alcohol? How many glasses, cans or bottles of alcohol do you drink a day?	0) No, 1) Yes 0) No, 1) Yes Number a day Number a day
Binge drinking ³²	How often in the last 4 weeks have you had more than 4 alcoholic beverages on one occasion?	Number of times, from "Never" to "9 or more"
Smoking ³²	Have you ever smoked a cigarette? Have you recently smoked a cigarette? How many cigarettes do you smoke per week?	0) No, 1) Yes 0) No, 1) Yes Categories; 10 pieces per category,"0-10" to "70 or more"
Nutrition ³²	How often do you have breakfast per week? How often do you eat vegetables per week? How often do you eat fruits per week?	Number of days Number of days Number of days
Physical exercise ³²	How do you travel to school usually? How long does it take you to walk or bike to school (one-way trip)? How many hours of gym class do you have at school each week? Are you a member at a sports club? How many hours a week do you spend at your sports club? How many hours a week do you spend on other sports related activities than previously addressed?	0) By bike, 1) Walking, 2) Else Number of mins Categories ranging from "0" to "4". 0) No, 1) Yes Number of hours Number of hours
Watching TV ³²	How many days a week do you watch TV? How many hours a day do you watch TV?	Number of days 0) Less than 30 mins, 1) 30 mins – 1 hour, 2) 1-2 hours, 3) 2-3 hours, 4) >3 hours
Using the internet/PC ³²	How many days per week do you use the internet/PC (not for school purposes)? How many hours a day do you use the internet/PC (not for school purposes)	Number of days 0) Less than 30 mins, 1) 30 mins – 1 hour, 2) 1-2 hours, 3) 2-3 hours, 4) >3 hours
Videogame playing ³²	How many days a week do you play videogames on a game console?	Number of days

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	How many hours a day do you play videogames on a game console?	0) Less than 30 mins, 1) 30 mins – 1 hour, 2) 1-2 hours, 3) 2-3 hours, 4) >3 hours
Compulsive internet use ²³	Compulsive Internet Use Scale (CIUS) E.g. Do you rather spend time on the internet than spending time with others? (total: 14 items)	0) Never, 1) Rarely, 2) Sometimes, 3) Often, 4) Very often
Compulsive videogame playing ²²	Videogame Addiction Test (VAT) E.g. Do you rather spend time playing videogames than spending time with others? (total: 14 items)	0) Never, 1) Rarely, 2) Sometimes, 3) Often, 4) Very often
Body Mass Index ³²	How tall are you (no shoes)?	Number of cm
Psychosocial problems ³⁶	What do you weigh?	Number of kg
General Self-Efficacy ⁴²	Strengths and Difficulties Questionnaire (SDQ). E.g. I am easily distracted, I find it difficult to focus (total: 20 items) General Self-Efficacy (GSE) Survey. E.g. If you are going to do something, are you afraid you will fail? (total: 11 items)	0) Not true, 1) A little true, 2) Very true 0) Never, 1) Sometimes, 2) Often, 3) Very often

Health outcomes

Three health-related indicators were measured. Firstly, psychosocial problems, which were measured by use of the Strengths and Difficulties Questionnaire (SDQ). This validated questionnaire measures emotional problems, conduct problems, hyperactivity, peer problems, and pro-social behavior, each composed of 5 items scored on a 3-point Likert-scale (0 = "not true", 1="somewhat true" or 2="certainly true"). Together, except for the pro-social score, they add up to a total SDQ-score of maximum 40 points.^{36,37} A score of 15 or higher is defined as "(potentially) problematic". The self-report SDQ's reliability and validity to measure the described psychosocial problem behaviors were recently demonstrated in a comparable sample of Dutch youth.³⁸ Van Widenfelt, Goedman, Treffers and Goodman later also stated that both the parent and self-report version of the SDQ are acceptable in terms of internal consistency, inter-informant correlations when compared to the "standards", i.e. the Child Behavior Checklist (CBCL) and the Youth Self Report survey (YSR).³⁹

Secondly, "being overweight" was used to indicate unhealthy weight, based on the BMI corrected for age and gender, with appropriate cut-offs in adolescents.⁴⁰ Thirdly, due to the importance of self-esteem, social anxiety and assertiveness in adolescent development and psychosocial functioning, a composite measure of these concepts was integrated, which in the literature is referred to as "general self-efficacy" (GSE).⁴¹ Schwarzer's conceptual definition of GSE is applied here and that refers to the concept of how one describes his/her beliefs in their capabilities to practice control over challenging demands and regarding their functioning across these domains.⁴² The operationalization of GSE measurement that was used was designed for use in Dutch adolescents⁴² and based on Rosenberg's Self Esteem Scale⁴³ and Schwarzer's Generalized Self-Efficacy Scale.⁴² The GSE questionnaire consisted of 11 questions with

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a 4-point Likert Scale, a higher score being indicative of more problems. The appropriate cut-off score of higher than 2.50 was used to indicate a problematic score.⁴²

Table 2 Student Characteristics (N=2.690)

	N (%)
Age in years	
11-12	648 (24.1)
13-14	1.300 (48.4)
15-16	639 (23.8)
17-18	102 (3.8)
Mean age in years	13.68 (SD 1.45)
Socio-economic status (FAS ¹ score)	7.13 (SD 1.49)
Low (0-2) – Medium (3-5)	393 (14.6)
High (6-9)	2.297 (85.4)
Watching TV (>14h/week)	549 (21.0)
Internet use (>14/week)	730 (27.1)
Videogame playing (>14/week)	186 (6.9)
Compulsive Internet Use, CIU ²	94 (3.5)
Compulsive Videogame Playing, CVP ³	108 (4.0)
Being bullied	124 (4.7)
Bullying	77 (2.9)
Alcohol user	702 (26.1)
Binge drinker	477 (19.6)
Marihuana user	170 (6.3)
Smoker	231 (8.6)
Sufficing to Dutch Norm Healthy Physical Exercise ⁴	1.974 (73.6)
Sufficing to Dutch Norm Healthy Nutrition ⁵	1.186 (44.1)

1: FAS = Family Affluence Scale; **2:** CIU = Compulsive Internet Use Scale Score >3.0 (range 0-4); **3:** CVP = Videogame Addiction Test Score >3.0 (range 0-4); **4:** Dutch Norm Healthy Physical Exercise = at least one hour of moderately intensive physical exercise every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness; **5:** Dutch Norm Healthy Nutrition = at least having breakfast, eating fruits and vegetables 5 times per week.

Statistical analyses

All statistical analyses were performed with SPSS v20. First, Principal Component Analysis (PCA) was used to identify underlying behavioral patterns from the described health behaviors. Varimax rotation was used. Using the Varimax rotation method minimizes the number of variables that have high loadings on each factor and, as such, simplifies the interpretation of the factors. The extraction of factors in the analysis was based on the Scree Test, a factor loading of at least 0.30 after rotation (based on sample size and

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number of tested variables^{44,45} and conceptual meaningfulness.⁴⁴ In a follow-up analysis, the number of factors to extract was assessed by parallel analysis⁴⁶, which compares Eigenvalues of factors from real data with factors from random data. Furthermore, two criteria were tested: the Kaiser-Meyer-Olkin Measure of Adequacy (KMO), a measure of sampling adequacy (threshold: KMO >0.60) and Bartlett's test of sphericity, which is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated (threshold: $p \leq 0.05$). This PCA produced standardized "component scores" via regression techniques.

Subsequently, a Two Step Cluster Analysis (TCA) was used to identify groups of adolescents with similar behavior and health outcomes.⁴⁵ The behavioral patterns (i.e. the component scores derived from the PCA) were used as input variables in the TCA, together with the socio-demographics age, gender, school level, ethnicity, socio-economic status and health outcomes (being overweight, GSE problems and psychosocial problems).^{44,45} A Two-Step Cluster Analysis is used here, due to the mixture of categorical and continuous variables. As stated by Norušis, other cluster analysis approaches will not suffice, since they rely on either continuous or categorical data (hierarchical clustering) or on a preset number of clusters to be distilled (K-means cluster analysis), whereas the TCA can perform an exploratory cluster analysis using a combination of different types of variables.⁴⁷

Results

A total of 2.690 adolescents (response rate 79.8%) aged 11–18 years completed the survey. Students' characteristics are listed in Table 2. Approximately 45% were boys and the students' average age was 14 years. Approximately 73% of the 2690 students were native Dutch students; the rest of the students were mostly part of the major ethnic sub-populations of people originating from Morocco, Surinam, Turkey and the former Dutch Antilles.

Principal component analysis

The sample was considered suitable for factor analysis^{44,45}, as both the KMO measure (0.69) and Bartlett test of sphericity ($p \leq 0.001$) exceeded the pre-set threshold. Results of the Principal Component Analysis (PCA) indicated that several separate distinct behavioral patterns (the "components" deduced from the PCA) underlie the individual behaviors. From the Scree Plot and further analysis four different behavioral patterns were deduced.^{44,45}

Table 3 Factor structure of health behaviors in the study sample (only loadings above .30 are presented)

Behavioral components	Factor 1 Risk-prone behavior	Factor 2 Bully behavior	Factor 3 Problematic screen time use	Factor 4 Sedentary behavior
Smoking	.66			
Cannabis use	.73			
Binge drinking	.78			
Quantity of alcohol use	.80			
Having had intercourse	.65			
Healthy nutrition				-.50
Healthy physical exercise				-.65
Excessively watching TV			.32	.57
Excessive PC/internet use			.32	.65
Excessively playing videogames			.80	
Compulsive PC/internet use		.32	.54	
Compulsive videogame playing			.85	
Being a bully victim		.82		
Being a bully		.86		
Eigenvalue	2.938	2.252	1.423	1.091
Variance explained %	19.132	13.725	11.216	10.959
Cumulative variance explained %	19.132	32.857	44.073	55.032

Note: KMO measure of sampling adequacy = .69 (based on Kaiser's criteria: KMO \geq .60 means that the factor analysis result is acceptable.). Bartlett's test of sphericity: $\chi^2 = 6853.250$ (df = 91; p < .000).

Selecting more or less than four factors was not in accordance with both the Scree Plot and Parallel Analysis⁴⁶, and left a non-interpretable factor solution. The four factors together explained approximately 55% of the total variance of the fourteen analyzed items. Further details of the PCA (item patterns, factor loadings and explained variance) are presented in Table 3. Only the items with a factor loading of at least 0.30 are presented in Table 3. From the PCA four main components were distilled, mainly indicating:

1. Risk-prone behavior (smoking, drug use, alcohol use and sexual activity).
2. Bully behavior (bullying, being bullied and compulsive Internet use).
3. Problematic screen time use (weekly time and compulsion of playing videogames and using the Internet).
4. Sedentary behavior (weekly time watching TV and using the Internet), unhealthy nutrition and insufficient physical exercise.

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The first factor consisted of the high-risk behaviors alcohol use, drug use and smoking, and was thus termed risk-prone behavior. The second factor consisted of bullying, being bullied and compulsive PC/Internet use, termed the bully behavior factor. Thirdly, the different aspects of screen time use (i.e. its compulsive component and its excessive use component) formed a separate factor. The fourth factor consisted of the components low physical activity, poor nutrition habits combined with excessively watching TV and using the PC/Internet. This particular aspect of screen time use was related to poor physical exercise and nutrition patterns, whereas the compulsiveness of screen time use had no correlation with those behaviors. This fourth factor was thus termed the sedentary behavior factor. Due to theoretical considerations, and because both loaded above 0.30 in the PCA, compulsive PC/Internet use was included in both factor 2 as well as in factor 3 and excessive PC/Internet use and excessively watching TV were also both included in two different factors (further elaboration upon these choices is presented in the Discussion).

Two-step cluster analysis

Four clusters were deducted from the Two-step Cluster Analysis (TCA); details are presented in Table 4. Cluster 1 presented the healthiest cluster with the most positive scores in terms of both health behaviors as well as health outcomes. These students were characterized by an average score with regard to sedentary behavior and a low score (i.e. healthy/positive score) on the other three behavioral pattern component scores. This "healthy cluster" was characterized by an average socio-economic status, a mix of different school levels, being of a native Dutch ethnicity and being girls.

Cluster 2 and 4 were also relatively healthy behaving students but differed in certain aspects from cluster 1. First, cluster 2 had a slightly higher socio-economic status than cluster 1 and consisted only of boys. Also, they presented unhealthier behavior than students of cluster 1 with regard to problematic screen time use (factor 3) and risk-prone behavior (factor 1, although they did not score above average on this factor). Cluster 2 also showed healthier behavior with regard to sedentary behavior (factor 4) compared to cluster 1. Furthermore, similar to cluster 1, cluster 2 was also characterized by positive scores on all three health outcomes.

Cluster 4 was similar to the other two "healthy" clusters in terms of scoring positive health outcomes and relatively healthy behavior in terms of risk-prone behavior (factor 1) and bully behavior (factor 2) as well as scoring average on sedentary behavior (factor 4). Typical for cluster 4 was that those students were of a non-Dutch ethnicity, had a low socio-economic status, and consisted of a mix of boys and girls.

Finally, cluster 3 differed from all other clusters. Cluster 3 contained the unhealthiest scores on all four behavioral patterns, as well as the unhealthiest outcomes, namely a high BMI, a problematic SDQ and GSE score. This cluster comprised of students from all ethnicities, an average socio-economic status and school level and consisted of both boys and girls.

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Table 4 Clusters of health behaviors, health outcomes and demographics, formed by Two Step Cluster Analysis (N = 2.690)

	Cluster 1 (35.6%)	Cluster 2 (26.4%)	Cluster 3 (19.8%)	Cluster 4 (18.3%)
Demographics characteristics				
Gender	Girl (100%)	Boys (100%)	Mixed (58% Girls)	Mixed (58% Girls)
Age	13.6 years	13.7 years	14.0 years	13.6 years
SES (FAS score) ¹	Normal to High (7.27)	High (7.50)	Normal (6.98)	Low (6.38)
School level	Average / Mixed	Average / Mixed	Average / Mixed	Average / Mixed
Ethnicity	Native Dutch (100%)	Native Dutch	Mixed (81% Native Dutch)	Non- native Dutch
Health behaviors^{2,3}				
Factor 1: Risk-prone behavior	Low (-0.16)	Normal (0.09)	High (0.48)	Low (-0.24)
Factor 2: Bully behavior	Low (-0.12)	Low (-0.20)	High (0.60)	Low (-0.19)
Factor 3: Problematic screen time use	Low (-0.39)	High (0.26)	High (0.29)	Normal (0.02)
Factor 4: Sedentary behavior	Normal (-0.06)	Low (-0.20)	High (0.18)	High (0.27)
Health outcomes				
Weight status	Normal BMI	Normal BMI	High BMI	Normal to High BMI
Self-efficacy problems	Normal GSE (100%)	Normal GSE (100%)	Problematic GSE (32%)	Normal GSE (100%)
Psychosocial problems	Normal SDQ (100%)	Normal SDQ (100%)	Problematic SDQ (71%)	Normal SDQ (100%)

1: Indications of low, medium and high are indicative of a relatively low, medium or high socioeconomic status in this particular sample of adolescents; **2:** A low score on a lifestyle factor score indicates less exertion of such behavior; **3:** All Factors are standardized regression scores with a mean of 0 and a standard deviation of 1.

Discussion

This study aimed to identify clustering of a comprehensive number of health-related behaviors in adolescents, and to identify groups of adolescents with similar behavior and health outcomes. Four distinct behavioral patterns were found, namely 1) risk-prone behavior, consisting of high/unhealthy scores with regard to smoking, alcohol use, drug use and being sexually active, 2) bully behavior, consisting of significant factor loadings from the variables of bullying, being bullied and compulsive internet use, 3) problematic screen time behavior, meaning a high/unhealthy score regarding compulsive and excessive screen time use, and 4) sedentary behavior, i.e. excessive screen time use combined with poor physical exercise and nutritional habits.

After integrating these behavioral patterns together with several demographic factors and health-related outcomes, four clusters of adolescents were distinguished. One cluster was dominantly the healthy cluster, in which all behavioral pattern scores were all relatively most healthy as well as their situation on account of the health-related outcomes. These students were native Dutch girls from a mix of different socio-economic status and school levels. Two other clusters (cluster 2 and 4) differed only slightly from the healthy cluster. Cluster 2 included native Dutch boys, with unhealthy scores on the problematic screen time behavior factor, and average instead of low scores on the risk-prone behavior factor. They also showed positive health-related outcomes. Cluster 4 consisted only of adolescents of non-Dutch ethnicity, mostly with a low socio-economic status, and consisting of a mix of boys and girls. The only behavior pattern in which they scored poorly (i.e. unhealthy) was sedentary behavior (factor 4). Being overweight was also a characteristic of this cluster. Cluster 3 showed strong clustering of both negative health-related outcomes and unhealthy scores on all behavioral patterns, independent of demographic factors.

Behavioral factors

Smoking, alcohol use, drug use and sex. The first deduced distinct behavioral pattern that was the risk-prone behavior factor. The individual behaviors that made up this factor (or pattern) were marihuana use, smoking, alcohol use and sexual activity. Of all studied behaviors these four all seem to present a norm-deviating behavior and therefore the factor was named risk-prone behavior. Their correlation is in accordance with previous research, which has mostly focused on these behaviors out of all those that were studied in the current research. Van Nieuwenhuizen et al. for example also showed a strong correlation of substance use related behaviors and sexual behavior with factor analysis techniques, yet due to the different scope of included behaviors these results were only partly comparable to those of the current study.¹² No major differences in behavioral patterns from the study of Van Nieuwenhuizen or other previous studies were found.^{9,12-15,48,49}

Bully behavior. Secondly, being bullied and being a perpetrator of bullying formed a behavioral component in the PCA. Compulsive Internet use also loaded significantly on this factor. Despite the fact that this behavior loaded stronger on another factor (namely on factor 3), it was included in this bully behavior factor also, due to theoretical considerations, since previous research also reported on the relationship between the internet use of adolescents and their bully behavior.⁵⁰ Compulsive screen time use when being bullied could possibly indicate a kind of 'flight behavior' to a relative anonymous online environment in which one would feel safer. Thus, in this context compulsive screen time use seems to be part of a distinctly different overarching behavior than in factor 3 (discussed below). Therefore, it was included in two different factors, as is common practice in factor analyses when theoretical considerations are taken into account instead of merely looking at statistical considerations.⁴⁵ However, it has to be taken into consideration that such a theory is relative speculation due to the few comparable other studies on the topic.

Furthermore, the subsequent TCA confirmed their relationship to General Self-Efficacy and psychosocial problems. Students that scored worst on, among other unhealthy behavioral scores, bullying/being bullied also reported the worst psychosocial and GSE outcomes.

Excessive versus compulsive screen time. In the current study screen time behavior consisted of two aspects, namely excessive and compulsive screen time behaviors. Although these showed to be strongly inter-related (forming a separate behavioral pattern, i.e. factor 3) the associations of excessive and compulsive screen time behaviors to problematic health-related outcomes differed. Excessive screen time was significantly related to being overweight (Cluster 4, Table 3), while compulsive screen time was significantly more prevalent among students that also indicated psychosocial problems, problems with GSE and behaviors such as bullying/being bullied (behavioral factor 2) and risk-prone behaviors (behavioral factor 1) (Table 3). The findings related to excessive screen time behavior were in accordance with previous studies^{18,19,49,51}. However, similar clustering studies that integrated the compulsive aspect of these behaviors in adolescents were not retrieved, although previous research has shown that, separately, compulsive and excessive screen time behaviors differ in their relation to outcomes such as psychosocial problems⁵², educational outcomes⁵³ or physical health indicators.²⁴ Therefore, based on these theoretical considerations, compulsive and excessive screen time behaviors were included in more than one behavioral factor (Table 2).

Screen time, physical exercise and eating habits. The fourth behavioral pattern was the so-called sedentary behavior factor. Scoring high on this factor meant that students reported more excessive screen time as well as low levels of physical exercise and unhealthy nutrition habits. Previous studies showed this clustering of nutrition and exercise^{11,14,17,18}, but relatively few also integrated screen time use. Studies that did

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Showed relatively similar cluster patterns.^{16,28,51} The current study shows that the more hours teens spend on watching television, using the internet and playing videogames, the less time they spend on physical exercise and the poorer they eat. Thus, for public health practice this would mean that solely focusing on e.g. weight reduction via attention for more sports participation and healthier nutrition seems inadequate. The screen time behavior of the children and adolescents of our digital age seems an inescapable phenomenon that has to be integrated in health promotion practices.

Clustering of health behavior with health outcomes and demographic factors

After deducing the overarching factors/behaviors from the individual behaviors, several noteworthy results were found in the subsequent TCA. Firstly, as expected from the literature, being overweight was significantly related to behavioral factor 4 (sedentary behavior). Poorer scores on this behavioral pattern was one of the few aspects in which clusters 2 and 4 differed from one another, together with non-Dutch ethnicity and the higher correlation to being overweight of cluster 4.

Secondly, the TCA revealed that poor scores on multiple behavioral patterns and poor health outcomes clustered within the same students. This was in accordance with previous comparable studies that showed that more problematic behaviors led to, or were associated with, poorer health outcomes.^{3,4,8,13,17} Also, the clustering of compulsive screen time and bully behavior with psychosocial problems and low GSE is in line with other literature.⁵⁴⁻⁵⁶

Furthermore, boys seem to exert unhealthier behavior than girls in comparable groups when reviewing cluster 1 versus cluster 2, especially with regard to risk-prone behavior and problematic screen time use. This is in line with the theory and findings of the meta-analysis of Byrnes, Miller and Schafer of over 150 studies on the subject that revealed a higher prevalence of risky behavior among males than females.⁵⁷

Finally, the clustering of health-related behaviors and -outcomes showed to be independent of demographic factors socio-economic status, gender, ethnicity and school level. This is a finding that would indicate that unhealthy behavior is the main indicator for subsequent poor health-related outcomes and that demographic factors have only a minor influence on this. This is not in accordance with several previous studies that indicated a significant effect of, especially, socio-economic status. It was difficult to assess whether the lack of clustering with socio-economic status in the current study could be specific to the study sample, due to the relatively minor variations in socio-economic status among Dutch adolescents in comparison to those in other countries.

Strengths and weaknesses

A strength of the current study was that we took into account a broad range of health-related behaviors that were previously not examined simultaneously in such a way. Many previous studies focused on subsets of these behaviors. Also, the use of validated

questionnaires is an important strength of this study. Last, the response rate of 79.8% was a respectable one. The fact that certain students did not fill out the questionnaire was mostly attributable to teachers not presenting the questionnaire to their class; the indicated reasons for this were interfering schedules or that it was forgotten by the teacher. Therefore, non-response bias can be assumed to be minimal.

A limitation is the lack of integrating a multilevel structure in the factor and cluster analyses. For more optimal estimates a multilevel approach is preferred, although such approaches are still in their infancy.⁵⁸ However, given the strong factor loadings and strong effects that were found, it is highly unlikely that the impact of integrating a multilevel structure would have significantly changed them. Such effects are especially to be expected and relevant when the variables that are dealt with are cross-level latent constructs.⁵⁸⁻⁶⁰ This means that if one were to measure higher level constructs (e.g. school climate) via individual level measurements, a multilevel approach would be more likely to be beneficial. However, this was not the case in the current study and therefore such approaches were less relevant. A second limitation of the current study is its cross-sectional design, which inhibits establishing any causal relations. Also, this study used a sample of young adolescents from the Netherlands, which is no guarantee for generalization to other countries. Especially the relatively limited variation with respect to socio-economic might limit the possibility for generalization of some results.

Conclusions

The results show that health-related behaviors tend to cluster, indicating that specific behavioral patterns underlie individual health behaviors. This resulted in the deduction of four distinct behavioral patterns, namely 1) Risk-prone behavior (alcohol and drug use, smoking and early sexual activity), 2) Bully behavior (bullying, being bullied and compulsive Internet use), 3) Problematic screen time use (excessively watching television and compulsively and excessively playing video games and using the Internet), and 4) Sedentary behavior (low physical exercise, poor nutritional habits and excessively watching television, playing videogames and using the Internet). Subsequently, four clusters of adolescents were identified; multi-problem behavior was associated with problematic physical and psychosocial health outcomes, as opposed to those exerting relatively few unhealthy behaviors. These associations were relatively independent of demographics such as ethnicity, gender and socio-economic status. Overall, this study adds to the current knowledge on how health behaviors cluster within individuals and that certain combinations of behaviors can be used to target high-risk individuals, which were shown to be of significantly higher risk of poorer physical and psychosocial health outcomes.

Additionally, the findings of this study have significant implications for future school-based prevention programs. As Wiefferink et al. suggested, such knowledge on health behavioral clustering can be used to design more effective and feasible school based

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interventions using Transfer-oriented Learning.⁶¹ Transfer-oriented Learning is said to take place when students apply independently and flexibly what they have learned in a context different to that in which they learned it.⁶¹ This means for example that, if resisting peer pressure would be an important tool to prevent youth from starting smoking, such a skill can also be learnt to be applied in a different context, e.g. when teaching students to resist drug use or to partake in unprotected sex; certain common determinants can be transferred to teachings on different topics. Although a specific behavioral context is still needed to teach knowledge, attitudes and skills, Transfer-oriented Learning does facilitate more feasible school based interventions, because topics can be integrated, which lightens the load on the curriculum. Also, it would increase the outreach that school based interventions could have when multiple behaviors are targeted simultaneously. Given these developments, it is a positive development to see school based interventions move towards a comprehensive, whole school approach that would facilitate a clustered approach to improving health behaviors among children and adolescents.³⁰ To improve upon current practices in this area, research on the clustering of health behaviors is vital, since it is necessary to identify common determinants across different types of health behaviors. This study therefore adds significantly to the current knowledge.

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ABSTRACT

Background

Several unhealthy behaviors are associated with psychosocial health in adolescents. Previous studies have shown that different adolescent health behaviors cluster, and in order to understand these associations, it is important to investigate the relations between individual behaviors and psychosocial problems.

Purpose

This study addressed the research question "Are adolescent health behaviors associated with psychosocial problems and to what extent do certain health behaviors confound the relations between other health behaviors and psychosocial problems in adolescents?"

Methods

Self-reported questionnaire data on a broad range of health behaviors and demographics were collected from 2.690 high school students in the Netherlands in September 2012.

Results

After adjustment for demographic characteristics, nearly all unhealthy behaviors were found to be significantly associated with psychosocial problems. However, after correction for confounding by other behaviors, psychosocial problems were associated with fewer behaviors, namely, compulsive internet use and videogame playing, smoking, cannabis use, and being bullied. These associations differed in boys and girls.

Conclusions

In multibehavioral analyses adjusted for behavioral clustering, which can cause considerable inter-behavioral confounding, several behaviors were associated with psychosocial problems in adolescents. This approach to behavior analysis provides a better insight into behaviors and psychosocial health, and the specific associations identified can be utilized when designing effective prevention programs, such as Health Promoting School interventions.

Introduction

Despite considerable efforts to promote health and healthy lifestyles, unhealthy behaviors remain a major cause of morbidity and mortality worldwide.¹ Several studies have investigated the associations between various unhealthy behaviors and physical or psychosocial health²⁻⁵, and in addition to traditional health-related behaviors, such as nutrition, physical activity, and substance use, “new” behaviors such as bullying^{3,6}, internet use⁷⁻⁹, and videogame playing^{4,10}, are becoming increasingly common among adolescents.

It is recognized that adolescent health behaviors cluster/co-occur, which has contributed to the growing complexity and comprehensiveness of adolescent health behavior interventions and studies.¹¹⁻¹³ This, in turn, has prompted the call to focus health promotion efforts on multiple health-related behaviors simultaneously.¹⁴⁻¹⁷ However, to date, most research on adolescents' psychosocial health has focused on its association with a single (or a small subset of) health behavior(s). Given the clustering of various health behaviors, it is likely that certain confounding effects have been overlooked in the past, which might have led to incorrect estimates of the associations between health behaviors and health outcomes and/or intervention effects. For this reason, the current study investigated the associations between a broad spectrum of health-related behaviors and psychosocial problems in adolescents, using multibehavioral analyses, and quantified the potential confounding effects, due to clustering, that different health behaviors may have on each other's association with psychosocial problems. This study thus addressed the research question “*Are adolescent health behaviors associated with psychosocial problems and to what extent do certain health behaviors confound the relations between other health behaviors and psychosocial problems in adolescents?*”

Methods

Sample and procedures

Self-report questionnaires were used to collect data and were completed individually in class, at the start of the school year in September 2012 at five Dutch high schools. These schools were part of a convenience sample and participated out of interest; no schools received financial or other incentives for participation. All were assisted with the questionnaire procedures by the research team. Students could complete the questionnaires voluntarily and anonymously. Data cleaning was performed, such that when 50% or more of the data were missing, the participant was deleted from the study. In addition, if answers were contradictory and/or unreliable for at least three main questionnaire topics (e.g., nutrition, alcohol use, physical activity), the entire case was deleted from the data analyses. Data cleaning resulted in usable questionnaires for over 95% of the participants. Data imputation was not used.

Measures

Survey items and their operationalization were similar to those of the Dutch Health Behavior in School-aged Children (HBSC) survey regarding the measurement of students' demographics, health behaviors, and psychosocial problems.¹⁸ The operationalization of the measures is shown in Table 1. "Recent behavior" concerned behavior in the month prior to questionnaire completion. Items that were not measured as indicated in the international HBSC survey are highlighted below. The sociodemographic variables were chosen as being most relevant to adolescent health behaviors, namely, gender, age, socioeconomic status (SES), ethnicity, and educational level.¹⁸ The main ethnic subgroups in the Netherlands are Dutch, Surinamese, Moroccan, Turkish, from the Dutch Antilles, or 'Other'. This variable may be of importance due to the significant differences across these subgroups in The Netherlands in terms of both health behavior as well as health status on outcomes such as psychosocial well-being and overweight. Furthermore, the factor of educational level was included due to differing health behavior patterns among students of different educational levels in general.

Bullying. Bully behavior was measured by items based on the Olweus Bully Score and the Olweus Bully Victim Score.¹⁹ These scores distinguish between bullies and bullied children from non-bullies and non-bullied children with a cut-off of "2 to 3 times a month". These measures have been validated previously.¹⁹

Physical activity and nutrition. Healthy exercise behavior was defined as at least 1 hour of moderately intensive physical activity at least twice a week, with a view to improving or maintaining physical fitness.¹⁸ Healthy eating habits were defined as a composite score of having breakfast and eating fruit and vegetables at least five times a week.¹⁸ Both measures are commonly used in the Netherlands.

Screen time. This concerns watching TV, using the internet, and playing videogames. Internet use was defined as use of internet for non-school-related purposes. Videogame playing was defined as (online) gaming on a game console such as the X-Box or PlayStation. The time spent playing and playing compulsiveness were measured separately. Spending more than 2 hours per day on screen-time behaviors was defined as "excessive" use, in accordance with the literature.^{18,20} The compulsiveness of a person's screen-time behavior was measured with the Compulsive Internet Use Scale (CIUS) for compulsive internet use²¹ and by the Videogame Addiction Test (VAT) for compulsive videogame playing.²² The VAT and CIUS both consist of 14 questions scored on a 5-point Likert scale and were used to evaluate compulsive videogame playing and compulsive internet use, respectively. A score higher than 3.0 points indicates compulsive behavior.

Psychosocial problems. Psychosocial problems were measured with the Strengths and Difficulties Questionnaire (SDQ)²³, which measures emotional problems, inattention-

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hyperactivity, peer problems, conduct problems, and prosocial behavior.²³ Subscales for emotional problems, hyperactivity, peer problems, and conduct problems are composed of 20 items scored on a 3-point Likert-scale (0= "not true", 1="somewhat true" or 2="certainly true") and add up to a total SDQ-score of maximum 40 points. A score of 0-19 points is considered a "normal" score, whereas a score higher than 19 is categorized as "(potentially) problematic".²³ The SDQ is a validated, reliable instrument for the population at interest in the current study.²³

Table 1 The operationalization of the studied health behaviors and health indicators (N=2.690).

Variable	Item	Operationalization	Label
Cannabis Use ¹⁸	Have you ever used cannabis?	0) No, 1) Yes	>0
	Have you recently (in the last 4 weeks) used cannabis?	0) No, 1) Yes	>0
Alcohol use ¹⁸	Have you ever drunk alcohol?	0) No, 1) Yes	>0
	Have you recently drunk alcohol?	0) No, 1) Yes	>0
	How many days a week do you drink alcohol?	Number a day	0-7
	How many glasses, cans or bottles of alcohol do you drink a day?	Number a day	1- >10
Binge drinking ¹⁸	How often in the last 4 weeks have you had more than 4 alcoholic beverages on one occasion?	Number of times, from "Never" to "9 or more"	>0
Smoking ¹⁸	Have you ever smoked a cigarette?	0) No, 1) Yes	>0
	Have you recently smoked a cigarette?	0) No, 1) Yes	>0
	How many cigarettes do you smoke per week?	Categories advancing 10 per category,"0-10" to "70 or more"	0-7
Nutrition ¹⁸	How often do you have breakfast per week?	Number of days	0-7
	How often do you eat vegetables per week?	Number of days	0-7
	How often do you eat fruits per week?	Number of days	0-7
Physical exercise ¹⁸	How do you travel to school usually?	0) By bike, 1) Walking, 2) Else	<2
	How long does it take you to walk or bike to school (one-way trip)?	Number of mins	-
	How many hours of gym class do you have at school each week?	Categories ranging from "0" to "4".	0-4
	Are you a member at a sports club?	0) No, 1) Yes	>0
	How many hours a week do you spend at your sports club?	Number of hours	-
	How many hours a week do you spend on other sports related activities than previously addressed?	Number of hours	-
Watching TV ¹⁸	How many days a week do you watch TV?	Number of days	0-7

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	How many hours a day do you watch TV?	0) Less than 30 mins, 1) 30 mins – 1 hour, 2) 1-2 hours, 3) 2-3 hours, 4) >3 hours	0-4
Using the internet/PC ¹⁸	How many days per week do you use the internet/PC (not for school purposes)?	Number of days	0-7
	How many hours a day do you use the internet/PC (not for school purposes)	0) Less than 30 mins, 1) 30 mins – 1 hour, 2) 1-2 hours, 3) 2-3 hours, 4) >3 hours	0-4
Videogame playing ¹⁸	How many days a week do you play videogames on a game console?	Number of days	0-7
	How many hours a day do you play videogames on a game console?	0) Less than 30 mins, 1) 30 mins – 1 hour, 2) 1-2 hours, 3) 2-3 hours, 4) >3 hours	0-4
Compulsive internet use ²¹	Compulsive Internet Use Scale (CIUS) E.g. Do you rather spend time on the internet than spending time with others? (total: 14 items)	0) Never, 1) Rarely, 2) Sometimes, 3) Often, 4) Very often	0-4
Compulsive videogame playing ²²	Videogame Addiction Test (VAT) E.g. Do you rather spend time playing videogames than spending time with others? (total: 14 items)	0) Never, 1) Rarely, 2) Sometimes, 3) Often, 4) Very often	0-4
Bullying ¹⁹	In the last 3 months, how often have you bullied someone?	0) Never, 1) Less than twice a month, 2) Two to three times a month, 3) At least once a week, 4) multiple times a week	0-4
Being bullied ¹⁹	In the last 3 months, how often have you been bullied?	0) Never, 1) Less than twice a month, 2) Two to three times a month, 3) At least once a week, 4) multiple times a week	0-4
Body Mass Index ¹⁸	How tall are you (no shoes)?	Number of cm	-
	What do you weigh?	Number of kg	0-4
Psychosocial problems ¹⁸	Strengths and Difficulties Questionnaire (SDQ). E.g. I am easily distracted, I find it difficult to focus (total: 20 items)	0) Not true, 1) A little true, 2) Very true	0-4

Data analysis

Logistic regression analyses were performed to determine the associations between different health behaviors and psychosocial problems. In unadjusted analyses, potential associations were controlled for confounding by age, SES, education level, school, and ethnicity. In adjusted analyses, the association between health behaviors and psychosocial problems was evaluated in a multibehavioral regression model in which relevant health behaviors identified in the unadjusted analyses were incorporated simultaneously. The differences between the associations in the unadjusted and

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adjusted analyses can be interpreted as the effect of confounding as a result of clustering of various behaviors.

Odds ratios with their 95% confidence intervals are presented. All statistical analyses were performed using the Enter Method logistic regression in SPSS V20.

Gender stratification. During adolescence, girls and boys behave quite differently when it comes to risky behaviors.²⁴ For this reason, analyses were conducted separately, to identify potential differences in health-related behaviors and psychosocial problems in teenage boys and girls.

Table 2 Student Characteristics (N=2.690)

Demographics and behavioral characteristics of the participating students	N (%)
11-12	648 (24.1)
13-14	1.300 (48.4)
15-16	639 (23.8)
17-18	102 (3.8)
Mean in years	13.68 (SD 1.45)
Socioeconomic status (FAS score) ¹	7.13 (SD 1.49)
Low (0-2) – Medium (3-5)	393 (14.6)
High (6-9)	2.297 (85.4)
Watching TV (>14 h/week)	549 (21.0)
Internet use (>14 h/week)	730 (27.1)
Video game playing (>14 h/week)	186 (6.9)
Compulsive Internet users (CIU) ²	94 (3.5)
Compulsive video game players (CVP) ³	108 (4.0)
Being bullied	124 (4.7)
Bullying	77 (2.9)
Alcohol user	702 (26.1)
Binge drinker	477 (19.6)
Marijuana user	170 (6.3)
Smoker	231 (8.6)
Meeting the Dutch norm healthy physical activity ⁴	1.974 (73.6)
Meeting the Dutch norm healthy nutrition ⁵	1.186 (44.1)
Mean Strengths and Difficulties Questionnaire (SDQ) score	10.07 (SD 5.30)
Psychosocial problems (potentially) present (SDQ>15.0)	378 (14.1)

1: **FAS** = Family Affluence Scale; 2: **CIU** = Compulsive Internet Use Scale Score >3.0 (range 0-4); 3: **CVP** = Videogame Addiction Test Score >3.0 (range 0-4); 4: **Dutch Norm Healthy Physical Activity**: at least 1 hour of moderately intensive physical activity at least twice a week, with a view to improving or maintaining physical fitness; 5:**Dutch Norm Healthy Nutrition**: at least having breakfast, eating fruit and vegetables 5 times per week.

Results

The Utrecht Healthy School survey 2012-2013 was completed by 2.690 students. The students' demographics and health behavior characteristics are presented in Table 2. Their educational level and ethnic composition were comparable to those of the Dutch adolescent population, but their SES was somewhat higher.¹⁸ In the unadjusted analyses, binge drinking, smoking, excessive and compulsive gaming and internet use, bullying, and being bullied were associated with psychosocial health in boys (Table 3), and smoking, using cannabis, bullying, being bullied, compulsive and excessive internet use, unhealthy nutrition, and insufficient physical exercise in girls (Table 4). In the adjusted analyses that incorporated these health behaviors, smoking (odds ratio (OR) 2.168, 95% CI 1.253-3.749), compulsive videogame playing (OR 3.630, 95% CI 2.050-6.428), and being bullied (OR 2.886, 95% CI 1.452-5.733) were significantly associated with psychosocial problems in boys (see Table 3), and using cannabis (OR 3.041, 95% CI 1.506-6.139), being bullied (OR 8.102, 95% CI 4.603-14.260), compulsive and excessive internet use (respectively OR 5.203, 95% CI 2.555-10.596 and OR 1.671, 95% CI 1.151-2.425), unhealthy nutrition (OR 1.759, 95% CI 1.462-2.314), and insufficient physical exercise (OR 1.791, 95% CI 1.416-2.710) in girls (see Table 4).

Table 3 Odds ratios with 95% confidence intervals of the associations between health behaviors and psychosocial problems in adolescent boys.

Health behaviors	Psychosocial problems (OR (CI 95%))	
	Unadjusted	Adjusted ¹
Marijuana use	1.541 (0.885-2.684)	Not included
Binge drinking	1.728 (1.144-2.609)**	1.284 (0.799-2.063)
Smoking	2.617 (1.622-4.222)**	2.168 (1.253-3.749)**
Excessive TV (>2 h/day)	1.356 (0.924-1.990)	Not included ¹
Excessive PC use (>2 h/day)	1.569 (1.105-2.227)**	1.337 (0.897-1.993)
Excessive gaming (>2 h/day)	1.771 (1.157-2.712)**	1.066 (0.631-1.800)
CVP ¹	5.524 (3.521-8.667)**	3.630 (2.050-6.428)**
CIU ²	7.017 (3.722-13.227)**	1.909 (0.865-4.212)
Bullying	2.373 (1.246-4.520)**	1.393 (0.665-2.921)
Being bullied	4.554 (2.484-8.351)**	2.886 (1.452-5.733)**
Unhealthy nutrition ³	2.331 (0.679-3.991)	Not included
Insufficient physical exercise ⁴	3.642 (0.428-6.586)	Not included

Note: All results were adjusted for gender, age, school, education level, ethnicity, and socioeconomic status. The "Adjusted" analyses are the estimates of the association between different health behaviors and psychosocial problems, with adjustment for the other measured behaviors that were significantly associated with psychosocial problems in the "Unadjusted" analyses.* p ≤ 0.05 level, ** p ≤ 0.01.

1: CVP = Videogame Addiction Test Score > 3.0, (range 0-4); **2:** CIU = Compulsive Internet Use Scale Score > 3.0, (range 0-4); **3: Dutch Norm Healthy Nutrition:** at least having breakfast, eating fruit and vegetables 5 times/week; **4: Dutch Norm Healthy Physical Activity:** at least 1 hour of moderately intensive physical activity at least twice/week, to improve or maintain physical fitness.

Table 4 Odds ratios with 95% confidence intervals of the associations between health behaviors and psychosocial problems in adolescent girls.

Health behaviors	Psychosocial problems (OR (CI 95%))	
	Unadjusted	Adjusted ¹
Marijuana use	4.215 (2.389-7.437)**	3.041 (1.506-6.139)**
Binge drinking	1.783 (1.179-2.697)**	1.093 (0.659-1.813)
Smoking	2.729 (1.719-4.333)**	1.570 (0.857-2.878)
Excessive TV (>2 h/day)	1.061 (0.726-1.550)	Not included ¹
Excessive PC use (>2 h/day)	2.088 (1.497-2.913)**	1.671 (1.151-2.425)**
Excessive gaming (>2 h/day)	1.304 (0.438-3.877)	Not included
CVP ²	Not applicable ⁶	Not included
CIU ³	5.888 (3.115-11.126)**	5.203 (2.555-10.596)**
Bullying	2.648 (1.100-6.373)*	1.583 (0.595-4.213)
Being bullied	7.375 (4.264-12.757)**	8.102 (4.603-14.260)**
Unhealthy nutrition ⁴	1.857 (1.467-2.721)*	1.791 (1.416-2.710)*
Insufficient physical exercise ⁵	1.894 (1.557-2.514)*	1.759 (1.462-2.313)**

Note: All results were adjusted for gender, age, school, year of school, education level, ethnicity, and socioeconomic status. The "Adjusted" analyses comprise estimates of the odds ratios of the association between different health behaviors and psychosocial problems, while additionally adjusted for the other measured health behaviors that were significantly associated with psychosocial problems in the "Unadjusted" analyses.* p ≤ 0.05, ** p ≤ 0.01 level.

1: **CVP** = Videogame Addiction Test Score > 3.0, (range 0-4); **2:** **CIU** = Compulsive Internet Use Scale Score > 3.0, (range 0-4); **3:** **Dutch Norm Healthy Nutrition**: at least having breakfast, eating fruit and vegetables 5 times/week; **4:** **Dutch Norm Healthy Physical Activity**: at least 1 hour of moderately intensive physical activity at least twice/week, with a view to improving or maintaining physical fitness.

Discussion

To the best of our knowledge, this is one of the first studies to assess a broad spectrum of health behaviors in relation to psychosocial problems in adolescent boys and girls. Overall, adolescents with psychosocial problems reported being a victim of bullying more frequently, were more often compulsive internet users and videogame players, exercised insufficiently, had poorer eating habits, and smoked cigarettes and cannabis more frequently than those without psychosocial problems. There were marked gender differences in the health behaviors giving rise to psychosocial problems, as described below.

Previous studies reported similar results regarding associations between psychosocial problems and compulsive internet use^{10,25}, smoking^{26,27}, use of marihuana^{28,29}, and being bullied.^{3,30} However, whereas we found the remaining behaviors not to be associated with psychosocial problems after correction for other behaviors, other studies reported significant associations with e.g. alcohol use.^{31,32} This difference can be

explained by the fact that most of these previous studies focused on the association between single unhealthy behaviors and psychosocial problems or focused on a smaller subset of behaviors, such as screen time, nutrition, and physical activity³³ or a combination of only screen time-related behaviors²⁰, whereas we corrected for the effect that unhealthy behaviors have on each other in terms of the confounding of their associations with psychosocial problems. This approach makes it possible to estimate the association between certain health behaviors and psychosocial problems in the context of other health behaviors. In the unadjusted analyses, we found excessive television watching and internet/computer use to be associated with psychosocial problems, as reported by Page and colleagues.³³ However, after correction for confounding by other unhealthy behaviors, the association between alcohol use or excessive playing of videogames or internet use and psychosocial problems was no longer significant.

Unadjusted versus adjusted analyses

Comparison of the findings of the adjusted and unadjusted analyses demonstrates the potential for overestimating the effect sizes of associations. In the unadjusted analyses, almost all behaviors were significantly associated with psychosocial problems, mostly at the $p \leq 0.01$ level. However, the adjusted analyses showed that many of these associations could be attributed to the interrelatedness (or clustering) of many of the health behaviors investigated. For example, alcohol use and smoking were significantly associated with psychosocial problems in the unadjusted analyses, but only smoking was significantly associated with psychosocial problems in the adjusted analyses. Although most more recent studies have investigated groups of health behaviors, such as substance use (alcohol use, smoking and drug use) or sedentary time (videogame playing, television watching and internet/computer use), it remains relatively uncommon to carry out a cross-domain comprehensive behavior assessment, so that potential associations between behaviors and health problems are still often overestimated in the literature.

However, there are other explanations for the discrepant findings. Firstly, behaviors and psychosocial problems are not always measured in a similar fashion in the various studies, which makes it difficult to compare study findings. In addition, few studies investigated a similar set of unhealthy behaviors, which may have led to different estimates of the associations of certain behaviors with a certain health outcome. An important aspect, specifically with regard to our current study, is that adolescents do not have a static perception of how acceptable or risky behaviors are, which could influence the association between these behaviors and psychosocial problems. For example, in the Netherlands over 53% of 13-year-old children use alcohol, a proportion that increases up to over 85% in 16-year-old children.¹⁸ Although an unhealthy behavior, drinking is socially accepted among Dutch youth and may not be an appropriate indicator of psychosocial problems. The opposite might be true for smoking, which has a prevalence of 5-10% in children younger than 16 years and

becomes less socially acceptable as children get older.¹⁸ These societal trends might differ in other countries or even in areas and are vital to take into account when interpreting research findings.

Screen time behavior and psychosocial problems

Although relatively new in the field of health research, there is evidence that compulsive screen time use is associated with psychosocial problems.^{4,7,9,25,34,35} Most studies have shown that time spent behind screens and compulsive use have different effects on health outcomes. Studies of screen time mostly report associations with physical outcomes such as BMI^{5,36,37}, unhealthy nutritional habits^{38,39}, or reduced physical activity in adolescents^{40,41}, whereas studies that tackle compulsive or addictive use mostly report an increase in psychosocial problems.^{10,25,42,43} In our study, the average daily screen time was not associated with psychosocial problems after controlling for its compulsive component in the adjusted analyses, as also found in an earlier study.³⁹ This finding emphasizes the importance of multibehavioral adjusted analyses when studying health and behavioral problems in adolescents and the danger of overestimating effects when studying these relations in unadjusted analyses.

However, more research into the specific mechanisms and associations between screen time and adolescent psychosocial problems is needed and new, promising ideas are appearing in the literature. For example, the association between screen time-related behaviors and psychosocial problems may show a U-shaped relation^{44,45}, such that to a certain extent screen time may stimulate social behavior, but at a certain moment (duration/intensity) the behavior becomes problematic and is associated with psychosocial problems. The constant development of new programs/games/websites and the use of smart phones and tablets make it increasingly difficult to analyze screen-time behaviors and their related problems properly.

Boys and girls: a world of difference

More health-related behaviors were associated with psychosocial problems in girls than in boys, and the associations between behaviors and problems were also often stronger in girls than in boys. This difference may be due to the difference in what is considered risk-taking behaviors in girls and boys, as suggested by Byrnes et al.²⁴ Certain unhealthy behaviors, such as cannabis use or unhealthy eating habits, seemed to be indicative of psychosocial problems (or norm deviating behaviors) in girls much more than in boys, and this gender difference may be even pronounced for binge drinking and smoking. Alcohol use is increasing among young people and is considered quite normal by Dutch teenagers (e.g., more than 70% of the students indicated that they had used alcohol, even though their mean age was less than 15 years). The reason that binge drinking was significantly associated with psychosocial problems in the unadjusted analyses is probably due to its strong correlation with cannabis use and cigarette smoking. In the adjusted models, binge drinking was shown to be a

confounder for the effect of cannabis use and smoking. A similar phenomenon was observed with regard to smoking, which was significant in both boys and girls. Since smoking is less and less considered a "cool" or "normal" behavior, and its prevalence rates are decreasing among Dutch youth, it is considered a norm deviating (or problematic) behavior in both sexes. Cannabis use is considered to be more 'normal' among boys than among girls, as illustrated by its prevalence among boys being double that of girls. Thus its use seems to be more illustrative of problematic behavior in girls than in boys, and the results confirmed this.

Strengths and limitations

This study investigated a broad range of health-related behaviors and factors that might influence adolescents' psychosocial health, including behaviors that are relatively new, such as bullying/being bullied and different screen time-related behaviors. Although previous studies have focused on subsets of these behaviors, this study addressed a more comprehensive set of behaviors. Validated questionnaires were used to gather data on health behaviors and psychosocial problems. Potential study limitations are that data were self-reported and that the cross-sectional study design means that it is not possible to make inferences about causal relationships.

Suggestions for future research

Longitudinal research in which health behaviors are studied in the context of each other, is needed to be able to draw causal inferences about the influence of a range of health behaviors in adolescents and to gain a better understanding of underlying processes. These studies should also take related concepts, such as self-efficacy, resiliency, and self-confidence, into account in order to gain a better understanding of these associations.⁴⁶

Conclusion

Several health behaviors (smoking, marihuana use, nutrition, compulsive internet use and videogame playing, being bullied, and insufficient physical exercise) were associated with psychosocial problems in adolescents. As many health behaviors cluster in adolescents, we assessed the role of unhealthy behaviors in psychosocial problems using multibehavioral analyses, to avoid inter-behavioral confounding when these associations were analyzed per behavior. The findings present a strong case to integrate relatively novel behaviors, such as compulsive computer/internet use, videogame playing, and bullying, into health-promoting school interventions. Furthermore, the specific associations found in the multibehavioral analyses can be utilized to design effective prevention programs, such as Health Promoting School interventions.

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CHAPTER 4

Busch V, Manders LA*, de Leeuw JRJ. Screen Time Associated With Health Behaviors And Outcomes In Adolescents. Am J Health Behav. 2013;37(6):819-830.

* Vincent Busch and Lieke Manders are both the main authors of this article.



ABSTRACT

Objectives

Study the associations of screen time (Internet / video games / television) with health-related behaviors and outcomes in adolescents.

Methods

Regressions analyses were performed to assess the associations of screen time with several health-related behaviors and outcomes in 2.425 Dutch adolescents.

Results

Screen time was associated with bullying, being bullied, less physical activity, skipping school, alcohol use and unhealthy eating habits. Compulsive and excessive screen time were associated respectively with several psychosocial problems and being overweight.

Conclusions

Screen time was of significant importance to adolescent health. Behavioral interrelatedness caused significant confounding in the studied relations when behaviors were analyzed separately compared to a multi-behavioral approach, which speaks for more multi-behavioral analyses in future studies.

Introduction

With the advance of technology, time spent on television, Internet and video games is increasing among today's youth.¹⁻³ Television viewing, Internet use and video game playing are summarized by the term 'Screen Time'. As early as in 1983, it was claimed video game playing could become an addiction like any other behavioral addiction and the same was argued for excessive Internet use several years later.^{4,5} Although a formal medical diagnosis for video game addiction or Internet addiction is (still) lacking in current medical practice, discussions are on-going to add them to the future Diagnostic and Statistical Manual of Mental Disorders (DSM).^{2,5} In general, unhealthy screen time behavior is characterized by 2 aspects: 1- whether or not one spends an excessive amount of time on it and 2- whether or not the behavior is considered "compulsive".

The evidence increases that excessive and/or compulsive screen time behavior holds the potential to be harmful to one's health^{3,6,7}; recent studies provide support for this belief, e.g., in relation to obesity^{8,9} and several psychosocial and psychiatric problems, such as depression, lower self-efficacy and conduct disorder.¹⁰⁻¹² In particular, self-efficacy is an aspect receiving increasing attention among interventions in the field of adolescent health promotion, since it is believed to be a mediating variable in the causal path of unhealthy behavior and psychosocial problems in adolescents.^{13,14}

Furthermore, some literature suggests that unhealthy behaviors are associated with and influencing each other instead of existing independently. This raises interest for the probable associations of screen time behaviors in relation to each other and their possible associations with other unhealthy behaviors and health outcomes, which has relevance for future health promotion interventions.¹⁵⁻¹⁹

This study investigates how a range of known unhealthy behaviors and health outcomes are associated with several, relatively 'new' unhealthy screen time behaviors, in a sample of Dutch high school students. In this study these unhealthy behaviors consist of marijuana use, alcohol use, smoking, unsafe sex, skipping school, bullying, poor nutritional behavior and less physical exercise, in accordance with the Health Behavior in School-aged Children study (HBSC).²⁰ The health outcomes consist of students' psychosocial problems, being overweight and General Self-Efficacy (GSE).²¹ In order to demonstrate the confounding effects of the interrelatedness of the screen time behaviors in their relations with other unhealthy behaviors and health outcomes, these associations are presented with and without correcting for (possible) confounding by the remaining screen time behavior variables.

Thus, the associations of different screen time behaviors with a range of unhealthy behaviors as well as the noted health outcomes were quantified, while preventing the introduction of bias due to the screen time behaviors' interrelatedness and

demonstrating the importance of multi-behavioral analyses in adolescent health behavior research.

Methods

Sample

Data were collected from 5 Dutch high schools as part of the Utrecht Healthy School study ($N = 2,425$) (UHS)²²; the UHS pilot study school and its 4 sister schools from the UHS itself. These schools were part of a convenience sample of schools that were recruited for the UHS. All 5 schools participated out of intrinsic motivation and were not provided with funds or other incentives to participate. All were assisted with the questionnaire procedures by the research team. All are situated in suburban areas of middle-to-large cities in the Netherlands. Therefore, all 5 schools should be categorized as in-between rural and urban.

Survey procedures

The UHS questionnaire was completed independently by participants in classroom settings at the start of the school year in September. Survey procedures allowed students to participate voluntarily and anonymously. Prior to the survey, students were informed of the questionnaire's purpose and content by means of a newsletter. These points were repeated at the time of the survey by a message presented on the questionnaire and by the classroom teachers. The only students that did not complete the survey were the ones which were not present at the time of the survey (due to conflicting course schedules, according to their teachers) or ones absent on the day of the survey; the surveys were unannounced, so this should not have been a source of bias. Taking into account these 2 reasons for being absent, the response rate was over 95%. Data cleaning was performed in such a way that when 50% or more of the data was missing the participant was deleted from the study; also, when answers were contradictory and/or unreliable on account of at least 3 main questionnaire topics (e.g., nutrition, alcohol use, physical activity) the entire questionnaire was deleted from the data analyses. Data cleaning resulted in usable questionnaires of over 95% of the participants. No forms of data imputation were applied.

Measures

Screen time. Watching television, using the computer/Internet and playing video games will be referred to as "screen time behaviors". Internet use was defined as use of Internet for non-school-related purposes. Video game playing was defined as (online) gaming on a game console such as the X-Box or PlayStation. Game use did not include games with monetary awards or gambling. Both the time spent on watching television, using the Internet or playing video games as well as the compusiveness of these behaviors was measured. Spending more than 2 hours/day on screen time behaviors was defined as "excessive" use, in accordance with current standards in the literature.^{6,23} The compusiveness of someone's screen time behavior was measured by

the Compulsive Internet Use Scale (CIUS) for compulsive Internet use²⁴ and by the Videogame Addiction Test (VAT) for compulsive video game playing.²⁵ Both the VAT and CIUS consist of 14 questions with a 5-point Likert scale, used to evaluate compulsive behavior, respectively for compulsive video game playing (CVP) and compulsive Internet use (CIU). A score higher than 3.0 points indicates compulsive behavior. These binary measures for compulsive and excessive use were used in all presented analyses, since these are considered indicators of "problem behavior".

Definitions of the unhealthy behaviors and student demographics. Questionnaire items and operationalization were largely similar to the Dutch HBSC questionnaire and covered several health outcomes and a range of different health behaviors and socio-demographics²⁰ "Recent behavior" was defined as behavior in the month prior to completing the questionnaire. Questions on recent behavior were asked with regard to alcohol and marijuana use, smoking, bullying and unsafe sex. These measures were all dichotomous (0= did not recently exert a behavior, 1= did exerted a behavior recently). These questions on unhealthy behaviors were posed as in the HBSC, which means that binge drinking was regarded as more than 5 alcoholic beverages in a single occasion, and skipping school as >3 hours of disallowed absence from school in the recent month.²⁰

Also measured, but not a standard part of the international HBSC survey, were questions regarding bullying and being bullied, based on the Olweus Bully Score and the Olweus Bully Victim Score.²⁶ These scores distinguish bullies and bullied children from non-bullies and non-bullied children with a cut-off of "2 to 3 times a month" (0 = not bullied/bullying, 1 = bullied/bullying). In previous research Solberg and Olweus demonstrated these measures' validity and reliability in a comparable sample of adolescents. They stated that these scores allow for prevalence estimates of bullying and being bullied to be obtained conveniently, that they have a reasonably well-defined meaning and that they are easily and unambiguously understood by users and researchers. Thereafter, Kyriakides, Kaloyirou and Lindsay assessed its validity and reliability, concluding it to be a psychometrically sound measure for bullying prevalence among adolescents.²⁷

Furthermore, healthy physical exercise patterns were defined as the following dichotomous measure: at least one hour of moderately intensive physical activity every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness²⁰ (0= not sufficing, 1= sufficing). This measure is commonly used in The Netherlands and is known as the Norm Healthy Physical Exercise. Finally, for healthy nutrition another commonly used composite measure was used, Norm Healthy Nutrition (0= not sufficing, 1= sufficing), defined as a composite score of having breakfast, eating fruits and vegetables, all at least 5 times per week.²⁰

Health outcomes. Three indicators for adolescents' physical and psychosocial well-being were used as health outcome measures. Firstly, psychosocial problems, which

were measured by the Strengths and Difficulties Questionnaire (SDQ).²⁸ This scale is comprised of 5 subscales (emotional problems, conduct problems, hyperactivity, peer problems, and pro-social behavior). The total SDQ score is the sum of the scores on the first 4 subscales (maximum score of 40). A problematic total SDQ score was defined as a score higher than 15, indicating more psychosocial problems; this dichotomous measure was used in the analyses to refer to students either having a 'normal' (=0) or '(potentially) problematic' SDQ score (=1).

A binary measure of healthy weight was used by means of the Body Mass Index (BMI), corrected for age and sex, with appropriate cut-offs for adolescents, based on previous research.²⁰ This means that a different cut-off for a healthy BMI or being over- or underweight was used based on age and sex.

Due to the importance of self-esteem, social anxiety and assertiveness in adolescent development and psychosocial functioning, a composite measure of these concepts was integrated into the UHS survey; as in the literature this concept was referred to as "General self-efficacy" (GSE).²¹ GSE has a broad definition in the literature without clear consensus. For this study, Schwarzer's definition of GSE is applied to refer to the concept of how one describes his/her beliefs in their capabilities to practice control over challenging demands and functioning across different psychological domains. The functional domains investigated in the current study are self-esteem, social anxiety and assertiveness, assessed by a survey consisting of a combination of the Rosenberg Self Esteem Scale²⁹ and Schwarzer's Generalized Self-Efficacy Scale.³⁰ GSE is quantified here by a score based on a series of 11 questions on a 4-point Likert Scale to indicate one's beliefs in his/her capabilities to practice control over challenging demands and over their own functioning across the aforementioned domains. The cut-off value for a low/reduced GSE was defined as score of higher than 2.50, based on previous literature (0 = normal score, 1= problematic score).^{29,30}

Statistical analyses

To answer the first research question on how the unhealthy behaviors and health outcomes are associated with the relatively 'new' screen time behaviors, logistic regression analyses were conducted. The different screen time behaviors serve as independent variables whereas the other health behaviors are the dependent variables. Odds ratios (ORs) are presented with confidence intervals (CIs) at the 95% level. In the analyses, collinearity tests were performed for the different independent variables and all were non-significant. All OR's were controlled for confounding by sex, age, school, year of school, educational level, ethnicity and socioeconomic status (SES). The OR's were checked for interaction by sex. When significant sex interactions were present the analyses were further performed on a sex-stratified sample.

To answer the second research question both the so-called "single-screen time analyses" and a "multi-screen time analysis" were performed. In the single-screen time analyses the associations were analyzed with only one screen time behavior as

predicting variable together with the demographic factors. In the multi-screen time analysis the group of confounders in the regression analysis was expanded to also include the remaining screen time behaviors. The differences between the effect sizes (and their significance) of the associations of the screen time behaviors and the other health behaviors and outcomes in the single-screen time behavior analyses versus those in the multi-screen time behavior analysis can be interpreted as the effect of the confounding due to the screen time behaviors' clustering.

All statistical analyses were performed with SPSS version 17.0.

This study has been approved by the Institutional Review Board of the University Medical Center Utrecht, The Netherlands. METC-protocol number 11-397 / C.

Table 1 Student characteristics

		Boys N (%)	Girls N (%)	Total N (%)
Age in years	11-12	212 (19.7)	347 (25.8)	559 (23.0)
	13-14	497 (46.1)	593 (44.2)	1.091 (44.9)
	15-16	328 (30.4)	363 (27)	691 (28.4)
	17-18	40 (3.7)	40 (3.0)	88 (3.6)
Mean in years		13.7	13.9	13.8
Socio-economic status (FAS ¹ score)				
Low (0-2) – Medium (3-5)		174 (16.3)	260 (19.5)	435 (18.1)
High (6-9)		896 (83.7)	1.076 (80.5)	1.972 (81.9)
Watching TV (>14h/week)		271 (25.9)	324 (24.5)	595 (25.1)
Internet use (>14/week)		288 (27.3)	340 (25.5)	628 (26.3)
Video game playing (>14/week)		48 (4.6)	8 (0.6)	56 (2.3)
CIU ²		50 (4.7)	45 (3.4)	95 (4.0)
CVP ³		43 (4.8)	5 (0.7)	48 (2.9)
Being bullied		86 (8.4)	84 (6.4)	170 (7.0)
Bullying		57 (5.5)	32 (2.4)	89 (3.7)
Alcohol user		300 (27.8)	308 (22.9)	608 (25.1)
Binge drinker		215 (20.9)	209 (15.8)	424 (17.5)
Marijuana user		105 (9.7)	67 (5.0)	172 (7.1)
Smoker		133 (12.7)	124 (9.3)	257 (10.6)
Sufficing to Dutch Norm Healthy Physical Activity ⁴		829 (78.1)	865 (65.0)	1.694 (69.8)
Sufficing to Dutch Norm Healthy Nutrition ⁵		366 (34.3)	551 (41.3)	917 (37.8)

1: FAS = Family Affluence Scale; **2:** CIU = Compulsive Internet Use Scale Score >3.0 (range 0-4); **3:** CVP = Videogame Addiction Test Score >3.0 (range 0-4); **4:** Dutch Norm Healthy Physical Activity: "at least one hour of moderately intensive physical activity every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness"; **5:** Dutch Norm Healthy Nutrition: at least having breakfast, eating fruits and vegetables 5 times per week.

Results

Overall, 2,425 students completed the questionnaire, a response rate of over 95% was reached. Characteristics on socio-demographics and screen time behaviors are listed in Table 1. Approximately 45% were boys, 55% were girls and their average age was 14 years (range 11-18 years). Their educational level and ethnic composition is representative for a Dutch sample of adolescents. Students' socio-economic status (SES), was reported to be somewhat higher than that of their peers in The Netherlands.²⁰

In the following section, several different models are presented by topic. Firstly, the single-behavior regression analyses will be presented, comprised of individual screen time behavior and standard socio-demographic confounders per analysis. Second, these different single-behavior analyses are combined into one multi-screen time analysis.

Table 2 Odds ratios of the association of screen time behaviors with other unhealthy behaviors.

	Excessive Watching TV (>14h/week)	Excessive Internet Use (>14h/week)	Excessive Gaming (>14h/week)	CIU ¹	CVP ²
Recent marijuana use	1.64* (1.11-2.41)	1.40+ (0.98-2.00)	N.S.	1.95 + (0.96-3.95)	Boys: 3.12** (1.32-7.36) Girls: N.S.
Recent alcohol use	N.S. ³	1.68* (1.32-2.13)	N.S.	1.69 + (0.99-2.86)	2.02* (1.00-4.08)
Binge drinking ⁴	N.S.	1.46* (1.13-1.89)	N.S.	1.79* (1.02-3.12)	2.44* (1.20-4.98)
Regular smoking	N.S.	1.53* (1.14-2.05)	N.S.	N.S.	1.96 + (0.91-4.26)
Unsafe sex	N.S.	N.S.	N.S.	N.S.	N.S.
Skipping school	Girls: 3.79* (1.35-10.68)	1.73* (1.01-2.95)	Boys: 3.30* (1.06-10.27)	5.65** (2.64-12.08)	4.91** (2.01- 12.00)
Bullying	1.51* (1.09-2.09)	2.33** (1.74-3.13)	N.S.	2.95** (1.72-5.04)	4.27** (2.13-8.57)
Being bullied	N.S.	N.S.	N.S.	2.48** (1.36-4.53)	N.S.
Nutrition norm ⁵	1.36** (1.10-1.69)	Boys: 1.36* (1.00-1.86)	N.S.	5.35** (2.54-11.27)	6.64** (2.03- 21.72)
Exercise norm ⁶	1.32* (1.06-1.64)	1.61** (1.31-1.99)	N.S.	1.51 + (0.96-2.39)	N.S.

Note. All results were adjusted for sex, age, school, year of school, education level, ethnicity and socioeconomic status. +: .10 > p > .05; *: p ≤ .05; **: p ≤ .01.

1: CIU = Compulsive Internet Use Scale Score > 3.0, (range 0-4); **2: CVP** = Videogame Addiction Test Score > 3.0, (range 0-4); **3: N.S.** = Not Significant, $p > .10$; **4:** among drinkers; **5: Dutch Norm Healthy Nutrition:** at least having breakfast, eating fruits and vegetables 5 times per week; **6: Dutch Norm Healthy Physical Activity:** "at least one hour of moderately intensive physical activity every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness".

Screen time behaviors' associations with other unhealthy behaviors.

Table 2 presents the OR's of the single-screen time behavior analyses. These analyses concern the influence of screen time behaviors (independent variable) on 'classic' unhealthy behaviors (dependent variables). Furthermore, in Table 3 the results of the multi-screen time behavior analyses are presented. In contrast to the results presented in Table 2, the Table 3 results are corrected for confounding with regard to these additional screen time behavior variables. Thus, the associations between a certain unhealthy behavior (eg, binge drinking) with a certain screen time behavior (eg, excessive television watching), while correcting for the remaining screen time behaviors are shown in Table 3.

Excessive television watching. In the single-screen time analyses, excessive television watching was associated with recent marijuana use (OR 1.64, 95% CI 1.11-2.41), bullying (OR 1.51, 95% CI 1.09-2.09), poorer nutritional behaviors (OR 1.36, 95% CI 1.10-1.69) and being less physically active (OR 1.32, 95% CI 1.06-1.64). Watching television excessively was also associated with skipping school, but only for girls (OR 3.79, 95% CI 1.35-10.68); this association was not statistically significant for boys (see Table 4). When combining the screen time behaviors into one multi-screen time analysis, thereby accounting for any confounding due to their interrelatedness, excessive television watching was only weakly associated with skipping school among girls (OR 4.14, 95% CI 0.96-17.82, $0.05 \leq p < 0.10$); its previous associations to drug use, bullying, nutrition and physical exercise were no longer statistically significant (see Table 5).

Using the internet/PC excessively. Excessive Internet use was associated in the single-screen time analyses with recent alcohol use (OR 1.68, 95% CI 1.32-2.13), binge drinking (OR 1.46, 95% CI 1.13-1.89), regular smoking (OR 1.53, 95% CI 1.14-2.05), skipping school (OR 1.73, 95% CI 1.01-2.95), bullying (OR 2.33, 95% CI 1.74-3.13), poorer nutritional behaviors (in boys OR 1.36, 95% CI 1.00-1.86 and in girls OR 2.09, 95% CI 1.57-2.78) and less physical exercise (OR 1.61, 95% CI 1.31-1.99) (Table 2). In the multi-screen time analysis (Table 3) a variety of classic unhealthy behaviors were still associated with excessive Internet use: recent alcohol use (OR 1.51, 95% CI 1.09-2.08), bullying (OR 2.12, 95% CI 1.41-3.18) and less physical exercise (OR 1.77, 95% CI 1.34-2.34). For girls only, a significant association of excessive Internet use and poorer nutritional behaviors (OR 1.87, 95% CI 1.22-2.86) emerged. These findings were very similar to those of the single-screen time analyses, despite slightly smaller effect sizes/regression slopes.

Playing video games excessively. Skipping school was the only behavior that was significantly associated with excessive video game playing (OR 3.30, 95% CI 1.06-10.27) (Table 2). This association was only significant in boys. This association remained virtually the same in the multi-screen time analysis (OR 3.69, 95% CI 1.09-12.54) (Table 3).

Table 3 Multivariate regression analysis: odds ratios of the association of screen time behaviors with other unhealthy behaviors.

	Excessive Watching TV (>14h/week)	Excessive Internet Use (>14h/week)	Excessive Gaming (>14h/week)	CIU ¹	CVP ²
Recent marijuana use	N.S. ³	N.S.	N.S.	N.S.	Boys: 2.73 + (0.94-7.93) Girls: N.S.
Recent alcohol use	N.S.	1.51* (1.09-2.08)	N.S.	N.S.	N.S.
Binge drinking ⁴	N.S.	1.42 + (0.99-2.03)	N.S.	N.S.	N.S.
Regular smoking	N.S.	1.45 + (0.96-2.20)	N.S.	N.S.	N.S.
Unsafe sex	N.S.	N.S.	N.S.	N.S.	N.S.
Skipping school	Boys: N.S. Girls: 4.14+ (0.96-17.82)	N.S.	Boys: 3.69* (1.09-12.54) Girls: N.S.	4.16** (1.45-11.96)	N.S.
Bullying	N.S.	2.12 ** (1.41-3.18)	N.S.	N.S.	2.90* (1.22-6.89)
Being bullied	N.S.	N.S.	N.S.	3.22** (1.43-7.22)	N.S.
Nutrition norm ⁵	N.S.	Boys: N.S. Girls: 1.87** (1.22-2.86)	N.S.	5.79** (2.01-16.70)	3.51* (1.02-12.07)
Exercise norm ⁶	N.S.	1.77** (1.34-2.34)	N.S.	N.S.	N.S.

Note. All results were adjusted for sex, age, school, year of school, education level, ethnicity and socioeconomic status. +: $.10 > p > .05$; *: $p \leq .05$; **: $p \leq .01$.

1: CIU = Compulsive Internet Use Scale Score > 3.0, (range 0-4); **2: CVP** = Videogame Addiction Test Score > 3.0, (range 0-4); **3: N.S.** = Not Significant, $p > .10$; **4:** among drinkers; **5: Dutch Norm Healthy Nutrition:** at least having breakfast, eating fruits and vegetables 5 times per week; **6: Dutch Norm Healthy Physical Activity:** “at least one hour of moderately intensive physical activity every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness”.

Compulsive internet use. In the single-screen time analyses CIU was associated with binge drinking (OR 1.79, 95% CI 1.02-3.12), skipping school (OR 5.65, 95% CI 2.64-12.08), bullying (OR 2.95, 95% CI 1.72-5.04), being bullied (OR 2.48, 95% CI 1.36-4.53) and poorer nutritional behaviors (OR 5.35, 95% CI 2.54-11.27) (Table 2). Many of these associations were still present in the multi-screen time analysis. Here, CIU was significantly associated with skipping school (OR 4.16, 95% CI 1.45-11.96), being bullied (OR 3.22, 95% CI 1.43-7.22) and having poorer nutritional behaviors (OR 5.79, 95% CI 2.01-16.70), although the effect sizes/regression slopes somewhat different (Table 3).

Compulsive video game playing. Compulsive gamers were, in comparison to students that did not play video games compulsively, more likely to report recent alcohol use (OR 2.02, 95% CI 1.00-4.08), binge drinking (OR 2.44, 95% CI 1.20-4.98), skipping school (OR 4.91, 95% CI 2.01-12.00), bullying (OR 4.27, 95% CI 2.13-8.57) and having poorer nutritional behaviors (OR 6.64, 95% CI 2.03-21.72). For boys also an association with recent marijuana use was significant (OR 3.12, 95% CI 1.32-7.36) (Table 2). In the multi-screen time analysis CVP was significantly associated with bullying (OR 2.90, 95% CI 1.22-6.89) and having poorer nutritional behaviors (OR 3.51, 95% CI 1.02-12.07) (Table 3).

Screen time behaviors' associations with health outcomes.

In Table 4 the findings of the single-screen time behaviors' associations with the health outcomes psychosocial problems, being overweight and GSE are shown and in Table 5 the multi-screen time analyses of the associations of different screen time behaviors with those health outcomes.

Watching television excessively. In the single-screen time analyses excessively watching television was the only screen time behavior that was associated with being overweight (OR 1.77, 95% CI 1.31-2.40). Furthermore, excessively watching television was also associated with peer problems (OR 1.31, 95% CI 1.02-1.68), a problematic total SDQ score (OR 1.30, 95% CI 1.00-1.68), and for girls also with conduct problems (OR 1.95, 95% CI 1.27-3.00) (Table 4). In the comprehensive multi-screen time analysis being overweight was still significantly associated with excessively watching television (OR 1.71, 95% CI 1.17-2.51) and a statistical trend with regard to its association to conduct problems was found, but the remaining associations from the single-screen time analyses were insignificant in this analysis (Table 5).

Using the internet/PC excessively. Excessive Internet use was significantly associated with emotional problems (OR 1.65, 95% CI 1.15-2.37, only significant in girls), conduct problems (in boys OR 1.81, 95% CI 1.30-2.53 and in girls OR 1.55, 95% CI 1.01-2.38), hyperactivity (OR 1.97, 95% CI 1.59-2.43), pro-social behavioral problems (OR 1.48, 95% CI 1.15-1.90), a problematic total SDQ-score (OR 1.77, 95% CI 1.39-2.26) and a low GSE in girls (OR 1.86, 95% CI 1.26-2.73) (Table 4). In the multi-screen time analysis the association to hyperactivity (OR 1.88, 95% CI 1.41-2.52) and (in girls) to low GSE (1.94, 95% CI 1.05-3.58) were still the only associations that were significant. However, the

associations to emotional problems, conduct problems, pro-social behavior and a problematic SDQ score were not (Table 5).

Playing video games excessively. Excessive video game playing was only significantly associated with conduct problems (OR 2.33, 95% CI 1.28-4.25) in the single-screen time analyses (Table 4). This association to conduct problems remained virtually similar (OR 2.46, 95% CI 1.29-4.69), but the weak association to peer problems and pro-social behavior were now not statistically significant. However, in this more comprehensive analysis, its association to less hyperactivity (OR 0.40, 95% CI 0.18-0.90) showed to be significant now (Table 5).

Table 4 Odds ratios of the association of screen time with psychosocial problems, being overweight and GSE.

	Excessive Watching TV (>14h/week)	Excessive Internet Use (>14h/week)	Excessive gaming <th>CIU¹</th> <th>CVP²</th>	CIU ¹	CVP ²
Emotional problems	N.S. ³	Boys: N.S. Girls: 1.65 ** (1.15-2.37)	N.S.	3.94 ** (2.40-6.48)	6.90 ** (3.45-13.80)
Conduct problems	Boys: 1.38+ (0.97-1.97) Girls: 1.95** (1.27-3.00)	Boys: 1.81 ** (1.30-2.53) Girls: 1.55 * (1.01-2.38)	2.33 ** (1.28-4.25)	3.47 ** (2.15-5.60)	3.47 ** (1.84-6.55)
Hyperactivity	N.S.	1.97 ** (1.59-2.43)	N.S.	2.64 ** (1.68-4.14)	2.90 ** (1.55-5.41)
Peer problems	1.31* (1.02-1.68)	N.S.	1.71 + (0.93-3.13)	Boys: 3.83 ** (2.00-7.32) Girls: 2.30 * (1.13-4.70)	4.09 ** (2.15-7.78)
Pro-social problems	N.S.	1.48 ** (1.15-1.90)	1.73 + (0.94-3.17)	Boys: 2.29 ** (1.23-4.29) Girls: 2.48 * (1.15-5.36)	1.75 + (0.91-3.37)
Problematic SDQ-score ⁴	1.30 * (1.00-1.68)	1.77 ** (1.39-2.26)	N.S.	5.06 ** (3.23-7.93)	4.76 ** (2.54-8.93)
Overweight	1.77 ** (1.31-2.40)	N.S.	N.S.	N.S.	N.S.
Low GSE ⁵	N.S.	Boys: 1.85 + (0.91-3.77) Girls: 1.86 ** (1.26-2.73)	N.S.	Boys: 3.35 * (1.18-9.56) Girls: 4.81 ** (2.45-9.47)	2.38 + (0.87-6.49)

Note. All results were adjusted for sex, age, school, year of school, education level, ethnicity and socioeconomic status. +: .10 > p > .05 *: p ≤ .05; **: p ≤ .01.

1: CIU = Compulsive Internet Use Scale Score > 3.0, (range 0-4); **2:** CVP = Videogame Addiction Test Score > 3.0, (range 0-4); **3:** N.S. = Not Significant, p > 0.10; **4:** SDQ = Strengths and Difficulties Questionnaire; **5:** GSE = General Self-Efficacy.

Compulsive internet use. In the single-screen time analyses CIU was significantly associated with emotional problems (OR 3.94, 95% CI 2.40-6.48), conduct problems (OR 3.47, 95% CI 2.15-5.60), hyperactivity (OR 2.64, 95% CI 1.68-4.14), peer problems (in boys OR 3.83, 95% CI 2.00-7.32 and in girls OR 2.30, 95% CI 1.13-4.70), pro-social problems (in boys OR 2.29, 95% CI 1.23-4.29 and in girls OR 2.48, 95% CI 1.15-5.36), a problematic total SDQ-score (OR 5.06, 95% CI 3.23-7.93) and a low GSE (in boys OR 3.35, 95% CI 1.18-9.56 and in girls OR 4.81, 95% CI 2.45-9.47) (see Table 4). In the multi-screen time analyses its associations to emotional problems (OR 2.70, 95% CI 1.32-5.53), conduct problems (OR 3.29, 95% CI 1.71-6.33), hyperactivity (OR 2.10, 95% CI 1.15-3.84), and with a problematic total SDQ score (OR 4.72, 95% CI 2.57-8.67) remained significant. Additionally, in girls, CIU was also related to a low GSE (OR 4.39, 95% CI 1.70-11.34) (see Table 5).

Compulsive video game playing. In the single-screen time analyses compulsive gaming was associated with emotional problems (OR 6.90, 95% CI 3.45-13.80), conduct problems (OR 3.47, 95% CI 1.84-6.55), hyperactivity (OR 2.90, 95% CI 1.55-5.41), peer problems (OR 4.09, 95% CI 2.15-7.78) and a problematic total SDQ score (OR 4.76, 95% CI 2.54-8.93) (see Table 4). The associations that remained significant in the multi-screen time analysis were those with emotional problems (OR 3.56, 95% CI 1.53-8.27) and peer problems (OR 2.90, 95% CI 1.39-6.04) (see Table 5).

Discussion

Associations of screen time behaviors with a broad range of other unhealthy behaviors and several health outcomes (being overweight, GSE and psychosocial problems) were analyzed. In these analyses the so called single-screen time behavior analyses were compared with the multi-screen time behavior analyses. In the single-screen time behavior analyses the association of a certain screen time behavior with a 'classic' unhealthy behavior or outcome was quantified, while only correcting for relevant socio-demographic factors. Thereafter, these analyses were compared with the so-called multi-screen time behavior analyses in which the associations were presented between a certain unhealthy behavior (eg, recent binge drinking) with a certain screen time behavior (eg, excessive television watching), whilst correcting for both similar socio-demographic factors and the remaining screen time behaviors. Therefore, in contrast to the presented single-screen time behavior analyses, these multi-screen time behavior analyses' results are "unconfounded" with regard to the other screen time behaviors. From here on when references are made to associations of screen time behaviors with other health behaviors or outcomes, reference is to the multi-screen time behavior analyses' unless explicitly stated otherwise.

Table 5. Multivariate Regression Analysis: Odds Ratios of the Association of Screen Time with Psychosocial Problems, Being Overweight and GSE.

	Excessive Watching TV (>14h/week)	Excessive Internet Use (>14h/week)	Excessive Video gaming (>14h/week)	CIU ¹	CVP ²
Emotional problems	N.S. ³	N.S.	N.S.	2.70 ** (1.32-5.53)	3.56 ** (1.53-8.27)
Conduct problems	Boys: N.S. Girls: 1.87+ (0.99-3.54)	N.S.	2.46 * (1.29-4.69)	3.29 ** (1.71-6.33)	N.S.
Hyperactivity	N.S.	1.88 ** (1.41-2.52)	0.40 ** (0.18-0.90)	2.10 * (1.15-3.84)	N.S.
Peer problems	N.S.	N.S.	N.S.	N.S.	2.90 ** (1.39-6.04)
Pro-social problems	N.S.	N.S.	N.S.	4.72 ** (2.57-8.67)	N.S.
Problematic SDQ- score ⁴	N.S.	N.S.	N.S.	N.S.	N.S.
Overweight	1.71** (1.17-2.51)	N.S.	N.S.	N.S.	N.S.
Low GSE ⁵	N.S.	Boys: N.S. Girls: 1.94* (1.05-3.58)	N.S.	Boys: N.S. Girls: 4.39** (1.70- 11.34)	N.S.

Note. All results were adjusted for sex, age, school, year of school, education level, ethnicity and socioeconomic status. +: .10 > p > .05 *: p ≤ .05; **: p ≤ .01.

1: CIU = Compulsive Internet Use Scale Score > 3.0, (range 0-4); **2:** CVP = Videogame Addiction Test Score > 3.0, (range 0-4); **3:** N.S. = Not Significant, p > 0.10; **4:** SDQ = Strengths and Difficulties Questionnaire; **5:** GSE = General Self-Efficacy.

Associations of screen time behaviors with other unhealthy behaviors

The first study aim was to identify the associations of the different screen time behaviors with other unhealthy behaviors. Students that reported watching television excessively were not significantly more likely to report more other unhealthy behaviors than their peers that did not watch television excessively. Our findings differed from those in other studies that did report on significant associations with bullying³¹, poorer eating habits³² and less physical exercise.³³ However, those studies used less comprehensive multi-screen time behavioral correction for confounding. In our single-screen time behavior analyses that are more comparable to those performed in these studies, similar significant associations were in fact also found between watching television excessively and peer bullying, poorer nutritional habits and less physical exercise. Therefore, the

current findings demonstrated the possible overestimation of associations due to multi-screen time behavior confounding.

Secondly, excessive Internet users were more likely to be active alcohol than non-excessive Internet users (Table 3), a finding comparable to several previous studies.^{34,35} In contrast to the study by Kim et al,³⁵ we found no associations between excessive Internet use and smoking or marijuana use, when correcting for confounding by other screen time behaviors. However, in the single-screen time behavior analyses, excessive Internet use was associated with smoking. This again illustrated the importance of multi-behavioral analyses. Shi and Mao³⁶ reported a significant association of excessive Internet use and poorer nutritional behaviors, similar to our findings, although the association in our study was only significant for girls. It was found that girls that used Internet excessively were more likely to report unhealthy eating patterns than non-excessive Internet users. Because no past studies reported this sex difference, this finding could not be interpreted using the existing literature. Furthermore, the findings that excessive Internet users were less physically active than those who were not excessive Internet users was confirmed by earlier research.³³

Thirdly, excessive video game players were more likely to report skipping school (only significant for boys) than students not reporting to play video games excessively. This effect was impossible to determine for girls, because too few of them reported excessive use of video games. This finding is comparable to other research that also found girls to engage in less video game playing. Furthermore, excessive video game playing was not associated with any other unhealthy behaviors, as other research³³ has demonstrated.

In addition, students that reported to be compulsive screen time users were more likely to report skipping school more often, being bullied by their peers, and having poorer nutritional habits. However, in contrast to the study of Ko et al³⁷, it was not significantly related to alcohol use. However, once more, in the single-screen time analyses students that were compulsive Internet users were more likely to be recent alcohol users than students that were not compulsive Internet users. However, no literature was found to compare these findings because measuring CIU is not a standard practice yet in many adolescent health studies. This makes the persistent findings in our study with regard to such a wide range of health behaviors and outcomes being related to CIU even more provocative.

Compulsive video game users were significantly more likely to be bullies and to report poorer nutritional habits, findings not previously reported in the literature. Like CIU, CVP may need to be included as part of the standard set of unhealthy adolescent behaviors measured, given our new digital age.

Associations of screen time behaviors with health outcomes

Part of the first study aim was to examine whether students that presented 'problematic' screen time behaviors were more likely to report negative health outcomes, i.e., having psychosocial problems, being overweight and having low GSE.

As in previous studies⁹, students that reported watching television excessively were more likely to be overweight. No other associations were found, which is comparable to previous research.³⁸ These results, however, are in contrast to the findings of McClure et al³⁹, who reported that students that watched television excessively had a lower self-esteem. However, direct comparability is limited by the fact that questions were not identical. Students reporting excessive Internet use were more likely to report being hyperactive (part of the SDQ survey). Similar to findings by Mathers et al³⁸, no other significant association was found between excessive Internet use total SDQ score. The specific association of excessive Internet use with psychosocial problems was only significant with regard to the hyperactivity sub-part of the SDQ. For girls an association with lower GSE was found for excessive Internet use, similar to what Nihill et al⁴⁰ found. Students who reported playing video games excessively were more likely to report conduct problems but less likely to report hyperactivity. Mathers et al³⁹ found no association between video game playing and psychosocial problems.

Compulsive Internet use showed strongest association among the screen time behaviors with psychosocial problems, i.e., emotional problems, conduct problems, hyperactivity, a problematic total SDQ score, and, for girls, a low GSE. These findings were similar to those of previous research.⁶ Lastly, students who were compulsive video game players were more likely to report psychosocial problems. These findings were similar to those from other studies.^{7,41,42}

Single- versus multi-screen time behavior analyses

The second aim of this study was to quantify the change in ORs that appeared after correcting for other screen time behavior variables in the multi-screen time analysis in comparison to the single-screen time analyses. Such a change would be indicative of a close interrelationship between the screen time behaviors and their relation to a particular outcome. Especially with regard to CIU, and to a lesser extent, with excessive Internet use, the significant associations of the single-screen time behavior analyses remained in the multi-screen time behavior analyses. However, the confounding effects that different screen time behaviors pose on each other's associations to the outcomes in question in this study (other unhealthy behaviors and health outcomes) often were statistically significant. This indicates that the single-screen time behavior analyses might overestimate the associations with other unhealthy behaviors or health outcomes. It also implies that for example the "associated" unhealthy behaviors and health outcomes of adolescents that watch television excessively and/or play video games excessively or compulsively can be mainly explained by excessive or CIU of those adolescents. This is an important finding to be aware of, particularly given previous

studies that only investigated one screen time behavior and did not take a broader spectrum of screen time behaviors into account. These differences in analyses seem to explain the majority of the discrepancies between the findings of this study and the existing literature. Although some of the 95% CI's were somewhat skewed (indicating a small cell size and that the results need to be interpreted with caution) this main conclusion still seems to hold true.

Strengths and limitations

Strength of the study is the study population's representativeness of Dutch adolescents. A second strength is the specific set of multivariate analyses, and the comprehensive measures of adolescent health. Many previous studies only used what we have referred to in this paper as single-screen time behavior analyses instead of more comprehensive multi-behavioral analyses. Therefore, the current study is more likely to be properly conservative in its presented associations and conclusions.

However, our data were based on self-report and could have resulted in some reporting bias. However, this effect was minimized by only using validated questionnaires, mostly based on the large (international) HBSC survey. Secondly, the reported associations cannot be interpreted as causal relations, due to the cross-sectional nature of this study. Also, it has to be taken into account that the used cut-off scores for excessive and compulsive screen time use are standard measures in the surveys used in the current study, but they may deviate from other investigations. The cut-off score for excessive screen time as problem behavior is sample dependent and study findings should not simply be generalized to other populations. Furthermore, many statistical tests have been performed, thereby raising the danger of an inflated Type-1 error. However, despite these precautions, major conclusions from this study offer provocative implications for future research.

Recommendations for future research

As shown, different screen time behavior variables are often closely associated. A screen time variable that was not included in our study is the use of smart phones or tablets. As Van Rooij et al previously stated “even during the time span of writing this thesis, various technological innovations have been introduced”.⁷ Technology rapidly increases and smart phones seem to increasingly intensify people's Internet use and with this increase, excessive and compulsive Internet use may evolve further. This study showed the potential for (psychosocial) problems associated with excessive or compulsive screen time behaviors, and therefore, the authors recommend that future studies take this development into account. A second important that currently is understudied is the content of the screen time behaviors i.e., what adolescents watch, do, and play behind screens. As Mathers et al³⁹ show, this might provide interesting new insights that shed light on these screen time behaviors.

Conclusions

The results show several significant associations between screen time behaviors and unhealthy behaviors as well as with health outcomes related to psychosocial problems, being overweight and low GSE. However, when correcting for the confounding effects by the other screen time behaviors in the multi-screen time analysis, declines and changes in these associations were noted. In this multi-screen time behavior analysis, excessive and compulsive Internet use was uniquely associated with unhealthy behaviors and undesirable health outcomes. Thus, these findings suggest that special attention should be paid in future to adolescents' screen time and associated unhealthy behaviors in a clustered, comprehensive fashion.

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CHAPTER 5

Busch V, Laninga-Wijnen L, van Yperen TA, Schrijvers AJP, de Leeuw JRJ. Bidirectional longitudinal associations of bullying and being bullied with psychosocial problems in adolescents: a cross-lagged panel study. *J Sch Health* (under review).



ABSTRACT

Background

Research on school bullying often focuses on the directional path of bullying and/or victimization leading to general psychosocial problems, while such one-dimensional views have been shown to be too simplistic. The present study explored the bidirectional, longitudinal associations of adolescent school bullying and victimization on several psychosocial problems, with a focus on gender differences.

Methods

A longitudinal, cross-lagged panel study on 1243 adolescents in The Netherlands were used to assess the bidirectional associations of peer bullying and victimization with psychosocial problems. Data were collected in September 2011 and 2012.

Results

All hypothesized bidirectional associations were significant and differed for boys and girls. Boys who were bullied reported more conduct problems, while those who bullied reported more conduct problems, lacking pro-social behavior and peer problems at follow-up. Girl victims reported more conduct problems, while girl bullies reported more peer problems, inattention-hyperactivity problems and lacking pro-social behavior at follow-up. Conversely girls with emotional problems were more likely to be bullied at follow-up, and those with lacking pro-social behavior were more likely to bully at follow-up. In boys, inattention-hyperactivity was associated with being bullied at follow-up, while no psychosocial problems were related to future bullying.

Conclusions

Significant ties between school bullying, victimization and particular psychosocial problems were shown. Both bullying and being a victim were associated with particular psychosocial problems one year later. Together with the identified gender differences, these results can help to tailor future anti-bullying interventions at schools.

Introduction

Many people have long considered bullying to be a harmless part of growing up, while this is a serious misconception.¹ Nowadays, it is increasingly perceived as a serious public health threat with severe consequences for victims' health, happiness, and life-long psychosocial and psychiatric problems.¹⁻⁵ Bullying is defined here as intentional and repetitive negative actions (e.g. physical aggression, verbal abuse or social exclusion) characterized by an imbalanced power between the victim and bully or perpetrator.² Recent studies in adolescents showed that psychosocial, behavioral problems such as conduct problems, aggressive behavior, hyperactivity, poor peer relations and lacking pro-social behavior skills are all related to bullying and being bullied.⁶⁻⁹ Much research on the topic often did not utilize a longitudinal design¹⁰ and/or was not performed specifically in adolescents.¹¹ Studies that were performed via longitudinal design in adolescents showed significant effects of bullying and being bullied on different psychosocial problems.^{3, 4, 6, 7, 12}

However, should bullying be seen a cause or as a consequence of such psychosocial problems? Or should it be seen as both? While in some studies bullying and victimization were demonstrated to lead to emotional and behavioral problems,^{13,14} others claim there is only evidence for the opposite direction of these effects.¹⁵⁻¹⁷ As highlighted by Fekkes and colleagues¹², many studies only address a single directional path in the analyses of bullying and psychosocial problems, while increasing evidence shows complex, bidirectional to be more likely the case for both internalizing as well as externalizing psychosocial problems. However, despite these advances recent studies state that more longitudinal studies are needed to unravel the complex, bidirectional associations between bullying behaviors and particular psychosocial problems.^{14,18} Reijntjes and colleagues also indicated this in their recent meta-analysis on the bidirectional associations between bullying and externalizing psychosocial problems.¹⁸ The current number of studies on the topic was insufficient to draw solid conclusions, and especially with regard to studying moderating and mediating factors such as gender.¹⁸ Similar conclusions apply to another recent meta-analysis on the topic of the bidirectional associations between bullying and internalizing psychosocial problems.¹⁹

Gender differences

Recent research has shown sex differences in school bullying regarding the amount as well as different forms of bullying. It shows that boys are not only more often involved in bullying, but also that they involved in different types of bullying than girls^{13, 20, 21,22}. Furthermore, coping strategies and particular psychosocial problems associated with bullying are also found to differ between boys and girls. Studies showed for example that girls are more at risk for internalizing symptoms and more likely to use avoidance strategies such as ignoring and not doing anything to stop the bullying, while boys are more likely to use physical aggression or revenge as a coping strategy, or humor as an

attempt to distract and stop the bullying.^{23,24} Such findings make gender a particularly relevant factor in exploring the causes and consequences of bullying.^{8,13,21}

Current study

Despite the advances in recent research on the effects of school bullying on adolescents' psychosocial well-being and vice versa,^{18,19} more longitudinal studies are needed to explore the bidirectional paths of these associations.^{14,18,19} Therefore, the main purpose of this study is to assess such bidirectional paths, while differentiating between particular psychosocial problems and taking into account potential gender differences.

Methods

Participants

A convenience sample of high school students in The Netherlands was asked to complete a survey in September 2011 (baseline) and September 2012 (wave 1) based on the Dutch Health Behavior in School-Aged Children (HBSC) questionnaire.²⁵ The schools participated out of intrinsic motivation, without being provided with funds or other incentives to participate. All schools are situated in, to Dutch standards, suburban areas of middle-large to large cities and included students from both urban and rural background.

Procedures

The survey was completed individually in class. Survey procedures were designed to allow students to participate voluntarily and anonymously. Students were informed about the nature of the survey beforehand, as were their parents. The fact that all answers would be confidential and that participation was voluntary was also made clear in advance. At any time, student and/or parent could decide to withdraw the student from participation; there were no parents who withdrew their child/children from the study. All schools were assisted with the questionnaire procedures by the research team. Within each wave of data collection approximately 80% of the students completed the survey; those who did not were absent from school on the day that the survey took place or they were not given the survey by their teacher (due to conflicting scheduling and time issues). Students who were in their last year of high school at baseline and those in their first year at wave 1 could, by design, only complete time point of data collection and were thus excluded from the analyses. The number of students who did not fill out the survey when presented with it was negligible. Of the surveys, 95% was fully complete on all used variables; no methods for data imputation were used.

Instruments

Demographic characteristics. The collected demographic characteristics were age, gender, ethnicity, socio-economic status (SES), which school and class a student

attended and his/her current educational level. All these characteristics were surveyed similarly as in the Dutch HBSC questionnaire. Students' SES was measured via the Family Affluence Scale (FAS), as integrated in the HBSC survey (FAS-score: 0-2 = low, score 3-5, = medium, 6-9=high).²⁶

Bully behaviors. Dan Olweus' conceptual definition of bullying was used, meaning that the following three criteria need to be met: (1) physically harming, making fun of, excluding and/or spreading rumors (gossiping) about someone, (2) the behavior must be carried on over time repeatedly, and (3) the bully and victim do not possess equal strength or power in the interactions.² This was questioned by asking whether students had been bullied in the recent three months, and then also more specifically whether this happened with regard to physical aggression, verbal abuse, gossiping/rumor spreading and/or via the Internet or mobile phone. Similar questions were also asked with regard to being the perpetrator of the bullying behavior. This operationalization of the measurement of bully behavior was based on the Olweus Bully Score and the Olweus Bully Victim Score.²⁷ The two scores distinguish bullies and victims from respectively non-bullies and non-victims with a validated cut-off of at least two times a month. These measures' validity and reliability were demonstrated in previous research, stating that these scores allow for prevalence estimates of bullying and being bullied to be obtained conveniently, that they have a reasonably well-defined meaning, and that they are easily and unambiguously understood by users and researchers.^{27, 28} To prevent ambiguity, those who are the perpetrators of bullying will be referred to as bullies, while those being victimized will be referred to as victims or being bullied. Other studies sometimes also identify a third category, namely those who are simultaneously the perpetrators and victims of bullying (the so-called bully-victims). These were not taken into account the current study due to sample size considerations.

Psychosocial problems. Psychosocial problems were measured with the Strengths and Difficulties Questionnaire (SDQ),²⁹ which measures behavioral characteristics on the topics emotional symptoms, inattention-hyperactivity, peer relationship problems, conduct problems and pro-social behavior.²⁹ The SDQ's reliability and validity were recently demonstrated in a comparable sample of Dutch youth to measure these five types of problems with appropriate distinction between them.³⁰ The subscales emotional symptoms, inattention-hyperactivity, peer problems and conduct problems, each composed of 5 items scored on a 3-point Likert-scale (0= "not true", 1="somewhat true" or 2="certainly true"), together add up to a total SDQ-score of maximum 40 points over the total of 20 items. A score of 0-19 points is considered a "normal" score, whereas a score higher than 19 is categorized as "(potentially) problematic". The pro-social behavior score is left out of this total score and analyzed separately, as is common practice.^{30, 31}

Data analysis

To assess the longitudinal, bidirectional associations between bullying and victimization with the latent construct of psychosocial problems, a cross-lagged panel analysis was performed on 2 data waves via structural equation modeling (SEM) in Mplus.³² This way, relationships of bullying on psychosocial problems were analyzed with a 1-year lag time, while controlling for reverse relationships. The same was done regarding victimization and psychosocial problems. This design was chosen because cross-relationships over time enable examining bidirectional relationships and a temporal order in these relationships. In order to control for the possible confounding effect of age, ethnicity, educational level and socioeconomic status, those variables were included in each model. Another advantage of the chosen analytical approach and statistical package was that all analyses were done within the same model, so that the problem of multiple testing (and a possibly inflated P-value) was averted.

As the latent scores on psychosocial problems were not distributed normally, the assumption of multivariate normality was not fully met. However, in SEM, multivariate normality concerns a sufficient but not necessary condition for applying the usual tests of statistical significance. Especially with larger samples, the parameter estimates are not likely to be biased when the normal-distribution assumption is violated.³³ Therefore, maximum likelihood estimations with robust standard errors (MLR) were used.³⁴

As stated, different associations between bullying and victimization with psychosocial problems were hypothesized for boys and girls, based on existing literature. Therefore, all analyses were performed on a gender-stratified sample.

The medical ethical committee of the University Medical Centre Utrecht has approved to the procedures of this study after reviewing its ethical considerations.

Results

A total of 1.242 adolescents aged 11-18 years completed the survey, 504 boys and 738 girls. Their mean age at baseline was approximately 13 years old (Mean 13.17, SD 1.21). Their educational level was representative for a Dutch sample of adolescents, while their socioeconomic status (FAS score, Mean = 7.12 (SD = 1.49)) was somewhat higher than that of their peers in The Netherlands.²⁵ Of the girls, 2% reported to have bullied recently, while 6% indicated to have been bullied recently at baseline. At follow-up 2% were perpetrators and 4% victims. For boys, 8% were recently bullied and 6% indicated to have bullied peer(s) recently. At follow-up 5% were victims and 4.5% perpetrators. At baseline psychosocial problems were present in 15% of the boys and 12% of the girls. At follow-up this was respectively 21% for girls and 15% for boys.

Firstly, the results of the "general model" present the bidirectional associations between bullying and victimization with overall psychosocial problems (Table 1). Bullied adolescents were more likely to also be bullied at follow-up (OR 4.50, 95% C.I. 2.48-8.14) and to report psychosocial problems at T1, i.e. a problematic SDQ score, (OR 1.87, 95%

C.I. 1.05-2.54). Adolescents who reported to bully others at baseline were more likely to report psychosocial problems at follow-up (OR 1.27, 95% C.I. 1.69-2.33) and to be bullies at follow-up (OR 1.74, 95% C.I. 1.33-2.28). Furthermore, adolescents who reported psychosocial problems at baseline were more likely to report them at follow-up (OR 7.47, 95% C.I. 5.43-10.3), more likely to report to be bullied at follow-up (OR 2.69, 95% C.I. 1.52-4.73), but they were not more likely to report being bullies than those without psychosocial problems at baseline (OR 1.11, 95% C.I. 0.51-2.24). Secondly, the results of the gender-specific analyses to explore the bidirectional associations of bully behaviors with specific psychosocial problems are reported in the following section and summarized in Table 2.

Table 1 The longitudinal associations of bullying and victimization with the development of psychosocial problems in adolescents (N=1242).

Longitudinal associations from baseline (T0) to time 1 (T1)		Odds Ratio (95% CI)
Being bullied at T0	> Being bullied at T1	4.50* (2.48-8.14)
Being bullied at T0	> Psychosocial Problems at T1	1.87* (1.05-1.54)
Bullying at T0	> Psychosocial Problems at T1	1.27* (1.69-2.33)
Bullying at T0	> Bullying at T1	1.74* (1.33 -2.28)
Psychosocial Problems at T0	> Psychosocial Problems at T1	7.47* (5.43- 10.29)
Psychosocial Problems at T0	> Being bullied at T1	2.69* (1.52 - 4.73)
Psychosocial Problems at T0	> Bullying at T1	1.11 (0.51-2.24)

*: $p \leq .05$

Bullied adolescents and their psychosocial problems

Boys and girls who were bullied at baseline reported more conduct problems at T1 (OR 2.58, 95% C.I. 1.38-4.81 for boys and OR 3.28, 95% C.I. 1.71-6.29 for girls). Victimization at baseline had no significant effects on psychosocial problems other than conduct problems at T1 (Table 2).

Furthermore, students who reported psychosocial problems at baseline were more likely to report being victimized at T1 than those who indicated no such problems at baseline. The strongest association with psychosocial problems at T1 (for all types of problems) was reporting them at baseline (Table 2). In boys, reporting attention-hyperactivity problems at T0 was also significantly associated with being victimized at T1 (OR 3.67, 95% C.I. 1.77-7.63). For girls only emotional problems at baseline T0 were a significant predictor of later victimization (OR 3.08, 95% C.I. 1.30-7.30).

Bullies and their psychosocial problems

Boys who were bullies at baseline reported more conduct problems (OR 1.50, 95% C.I. 1.19-1.90), peer problems (OR 1.35, 95% C.I. 1.07-1.70) and lacking pro-social behavior (OR 1.46, 95% C.I. 1.17-1.82) at T1 than those who were not (Table 2). Girls who were bullies at baseline also reported more peer problems (OR 1.59, 95% C.I. 1.18-2.16) and lacking pro-social behaviors (OR 1.89, 95% C.I. 1.36-2.63) at T1 than those who were not

bullies at baseline. In addition, for girl bullies, the association of bullying with inattention-hyperactivity problems was borderline significant (OR 1.38, 95% C.I. 0.99-1.91).

For boys, no psychosocial problems at baseline were associated with being a bully at T1. For girls, lacking pro-social behavior was associated with being a bully at T1 (OR 8.45, 95% C.I. 2.98-23.97).

Table 2 The longitudinal associations of bullying and victimization with the development of psychosocial problems in adolescents, stratified by gender.

Longitudinal associations	Follow-up (T1)	Boys (N=504)			Girls (N=728)		
		Baseline (T0)	Odds Ratio (95% CI)	Baseline (T0)	Odds Ratio (95% CI)		
Being bullied	Emotional problems		1.23 (0.46-3.35)		1.57 (0.75-3.28)		
Bullying	Emotional problems		0.76 (0.47-1.22)		1.04 (0.70-1.55)		
Being bullied	Conduct problems		2.54* (1.36-4.75)		3.27* (1.71-6.25)		
Bullying	Conduct problems		1.47* (1.17-1.86)		1.11 (0.75-1.65)		
Being bullied	Peer problems		1.56 (0.80-3.04)		1.04 (0.50-2.14)		
Bullying	Peer problems		1.32* (1.04-1.66)		1.60* (1.18-2.16)		
Being bullied	Inattention-Hyperactivity		0.74 (0.36-1.52)		0.73 (0.36-1.46)		
Bullying	Inattention-Hyperactivity		1.05 (0.83-1.32)		1.37 (0.99-1.90)		
Being bullied	Pro-social problems		1.33 (0.72-2.46)		1.34 (0.86-1.72)		
Bullying	Pro-social problems		1.46* (1.17-1.82)		1.90* (1.36-2.63)		
Emotional problems	Emotional problems		5.03* (2.09-12.1)		17.1* (10.8-27.1)		
	Being bullied		0.90 (0.24-3.30)		3.35* (1.46-7.67)		
	Bullying		1.15 (0.27-4.89)		0.42 (0.06-2.75)		
Conduct problems	Conduct problems		4.74* (3.06-7.34)		1.77 (0.89-3.54)		
	Being bullied		1.66 (0.73-3.81)		0.85 (0.24-3.02)		
	Bullying		2.30 (0.95-5.56)		1.37 (0.29-6.50)		
Peer problems	Peer problems		6.08* (3.85-9.58)		4.41* (2.79-6.98)		
	Being bullied		0.95 (0.35-2.55)		0.88 (0.30-2.60)		
	Bullying		0.91 (0.34-2.41)		0.75 (0.16-3.45)		
Inattention-Hyperactivity	Inattention-Hyperactivity		5.92* (4.00-8.75)		10.2* (7.23-14.4)		
	Being bullied		3.70* (1.78-7.68)		0.73 (0.30-1.76)		
	Bullying		1.83 (0.83-4.05)		1.13 (0.40-3.21)		
Pro-social problems	Pro-social problems		3.57* (2.40-5.32)		6.73* (3.92-11.5)		
	Being bullied		0.94 (0.80-1.10)		1.22 (0.95-1.53)		
	Bullying		1.97 (0.85-4.57)		8.45* (2.98-24.0)		

*: p ≤ .05

Discussion

This study presented the bidirectional longitudinal associations of bullying and victimization with psychosocial problems in a sample of Dutch high school adolescents via a cross-lagged panel design. Bullying and victimization at baseline were both associated with more psychosocial problems a year later. Conversely, psychosocial problems at baseline were associated with victimization of bullying, but not with being a bully a year later.

When looking at the subscales of the SDQ, boys who reported to bully their peers at baseline reported more conduct problems, peer problems and pro-social behavior at follow-up than those who did not. Among girls, those who bullied their peers at baseline reported more peer problems, lacking pro-social behavior and inattention-hyperactivity at follow-up than girls who did not. These findings were consistent with previous research.^{1, 6, 12-14, 35}

Furthermore, only boys who reported attention-hyperactivity problems at baseline were more likely to be victimized at follow-up. For girls emotional problems at baseline were significantly associated with being bullied at follow-up. For girls, lacking pro-social behavior at baseline predicted being a bully at follow-up, whereas for boys no psychosocial problems were associated with bullying at follow-up.

The design of the current study allowed for distinguishing between the directions of the different studied associations. Generally, in most previous studies, bullying/being bullied and psychosocial problems were seen only as one being the consequence of the other.⁶ However, by such an approach one is more prone to make too simplistic inferences about true effects and mechanisms. The results of the current study indicated that some specific psychosocial problems were associated with adolescents being bullying victims or becoming perpetrators themselves, while vice versa being a perpetrator or victim were also associated with specific psychosocial problems. These findings indicated that more research on this subject is needed with a focus on these specific dynamics.

Are adolescents with psychosocial problems more often bullies and/or victims?

In line with previous studies, the current study showed that emotional problems and inattention-hyperactivity problems were significantly associated over time with being bullied.¹⁵⁻¹⁷ In addition, Veenstra and colleagues demonstrated significant effects of conduct problems on being a bully later on¹⁷, while this association was not significant in the current study (Table 2). A reason for this could be that Veenstra and colleagues explored these relationships in younger children instead of adolescents. However, these inconsistencies should be clarified in future studies on the topic.

Overall, based on our results, certain psychosocial problems were related to future bullying and bullying victimization. These associations differed for boys and girls. Among

girls, emotional problems and lacking pro-social behavior were associated with respectively being a victim and perpetrator of peer bullying, while these relations were not significant among boys. Conversely, inattention-hyperactivity problems seemed to make boys especially prone to being victimized. These findings indeed seem to point to different mechanisms between bully behaviors and psychosocial problem development in boys and girls in adolescents, with more externalizing problem behaviors being associated with bullying in boys than in girls, in which these bully behaviors seem to be more related to internalizing problems.²²⁻²⁴

Are bullies more likely to develop psychosocial problems?

Psychosocial problems at baseline showed the strongest association with reporting those problems at follow-up, as also seen in other studies.^{4,36,37} Consistent with several recent studies being a perpetrator of bullying was also associated with developing psychosocial problems; in particular, it is linked to more conduct problems and poor peer relations.^{5, 11-13, 18, 35} In contrast to other studies, the associations of bullying with emotional and inattention-hyperactivity were not significant.^{5,11} However, the studies that did report significant relationships of all distinct problems that are measured by the SDQ were studies that only took into account the effects of physical aggression as a measure for bullying. In contrast, the current study used a broader measure for bullying that also includes other kinds of damaging behavior such as gossiping or verbal abuse were characterized as types of bullying, based on Solbeg and Olweus.²⁷ Since it is to be expected that physical aggression is the most extreme form of bullying, it will also lead to stronger effects on psychosocial problems. Further reasons to explain the possible differences with previous research are highlighted in the next section.

The associations of bullying with developing peer problems and lacking pro-social behavior as reported in the current study were in line with those of comparable studies.^{7,18,38} Bullying was associated strongest to peer problems, and also had significant associations with impaired pro-social behavior.

Are bullied adolescents more likely than others to develop psychosocial problems?

Victims of bullying were overall more likely than others develop psychosocial problems, consistent with results from other research.^{11, 18, 19, 39} The somewhat differing definitions of bullying used in some earlier studies, as exemplified in the previous section, might explain the somewhat smaller and less often significant effects of the current study.

Also consistent with previous research, the psychosocial problems that were related strongest with being bullied were conduct and peer problems.^{5, 8, 13, 18, 40-42} However, in the current study it was not found that being bullied resulted in more emotional problems and lacking pro-social behavior, whereas some other studies did.^{5, 16}

Factors that might explain why other studies reported different results than the current study might be that some used a particular problem (such as emotional problems or peer problems) as a single main outcome. This might lead to an overestimation of the

associations when certain psychosocial problems are significantly inter-correlated, such as those of the SDQ. As a consequence, when they are not being analyzed together in comprehensive analyses, this inter-relatedness might lead to confounding. Therefore, since all analyses in the current study were performed within the same statistical model, this problem was averted, as was the potential problem of multiple testing and an inflated p-value. Thus, the current study presents relatively conservative findings. Furthermore, as stated before, some studies used other measures to assess bullying victimization and/or perpetration, which could have led to different results. For example, Wienke Totura and colleagues used a multiple informant strategy, meaning that they included peer- and teacher indicators in addition to using self-reported surveys to identify bullying victims and perpetrators. Lastly, some past studies were performed in younger children than adolescents, which may have led to different effects, although it is hard to speculate about the direction of these differences.

Gender differences that were observed were that the effects were stronger for girls than boys. These differences were fairly limited, which was in line with two recent meta-analyses^{18,19} and other research⁴², but less prominent than expected from earlier literature^{8, 20-24}. These contradictions make a case for more gender-specific studies in this field.^{8, 20-24} When in future studies more distinction would be made between the types of bullying perpetration and victimization, it would be better possible to identify more differentiating patterns of effects between boys and girls, as illustrated by Carbone-Lopez and colleagues.⁴³ Additionally, the found differences might arise from the fact that boys and girls perhaps cope differently with events such as being bullied, resulting in different effects on psychosocial problems.

Strengths and limitations

This study is one of the first to have quantified the associations of different psychosocial problems with bullying and victimization in adolescents via a cross lagged panel design, while also exploring gender differences. Most previous studies that entailed a longitudinal design only took into account a one-way effect from bullying to psychosocial problems or vice versa. In addition, many of such studies did not specifically explore gender differences, rarely distinguished between different types of psychosocial problems and/or often explored such associations in primary school children and not adolescents. In addition the utilized cross-lagged panel model allowed for the analyses to be performed in a single model, which prevented confounding by correlated psychosocial problems and it averted the problem of multiple testing and an inflated p-value. This adds significantly to the reliability of our findings.

A limitation of the current study is the use of self-report instruments, although it is the predominant methodology in current research on the topic. When this would be combined with parallel data collection from parents, teachers and/or peers in a multiple informant strategy it could lead to more reliable and valid estimates that are

less prone to inflated correlations as well as to recall and self-presentation biases.^{5, 6, 44} However, online, confidential self-report measures in this context have been shown to be sufficiently reliable and valid in previous research.⁴⁵ Also, the study duration was 1 year, while a longer follow-up time would provide the findings with more strength. Thirdly, even though longitudinal relationships were presented in this study, it does not mean that such relationships are causal, since third factors, such as adverse parenting practices or a bad school environment, could possibly lead to both. Lastly, the results from this relatively small study should be replicated in larger studies to increase the reliability of the findings.

Conclusions

The current study shows significant associations between bullying perpetration and victimization with psychosocial problems in adolescents. To the authors' knowledge no previous studies reported on the bidirectional paths of these particular psychosocial problems and peer bullying, while exploring specific gender differences, via a longitudinal cross-lagged panel study design in adolescents. Bullying perpetration and victimization were associated with a greater likelihood of particular psychosocial problems at follow-up as well as the vice versa effects; this means that having psychosocial problems at baseline lead to being more likely to be bullied and victimized at later times. Results illustrated significant gender differences in these relationships, in line with recent meta-analyses, but less pronounced than those found in earlier studies. These findings may have important implications for future studies as well as for parents, educators and professionals, since interventions can now be targeted and fine-tuned more specifically.

Implications for school health

Significant temporal associations were shown between current and future bullying perpetration. Similarly, the same was shown for bullying victimization and for psychosocial problems. Since bullying and being bullied both led to more psychosocial problems and vice versa, their associations to psychosocial problem development seem to form vicious circles once started. Studies showed that these consequences can be serious and long-lasting.^{4,36,37} As Kaltiala-Heino and colleagues illustrated: "*being a victim is known to be a long-lasting situation that is even repeated in new surroundings*".⁴ This suggests that interventions to prevent bullying are vital to break this dark cycle.¹⁵ Since adolescents spend most of their time in school and also experience an important part of their psychosocial development and socialization there, schools seem to be the ideal place for such intervention. As Richard, Schneider and Mallet stated, a whole-school approach (WSA) setting is probably the most effective approach to tackling school bullying.⁴⁶ Via HLM techniques they determined that between-school effects, with the climate variables of school security and the quality of student-teacher relationships were the strongest predictors of school bullying. Woods, Done and Kalsi add to this by concluding that the fact that "bullying is very much a

group process that bolsters the argument for a systemic approach to its correction".⁴¹ The Health Promoting School's whole-school approach presents such an approach and more studies should therefore aim to research its effectiveness in reducing bullying victimization and perpetration.

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CHAPTER 6

Busch V, Loyen A, Lodder M, van Yperen TA, Schrijvers AJP, de Leeuw JRJ. The effects of adolescent health-related behavior on academic performance: a systematic review of the longitudinal evidence. Rev Educ Res, online version published Jan 3, 2014.



ABSTRACT

Schools are increasingly involved in efforts to promote health and healthy behavior among their adolescent students, but are healthier students better learners? This synthesis of the empirical, longitudinal literature investigated the effects of the most predominant health-related behaviors, namely, alcohol and marijuana use, smoking, nutrition, physical activity, sexual intercourse, bullying, and screen time use (television, Internet, video games), on the academic performance of adolescents. Thirty studies dating back to 1992 were retrieved from the medical, psychological, educational and social science literature. Healthy nutrition and team sports participation were found to have a positive effect on academic performance, whereas the effects of alcohol use, smoking, early sexual intercourse, bullying, and certain screen time behaviors were overall negative. Generally, all relations of health-related behaviors and academic performance were dependent on contextual factors and were often mediated by psychosocial problems, social structures, and demographics. Findings were interpreted with use of sociological theories.

Introduction

Education and health have long been associated, and there is a growing body of evidence that various health behaviors can be positively changed by means of health promotion at school.¹⁻³ Since the late 1980s, the World Health Organization (WHO) has fostered the links between health and education by means of Health Promoting Schools (HPS), starting with the 1986 Ottawa Charter.⁴⁻⁶ This initiative has developed into comprehensive theoretical frameworks of good practices and there is empirical evidence that these initiatives improve students' health (behaviors).^{1,7}

Less is known about the effects of health-related behaviors, that are often assumed to be unhealthy in nature, on the academic performance of students.^{8,9} As Brian Flay stated in 2002 in the American Journal of Health Behavior: "We need to link prevention and health promotion with success in school and life. To date, most prevention, health promotion, character education, and social-emotional learning programs (and research) neglect the obvious link with academic achievement. Researchers who state that improved behavior might lead to improved school performance are rare."^{10 (P.407)} A recent issue of The Journal of School Health (October 2011, entitled "Healthier students are better learners?") was devoted to this subject, with articles focusing on the effects of, for example, aggression, physical activity, and eating breakfast on educational outcomes.¹¹⁻¹³ The gist of the articles was that certain health-related behaviors affected students' academic performance.

Most studies to date have focused on the associations between adolescent health-related behaviors and educational performance, using a cross-sectional study design, which limits the possibility to predict possible causal pathways¹⁴, and only few studies have reviewed the longitudinal evidence for such effects. The aim of this study was to systematically review the longitudinal effects of adolescents' most prominent health-related behaviors on their academic performance.

Methods

This systematic literature review was designed according to the Cochrane Collaboration's definition, as elaborated further in the PRISMA and MOOSE statements.¹⁵⁻¹⁷

Search Strategy

Six databases (PubMed, PsycInfo, Embase, Web of Science, Education Resources Information Center (ERIC) and Cinahl) were systematically searched using a comparable search strategy, with adapted index terms per database. These databases were selected as being the main databases in the fields of health and medical sciences, psychology, social sciences, and education research. The health-related behaviors investigated were those of WHO's Health Behavior in School Aged

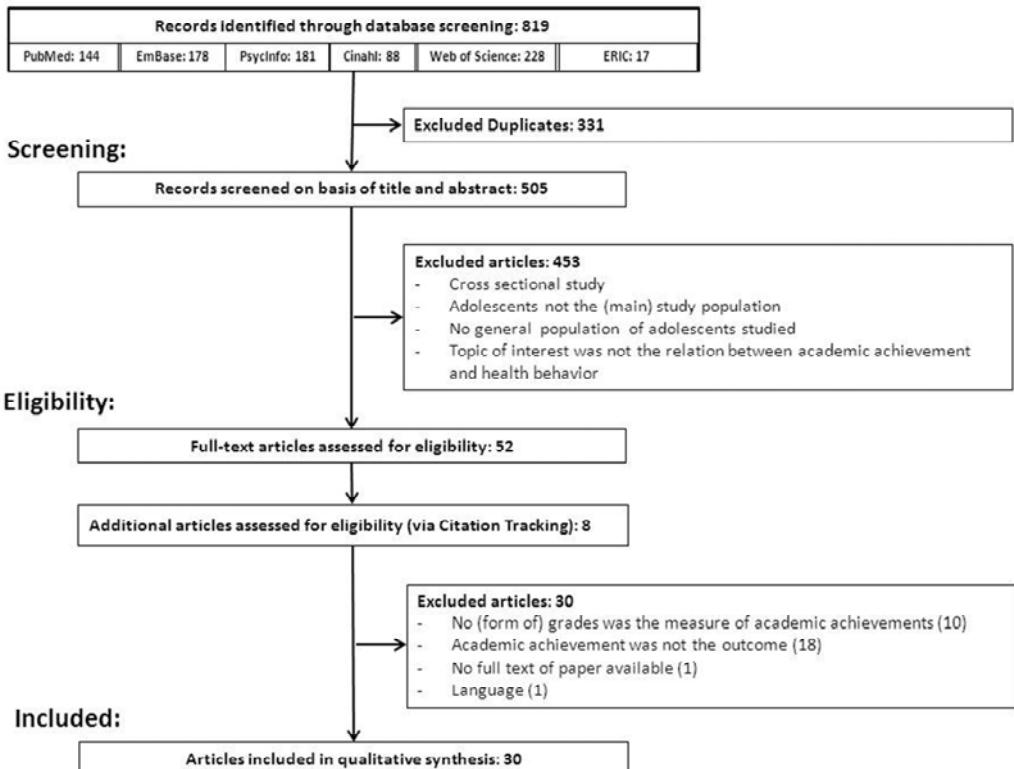
Children (HBSC) survey: alcohol use, marijuana use, smoking, physical activity, nutrition, bullying/being bullied, sexual activity, watching television, Internet use, and video game playing. Four components (the target population were adolescents, the study entailed research on academic performance and on one or more of the specified HBSC health-related behaviors, and the study design was longitudinal) were combined by the Boolean "AND" function. Synonyms, conjugations, and plural forms of the search words were also included; both UK and US English versions of words were used. Filters were set (if possible) to only include peer-reviewed articles, written in English, and published between 1992 and 2012. Articles were included if the search terms were used in the title and/or abstract or for indexing in the database. The year 1992 was chosen as starting date because in that year the WHO, UNESCO, and UNICEF jointly published the report "*Comprehensive school health education suggested guidelines for action*", stating the importance of creating stronger alliances between the education and health sectors by means of comprehensive school health promotion.⁶ Furthermore, the search strategy was peer reviewed by a second, independent researcher. See the Appendix for an example of a search string for PubMed.

Study Selection Procedure

Retrieved articles were exported to Reference Manager and duplicates were hand searched and removed. Then, based on the title and the abstract, two independent researchers included from the retrieved articles only original research papers that studied school grades as the outcome variable of interest in which health-related behavior(s) were the predicting variable(s) of interest and the study population entailed a general population of adolescents. Both qualitative and quantitative studies were included, as long as they had a longitudinal design; editorials, presentations, conference reports, and commentaries were excluded. Inconsistencies in the decision to include or exclude a study were resolved by a third independent researcher; this was rarely necessary. Of the remaining articles, full-text copies were retrieved. If this was not possible, all authors were contacted by email. Those articles were similarly assessed for inclusion as described above. Their references were then scanned (citation tracking) for further relevant source papers and similarly in-/excluded. Reviews, on basis of not containing original empirical research, were used for citation tracking only.

Figure 1 Flow Diagram of the Review Inclusion Process according to the QUORUM Statement 15.

Identification:



Data Extraction Process

Two authors independently extracted the following data from the included studies: (1) study design; (2) type of data collected; (3) number of participants; (4) health-related behaviors studied; (5) operationalization of health-related behaviors and educational performance; (6) duration of the study and follow-up; and (7) main study findings. Disagreements were again resolved by discussion between the two review authors, and if necessary by a third independent researcher.

Results

The search retrieved 819 citations, 329 of which were duplicate publications. Of the remaining 490 studies, 438 were not eligible for inclusion (see Figure 1). Another 30 articles were excluded after review of the full-text articles. Citation tracking identified 8 previously unidentified studies, leaving 30 articles that met inclusion criteria and which were included in the review (Table 1).

Table 1 Main Characteristics of all retrieved Studies.

Behavior(s) studied	Main author	Year	Duration	N	Location	Study design
Sexual behavior	Resnick	1994	5 years	1.806	USA	Retros. cohort
Sexual behavior	Schvaneveldt	2001	10 years	1.145	USA	Prosp. cohort
Sexual behavior	Sabia	2007	5 years	27.000	USA	Prosp. cohort
Sexual behavior	Tubman	1996	2 years	1.167	USA	Prosp. cohort
Smoking	Tucker	2008	10 years	6.527	USA	Prosp. cohort
Smoking	Pennanen	2011	2 years	2.188	Finland	RCT
Smoking	Ellickson	2001	5 years	4.327	USA	Prosp. cohort
Alcohol use	Balsa	2011	1 years	4.292	USA	Prosp. cohort
Alcohol use	Peleg-Oren	2009	1 years	12.352	USA	Prosp. cohort
Alcohol use	Sabia	2009	1 years	16.721	USA	Prosp. cohort
Alcohol use & physical activity	Crosnoe	2002	3 years	2.651	USA	Prosp. cohort
Physical activity	Broh	2002	2 years	12.578	USA	Prosp. cohort
Physical activity	Coe	2006	1 years	214	USA	RCT
Physical activity	McNulty-Eitle	2002	2 years	10.087	USA	Prosp. cohort
Physical activity	McNulty-Eitle	2005	2 years	5.081	USA	Prosp. cohort
Physical activity	Hanson	1998	2 years	11.683	USA	Prosp. cohort
Physical activity	Miller	2005	2 years	586	USA	Prosp. cohort
Physical activity	Nelson	2006	1 years	11.957	USA	Prosp. cohort
Physical activity & screen time	Dumais	2008	2 years	15.362	USA	Prosp. cohort
Screen time	Gentile	2011	2 years	3.034	Singapore	Longitudinal panel study
Screen time	Johnson	2007	8 years	678	USA	Prosp. cohort
Screen time	Sharif	2010	2 years	6.468	USA	Prosp. cohort

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Screen time	Smith	1992	2 years	1.208	USA	Prosp. cohort
Bullying & screen time	Norris	2010	2 years	Unknown	USA	Prosp. cohort
Bullying	Beran	2009	1 years	4.111	Canada	Retros. cohort
Bullying	Forrest	2012	2 years	1.457	USA	Prosp. cohort
Bullying	Juvonen	2011	3 years	2.300	USA	Prosp. cohort
Bullying	Rothon	2011	2 years	2.093	UK	Prosp. cohort
Bullying	Stavrinides	2011	2 years	238	Cyprus	Prosp. cohort
Nutrition	Chen	2002	1 years	690	Taiwan	Prosp. cohort

Study Characteristics

Some studies investigated more than one ‘unhealthy’ behavior. Out of the total of 30 included studies, seven investigated the effect of substance abuse on students’ academic performance (3 investigated smoking and 4 alcohol use; none investigated the effect of marijuana use), 6 the effects of being bullied and/or bulling, 4 the effects of (early) sexual intercourse, 9 the effects of physical activity, 1 the effects of nutrition, and 6 the effects of screen time use (1 on Internet use, 4 on playing video games, and 4 on watching television) (Table 1). Important to note is that it may seem that the total number of studies exceeds 30 in tables other than Table 1, but this is because some studies included more than one type of health-related behavior and the tables were ordered per type of behavior. The study designs were fairly uniform (24 prospective cohort studies, 3 retrospective cohort studies, 2 randomized controlled trials, 1 prospective panel study). Most studies ($N = 24$) came from the United States; the remaining studies came from Canada, Cyprus, the United Kingdom, Singapore, Taiwan and Finland. The number of study participants ranged from 214 to more than 27,000, and study duration ranged from 1 academic year to more than 10 years; only 3 of the 30 studies lasted more than 5 years. The quality of the included studies was assessed, inspired by the STROBE statement¹⁸ (Table 2). The main study findings are summarized in Table 3.

Table 2 Overview of the Quality of the included Studies.

Main author	Sample characteristics			Loss to follow-up	Address missing data	Statistical analyses		MI ^a analyses
	Nat.	SES	Ethn.			Demogr. Cor. ^b	Behav. Cor. ^c	
Resnick	Yes	Div.*	Div.	12-18	Unkn.	No	Yes	No
Schwanenvelt	Yes	Div.	Div.	7-22	50%	Yes	Yes	Stratified by gender and ethnicity.
Sabia (2007)	Yes	Div.	Div.	12-18	29%	Yes	Yes	Stratified by gender and age.
Tubman	No	Restr.	Restr.*	15-17	<10%	Yes	Yes	Stratified by gender.
Tucker	No	Div.	Div.	13-23	34%	Yes	Yes	Stratified by gender and age.
Pennanen	No	Div.	Div.	13-16	20%	Yes	Yes	Interactions with gender and intervention.
Ellickson	No	Div.	Div.	12-18	33%	Yes	Yes	No.
Balsa	Yes	Div.	Div.	12-18	54%	Yes	Yes	Stratified by gender and interactions with age and baseline GPA.
Peleg-Oren	Yes	Div.	Div.	13-18	N/A	No	Yes	Stratified by gender and race.
Sabia (2010)	Yes	Div.	Div.	12-18	29%	Yes	Yes	Stratified by gender.
Crosnoe	No	Div.	Div.	14-17	36%	Yes	Yes	Unclear
Broh	Yes	Div.	Div.	13-18	49%	Yes	Yes	Mediations by general self-esteem.
Coe	No	Restr.	Unkn.*	11-13	7%	No	No	Stratified by gender and ethnicity.
McNulty-Elle and Elle	Yes	Div.	Div.	13-16	21%	Yes	Yes	Stratified by gender with race interactions.

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McNulty-Elite	Yes	Div.	13-16	21%	Yes	Yes	No	Stratified by gender with race interactions.	Yes
Hanson	Yes	Div.	15-18	61%	No	Unkn.	Yes	Stratified by gender.	No
Miller	No	Div.	13-18	< 20%	No	Yes	Yes	Stratified by gender and race.	No
Nelson	Yes	Div.	12-18	19%	Yes	Yes	Yes	Behavioral cluster analyses.	Yes
Dumas	Yes	Div.	15-18	24%	Yes	Yes	Yes	Stratified by SES-quartiles.	No
Gentile	Yes	Div.	7-15	12%	Yes	Yes	Yes	No.	Yes
Johnson	No	Div.	14-22	13%	No	Yes	No	No.	No
Sharif	Yes	Div.	10-14	30%	No	Yes	Yes	Mediation by substance use, problem behavior and sensation seeking.	No
Smith	No	Div.	12-15	24%	Yes	Yes	Yes	Interaction by SES.	No
Norris	Yes	Div.	14-22	Unkn.	Yes	Yes	Yes	Mediated by excessive Internet use, gender and race.	Yes
Beran	Yes	Div.	12-15	N/A	Yes	Yes	Yes	Mediated by psychosocial problems.	Yes
Forrest	No	Div.	9-13	16%	Yes	Yes	Yes	Stratified by gender, SES, and ethnicity.	Yes
Juoronen	No	Div.	11-15	25%	Yes	Yes	Yes	Interactions with gender and ethnicity	Yes
Rothon	No	Unkn.	11-14	25%	Yes	Yes	Yes	Stratified by gender	Yes
Stavrinides	No	Unkn.	10-12	0%	No	Yes	No	Exploratory Factor Analysis	No
Chen	No	Unkn.	15-17	0%	Yes	Yes	No	No	No

Note. * Nat. Repr. = Nationally Representative, Div. = Diverse, Restr. = Restricted, Unkn. = Unknown. 1: Minimum controlling for demographic confounders, defined as controlling for gender, age, SES; 2: Corrections for confounding applied for correlated/clustering HBSC-behaviors; 3: ML = Multilevel analyses; 10 account for a hierarchical datastructure (e.g. students within classes; classes within schools). Unless explicitly stated, it was assumed that the analysis did not specifically correct for this structure via multilevel analyses.

Drinking alcohol, smoking and marijuana use.

An overview of the effect sizes of drinking and smoking on adolescents' grades is given in Table 4. The four studies that specifically investigated the effects of alcohol use on academic performance revealed that alcohol use has a more complex effect than the often assumed straightforward negative effect, although all studies showed alcohol use to adversely affect academic performance.^{14,19,21,54} These studies were all large cohort studies including students of different ethnic and socioeconomic backgrounds and used complex multilevel, multi-behavioral models to account for the nested data structure and potential inter-behavioral confounding. Three studies specifically investigated potential gender- and race-specific effects, to unravel causal pathways.^{14,19,21}

Two of those studies reported that (extreme) alcohol use by adolescents had a much smaller effect on academic performance than is often assumed.^{14,21} They stated that poorer school performance was significantly subject to interactions with socioeconomic status (SES), gender and/or pre-existing psychosocial problems. It was found for example that increased alcohol consumption significantly lowered the Grade Point Average (GPA; commonly used measure for school grades in North America) in boys, although with relatively small effect sizes, whereas no such associations was found in girls.¹⁴ In addition, they stated that inter-behavioral confounding often arises when clustered behaviors (e.g. smoking, alcohol use and drug use) are analyzed without using multi-behavioral analyses; then effects are likely to be overestimations of true effects.²¹

Most investigators explained the relation between alcohol use and academic performance in terms of Social Exchange Theory (SET).²² Simplified, this theory states that certain behaviors or actions are driven by the reciprocal benefit that one gains from it. Thus, via SET these interactions are viewed in a more or less cost-benefit manner. Concretely, this theory was used to demonstrate that the gain in students' social status due to alcohol use acted as a positive stimulus for their school performance, while other effects of alcohol use impaired their school performance; the net balance of this was a negative effect on alcohol users' grades. Some others explained their findings in lights of another theory, namely Social Capital Theory (SCT).²³ In short, SCT states that relationships can be established and purposefully be employed to generate material and immaterial benefits. The benefits could be social, psychological, emotional and economical. As Coleman put it: "*just as physical and human capital facilitate productive activity, social capital does as well*".²³ In the study by Crosnoe (2002) this theory was similarly used to illustrate that alcohol use causes a trade-off to be in place of social capital by balancing a student's relatedness to school versus popularity and stronger relations with peers.¹⁹ Overall, all four studies reported alcohol use to adversely affect the academic performance of adolescents.

Three studies investigated the effects of smoking on school grades.^{20,24,25} While the study populations were ethnically and socioeconomically diverse, they were not representative. Loss to follow-up was average (20–30%) and the studies used multilevel analyses to cope with the nested data structure (Table 2). As shown in Table 4, all three studies found smoking to adversely affect students' grades, but none provided a specific theoretical framework to explain the observed effect of smoking and possible causality.

There were no longitudinal studies that primarily assessed the effects of marijuana use on adolescents' academic performance; only one study investigated marijuana as part of a combined substance use measured together with smoking and alcohol use.¹⁹

Sports and Physical Activity

Nine studies investigated the effect of physical activity on students' grades.^{19,26–33} These were all relatively large studies that involved nationally representative samples of adolescents, with the exception of two.^{27,33} These were much smaller studies and not nationally representative. All studies investigated the effects of potential modifiers such as SES, gender, race, and (general) self-esteem measures. Only one study used multi-behavioral analyses to account for possible confounding by inter-behavioral correlations with several unhealthy behaviors²⁶, and only one used a multilevel structure to account for the nested data structure.²⁸ Loss to follow-up varied significantly across studies, from 7%³³ to 61%³⁰ (see Table 2). In general, participation in sports teams and interscholastic sports (e.g. school football, basketball, or soccer) had a positive effect on students' grades, whereas doing individual sports, cheerleading, and physical exercise had a more mixed effect (see Table 4).

Most studies concluded sports participation to benefit students' school grades.^{26,27,30,33} However, with the exception of one³³, none found a simple, straightforward association (more sport leading to better grades). For example, one study found interscholastic sports to have a more pronounced effect on school grades than intramural sports or cheerleading³², while two others found there to be significant interaction effects between gender, ethnicity, and especially SES that modified the association between sports participation and academic performance.^{29,30} These investigators found white, upper-class female athletes' grades to benefit the most from sports participation. In a follow-up study, similar interactions were demonstrated, but these were less consistent than in the original study.²⁸

Table 3 Retrieved studies: predictor measures, outcome measures, and main finding(s).

Author	Predictor(s)	Outcome(s)	Main Study Finding(s)
<u>Substance use (smoking, alcohol- and marijuana use)</u>			
Tucker	Active smoking (and quantity and frequency)	Self-reported grades	Reciprocal association between smoking and academic performance, with smoking acting as a stronger antecedent of poor grades than a consequence.
Pennanen	Smoking	Standardized grade scores	Bidirectional relationship was found between smoking and academic performance.
Ellickson	Non-smokers, experimenters, smokers	Grades \geq C	Compared with non-smokers, early smokers in grade 7 were more likely to have academic problems (...) By grade 12 experimenters had academic difficulties.
Balsa	Alcohol use	GPA1	Alcohol use affected students' grades negatively, but modestly. Significant gender differences were reported.
Peleg-Oren	Early onset alcohol use	Self-reported and school record grades	Early alcohol use was related to poorer academic performance.
Sabia (2009)	Frequency of Binge Drinking	GPA	Effect was shown for alcohol use on academic performance, until correcting for drug use and psychosocial well-being.
Crosnoe	Combined substance use measure.	GPA	Substance use negatively affected students' grades; these effects were strongest for females and/or athletes.
<u>Bullying/Being bullied</u>			
Beran	Self-reported harassment	Self- and Teacher report of grades	Peer-harassed adolescents performed worse academically, mediated by disruptive behavioral problems and poor peer-interactions.
Forrest	Healthy Pathways Child-Report Scale	State Achievement Test Scores	Significant relation between higher State Achievement Test Scores and low bully victimization levels.
Juvonen	Modified Peer Victimization Scale	GPA	Being bullied affected students' poor grades negatively.
Norris	Christie-Metzel bully behavior scale	PIAT-score2	Only in combination with excessive Internet use did bullying/being bullied affect students' grades.

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Rothon	Olweus Bully-Victim Score	GLES-Score > 53	Girls' grades were negatively affected by being bullied.
Stavrinides	Olweus Bully-Victim Score	Academic achievement test	Both behaviors negatively affect academic performance.
Sexual behavior			
Resnick	Early sexual intercourse (<10 yrs)	Below average GPA	Early onset of sexual intercourse was related to poorer academic performance.
Schvaneveldt	Age of first sexual intercourse	Self-perceived academic performance	Earlier onset of intercourse was associated with poorer academic performance.
Sabia (2007)	Ever sexual intercourse	Self-reported GPA construct	For females a small effect was found, but in general no substantial effects were found.
Tubman	Variety of sex-behavior related issues	GPA	Earlier sexual onset was significantly related to lower grades.
Physical activity			
Broh	Participation in sports	Standardized grade scores	Positive relation between participation in sports and academic performance across all measured dimensions.
Dumais	Hours of sports/week	NCES IRT-score4; GPA	Negative association with non-school related activities such as sports participation.
Coe	Self-reported physical activity	GPA construct Terra Nova Scores5	Vigorous physical activity patterns led to improved grades.
Crosnoe	Self-reported extracurricular activities	Self-reported GPA	Positive relation of sports participation and academic performance.
McNulty-Eitle	Self-reported sports participation	Standardized test scores	Positive effects of sports participation on grades.
McNulty-Eitle and Eitle	Self-reported sports participation	Self-reported grades	Basketball or football team sports were not associated with higher grades, participation in "other sports" was.
Hanson	Self-reported participation in sports and cheerleading	Self-reported grades and standardized test scores	Negative association between academic performance and cheerleading. No other significant associations.

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Miller	Self-reported sports participation	Self-reported GPA	Female athletes reported higher grades.
Nelson	Self-reported sports behavior in groups	Self-reported grade scoring	High grades related to higher grades.
Nutrition			
Chen	Breakfast attendance	Standardized grade scores	School performance is negatively affected when breakfast is omitted.
Screen time (Video game playing, Internet use and watching television)			
Gentile	Hours/week gaming	School Performance Score	Excessive video game playing negatively affects academic performance.
Johnson	Hours/week watching TV	School grades	Excessive/Frequent TV watching showed a relationship with poorer academic results.
Dumais	Hours/week gaming and watching TV	NCES IRT-score	Study shows a negative relationship between video game playing and watching TV and academic performance.
Norris	Hours/week gaming and internet use.	GPA	Excessive Internet was negatively associated with reading and vocabulary performance. Excessive online gaming showed a positive association with reading performance.
Sharif	Hours/week gaming and watching TV	PIAT score	Adverse effects for both behaviors on school performance, mostly due to increased sensation seeking behavior.
Smith	Hours/week watching TV	Self- and Parental grade reporting	Effects depended on (parental) SES: students with higher SES are negatively impacted on their academic performance by excessive television watching, whilst the associations are significant for better grades in low SES students.

1: Grade Point Average; 2: Peabody Individual Achievement Test; 3: General Certificate of Secondary Education Examinations; 4: National Center for Education Statistics Item Response Theory Score; 5: National standardized test score for educational performance.

Thus, most studies concluded that the observed effects were not explained by the “physical activity component” of sports but instead by the “team component”. It was hypothesized that the beneficial academic effect of school sports was because sports participation helped students climb the social status ladder and gain entry to certain social groups (SCT)³² Such networks may create beneficiary social capital through the acquisition of new information, resources, opportunities, and networks, which in turn

may improve students' academic performance.^{26,32} "students who are engaged in activities become more aligned with society's dominant institutions (i.e. school) and thus devote more time to their schoolwork"²⁶ This was stated to be an important pathway by which school sports exert their positive effects, given that interscholastic sports have greater effects on students' grades than individual or out-of-school sports^{26,28,29,32} Another study showed that participation in school music groups (which is assumed to convey benefit as a result of similar social network gains) influenced students' academic performance to the same extent as sports team participation did³², strengthening confidence in a SCT explanation of effects. Similarly, the physiological explanation that students that exercise during the school day are more aroused, concentrated and have an increased attention span to benefit performances was even more rebutted by the studies that differentiated between types of sports, because similar activity levels had different effects on academic performance, whereas one would expect all athletic students to show similar improvements^{26,30,32} Finally, the differing effects seen in different SES groups³⁰ or in males and females²⁹ made for an even stronger case for the 'socialization explanation'.

Table 4 Health Behavior and School Grades: Specific Main Study Effects.

Study	Follow-up ¹	Predictor measure(s)	Outcome measure(s) and range	Main Study Effect(s) ³
Substance use (smoking, alcohol- and marijuana use)				
Tucker Pennanen	10 years 2 years	Smoking vs. not smoking Never smoked (1), <1/month (2), >1/month (3, >1/week [4])	GPA ² GPA on 6-point scale	$\beta = -.12^*$ Standardized Correlation Coefficient: .24**
Ellikson Balsa	5 years 1 year	Non-smokers, experimenters, regular smokers Alcohol use: >100 drinks/month [2] Monthly Binge Drinking	Grades $\geq C$ GPA	OR 2.00-3.00* >100 drinks/month: Boys: $\beta = -.06$ [SE .03] Girls: $\beta = .03$ [SE .04] Monthly Binge Drinking: Boys: $\beta = .04$ [SE .03] Girls: $\beta = .07$ [SE .04]
Pelegrinen	1 year	Alcohol use: Non-users (1), early users, $<$ age 13 (2, very early users \geq age 13 [3])	GPA, $<C$	Very early vs. early users: OR 2.29 [1.64, 3.19]* Very early users vs. nondrinkers: OR 3.22 [2.02, 5.10]*
Sabia (2009)	1 year	Alcohol use: Binge Drinking ≥ 2 /month [not = 0, yes = 1]	Overall GPA construct: 4-point range	Binge Drinking: Girls: $\beta = .08$ [SE .05] Boys: $\beta = .12$ [SE .05]*
Crossnoe	3 years	By athletic status and gender	GPA, 4 pt. range	Boys: non-athletes: $\beta = -.01$ [SE .05] athletes: $\beta = .07$ [SE .03] Girls: non-athletes: $\beta = .01$ [SE .02] athletes: $\beta = .07$ [SE .03]*
Bullying@/Being bullied				
Beran Forrest	1 year 2 years	Being bullied	GPA	Unable to retrieve direct effect. Not being bullied: $\beta = 1.70^{***}$
		Being bullied: low bully victim score	State Achievement Test	

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Nomis	2 years	Bullying: Bullying score		PIAT Math test score ³	Being Bullied: B: .00 [SE .00] Being Bullied: B: .00 [SE .00] Being bullied: OR 46 [28-76]**
Rothan	2 years	Being bullied		PIAT Vocabulary score	
Stavrinides	6 months	1) Being bullied, 2) Bullying		Grades ≥ D	
				Overall achievement score	Being bullied: β = -.23* Bullying: β = -.55**
<hr/>					
Resnick	5 years	Early onset sexual intercourse (<10 years)	Below average GPA	Boys: OR 1.47*, Girls: not sign/reported.	
Schwanneveldt	6 years	Sexually active yes/no	GPA	β = -.35*	
Sabia (2007)	5 years	Sexually active yes/no	GPA	Boys: β = -.20*, Girls: β = -.17	
Tubman	2 years	Age of first sexual intercourse	GPA, 7 pt. range	Significant correlation***	
<hr/>					
Broh	2 years	Sports participation: 1) intrascholastic, 2) interscholastic	Physical activity	Interscholastic: B = .06 [SE .01]*** Intramural: B = -.067 [SE .02]***	
Schwanneveldt				Interscholastic: B = .005 [SE .02]	
Sabia (2007)				Intramural: B = -.096 [SE .03]***	
Tubman				Interscholastic: B = .111 [SE .02]***	
				Intramural: B = -.194 [SE .04]***	
				Interscholastic: B: .141 [SE .02]***	
				Intramural: B = -.193 [SE .03]***	
Dumas	2 years	Hours of sports/week	GPA	Hours sports / week: B = -.02 [SE .00]***	
Coe	1 year	Sports participation: low (1), medium (2), vigorous (3)	GPA	Hours sports / week: B = -.30 [SE .030]***	
Crosnoe	3 years	Sports participation by gender: male non-athletes are the reference category	GPA, 4 pt. range	Low to vigorous activity: +10% in test scores [1] and grades [2]; not significant.	
				Boys athletes: β = .09 [SE .04]* Girls: non-athletes: β = .10 [SE .04]** athletes: β = .18 [SE .04]***	

McNulty-Elite and Elite	2 years	Sports participation: 1) Football, 2) Basketball, 3) other interscholastic sports	1) Standardized composite GPA score, range 0-4, 2) Stand. Math-Reading tests composite range 30-70 pts. [M 50.25 pts., SE 0.25]	GPA: Football OR 1.03 Basketball OR 1.71*** Other OR 1.51***
		Team and individual sports participation	Test scores in Math Test scores in Science	Test score: Football: OR .99 Basketball OR .98*** Other: OR:1.00
McNulty-Elite	2 years	Team and individual sports participation	Team sports: boys: $B = 1.21$ [SE .57]*** Indiv. sports boys: $B = 1.08$ [SE .57] Indiv. sports girls: $B = 95$ [SE .44]* Team sports: boys: $B = .84$ [SE .50] Team sports: girls: $B = 1.19$ [SE .41]** Indiv. sports boys: $B = 1.19$ [SE .52]** Indiv. sports girls: $B = 1.02$ [SE .36]** Team sports: boys: $B = .01$ [SE .051] Team sports: girls: $B = .68$ [SE .043] Indiv. sports boys: $B = .08$ [SE .47] Indiv. sports girls: $B = .55$ [SE .41]	Team sports: boys: $B = 1.49$ [SE .39]*** Indiv. sports boys: $B = 1.08$ [SE .57] Indiv. sports girls: $B = .95$ [SE .44]* Team sports: boys: $B = .84$ [SE .50] Team sports: girls: $B = 1.19$ [SE .41]** Indiv. sports boys: $B = 1.19$ [SE .52]** Indiv. sports girls: $B = 1.02$ [SE .36]** Team sports: boys: $B = .01$ [SE .051] Team sports: girls: $B = .68$ [SE .043] Indiv. sports boys: $B = .08$ [SE .47] Indiv. sports girls: $B = .55$ [SE .41]
		Sports participation	GPA	Sports Participation: Boys: $\beta = .06^{**}$ Sports Participation: Girls: $\beta = -.06^{**}$ Sports Participation: Boys: $\beta = -.09$ Sports Participation: Girls: $\beta = .12^{**}$ RR 1.08 [1.01, 1.15]* RR 1.06 [99, 1.13]
Hanson	2 years	Sports participation	Last grade in math: an A	Nutrition
		Sports participation	Last grade in English: an A	GPA ranking on Math GPA ranking on Chemistry GPA ranking on Chinese GPA ranking on Chemlab GPA ranking on Anatomy GPA ranking on English
Miller	2 years	Sports participation		Correlation Coefficient: .48** Correlation Coefficient: .49** Correlation Coefficient: .47** Correlation Coefficient: .44 Correlation Coefficient: .42** Correlation Coefficient: .48**
		Physical activity, >5 times/week		
Nelson	1 year			

Screen time (Video game playing, Internet use and watching television)					
Gentile Johnson Dumais	2 year 8 years 2 years	Compulsive gaming; GPA difference compulsive gamers and other students. Watching TV: <1hr/day versus >3hrs/day Hours/ week: 1) (online) gaming, 2) watching TV	GPA: 1) 1 year follow up. 2) 2 year follow up Grades ≥ D	1) GPA Difference: $B = -0.48^*$ 2) GPA Difference: $B = -0.41^*$ OR 1.64 [1.08-2.46]^*	
Noms	2 years	Internet use: 1) E-mail, 2) chatting, 3) games, 4) surfing	Standardized PIAT Math score	Gaming: $B = -.42$ [SE .10]*** TV: $B = -.71$ [SE .08]*** Gaming: $B = -.04$ [SE .01]*** TV: $B = -.02$ [SE .01]*** Email: $B = .00$ [SE .00]	
Sharf	2 years	Hours/week: 1) (online) gaming, 2) watching TV	Standardized PIAT Vocabulary score	Chatting: $\beta = -.01$ [SE .00]* Surfing: $\beta = .00$ [SE .00] Gaming: $\beta = .00$ [SE .00] Email: $\beta = .01$ [SE .00]	
Smith	2 years	Hours/weekwatching TV	School performance: 1) excellent, 2) good, 3) low	Chatting: $\beta = -.01$ [SE .00]* Surfing: $\beta = .00$ [SE .00] Games: $\beta = .00$ [SE .00] Gaming: $\beta = .10^{***}$ Watching TV $\beta = .13^{***}$ B-.03 [SE .05] B-.11 [SE .07] B-.17 [SE .09] B-.07 [SE .09]	

Note: All effects were presented with their 95% confidence intervals (in case of OR's) or with their respective p-value (in case of B's or Beta's) where possible. Effects that lack these specifications were presented as such due to lacking information in the original papers. * = $p \leq 0.05$, ** = $p \leq 0.01$, *** = $p \leq 0.001$. 1: Follow up period here stands for the period of time for which the specific data presented in this table are presented in each study, it does not necessarily present the total study duration; 2: Grade Point Average; by default this measure is indicated by a 5-point range, since most studies used this measure; 3: Peabody Individual Achievement Test; 4: General Certificate of Secondary Education Examinations; 5:8 = unstandardized effect size measure; β = standardized effect size measure.

Nutrition

Only one study investigated the effects of healthy nutrition on school grades.³⁴ This study was small and relatively limited in quality (Table 2). Skipping breakfast and having irregular dietary patterns were both found to be significantly associated with poorer grades across a variety of school subjects (Table 4).

Bullying

Six studies investigated the effect of bully behaviors (i.e. bullying and/or being bullied) on school grades.³⁵⁻⁴⁰ These studies were all of small to modest size. All had a diverse, but not nationally representative population of teenagers regarding SES and ethnicity, with the exception of one representative study.³⁵ One study lacked a description of the participants' demographic characteristics.⁴⁰ All six studies had a relatively low loss to follow-up (0% - 25%), and all emphasized studying causal pathways by studying interactions with gender^{36,37,39}, SES³⁶, and psychosocial problems.^{35,40}

The authors of all six studies concluded that bully behaviors affected school grades. Most analyzed direct effects of this and indirect effects via mediation of psychosocial problems. Although revealing, these characteristics make it difficult to compare the effects of bullying to the effects of other behaviors (Table 4).

Two studies found that bully behaviors did not directly influence academic performance.^{35,36} Instead, the adverse effects of bullying on academic achievement resulted from mediation by psychosocial problems in those studies. Bullied adolescents obtained lower grades than their non-bullied peers because they had more emotional problems, conduct problems, and hyperactivity, and had fewer pro-social skills. Several authors concluded that it is predominantly the students who have difficulties interacting with peers and managing behavior problems such as hyperactivity and misconduct who perform poorer academically when being bullied^{35,36,40}. Similar social stressors and depressive symptoms were also found to be similar mediators of this association.^{37,39}

Two studies even showed that fear of being bullied already adversely affected the relationship with teachers and peers.^{35,36} This avoidance and mistrust has been shown to lead to lower grades and avoidance of academic tasks. Being bullied was also found to lead to conduct problems and emotional problems, both of which also adversely affect academic performance. Authors of the included studies suggested that bully behaviors should be seen as part of a dynamic interplay with other aspects of a child's socialization processes rather than simply as a cause or effect of poor adjustment. The observation that the support of family and friends is protective against the academic effects of bully behavior further lends support to this explanation.^{37,39}

In summary, evidence showed that being bullied may lead to lower school grades as a result of causing psychosocial problems, which have been shown to adversely affect academic performance in adolescents. When being bullied did not lead to

psychosocial problems, the association between being bullied and school grades was much weaker or even absent.

Sexual activity

Four papers studied the effect of early sexual activity on school grades and all reported negative effects⁴¹⁻⁴⁴ (see Table 4). All studied representative populations except one which used a restricted population regarding SES and ethnicity.⁴⁴ All four performed gender-specific analyses of which one additionally used age-specific stratified analyses and multilevel models⁴²; this was also by far the largest study (>27,000 versus 1145-1806 participants (Table 2)).

Although having sex is not a risky health behavior per se, some aspects, such as lack of condom use or early intercourse initiation, are associated with certain health risks and therefore can be seen as risky behaviors. All four studies tackled the issue of early sexual initiation and found significant associations between early intercourse initiation and poorer school grades. They all concluded that this association seems more complex than a straightforward, negative causal effect; they studied explanations by third factors, such as other health-related behaviors, SES, race, family conditions. One of the studies reported possible confounding by other, related psychosocial problems and behavioral problems, such as alcohol use and delinquency⁴⁴: “among some adolescents, the co-occurrence of intercourse onset and rapid increases in delinquent behavior may reflect greater integration into deviant peer networks, the increasing importance of peer relationships, and/or the overt expression of autonomy from parents and other authority structures such as school”.⁴⁴ The authors also found that teenagers who started having sex relatively later were more influenced by protective factors, such as a having strong family support and a higher SES. In general, when behaviors such as early sexual intercourse were considered ‘normal’ in teenagers’ social environment, these behaviors were less related to a decrease in school grades, because interest in academic performance was already lower in these groups. Tubman and colleagues concluded that SES and social environment (eg, peer groups and family support) explained most of the seen association of being sexually active early and school grades.⁴⁴

Consistent findings were reported by two other studies that also concluded these social factors to confound the relationship between early sexual intercourse initiation and school grades.^{41,43} They also explained these findings with SET and SCT; possible rewards (i.e. capital or exchange) for sexual intercourse initiation could be peer group acceptance, satisfying curiosity about sex, or an increase in status, whereas rewards for not initiating such behavior would be a better position on the job market or attending a better university as a result of a better academic performance. The way that these interests were perceived, differed by SES group and by social/family environment and support, similar to the findings of Tubman et al.⁴⁴ Some students felt that school was not

useful and would not provide them with positive things such as a better position on the job market in the future. In these students, sexual intercourse initiation hardly changed their perception of the value of good school grades and thus sexual activity had the least effect on school grades. This effect was strongest among black, low SES males, who had the most negative view about the educational and occupational opportunities open to them in the USA; white high SES females were on the other end of this "spectrum".⁴³

The findings of the three smaller studies were generally confirmed in the one study that was much larger than the others on the topic.⁴² That study found that the effect of sexual initiation was substantially reduced in terms of effect size and statistical significance when a multi-behavioral approach was applied with correction for social factors. The gender differences identified in the other studies could also in part be explained by underlying socioeconomic constructs and the perceived benefits that intercourse initiation offers in contrast to higher school performance.⁴²

Watching TV, playing video games and internet use: screen time behaviors

Screen time behaviors (watching TV, playing (online) video games, and Internet/computer use) showed to have complex effects on school grades (Table 4).^{26,38,45-48} The six studies on this topic all had socioeconomically and ethnically diverse study populations with average losses to follow-up of 12–30% (one study did not provide relevant data³⁸). All corrected for confounding by age, SES, and gender. Their statistical analyses included application of multilevel models^{38,45} and corrections for possible inter-behavioral confounding.^{45,47} In addition, three also looked at possible interaction effects with other health behaviors, SES, and psychosocial problems.^{38,47,48}

Firstly, excessive television watching was associated with developing attention problems, learning difficulties, and adverse long-term educational outcomes.⁴⁶ Adolescents that watched 1 or more hours of television a day had a higher risk of poor homework completion, negative attitudes toward school, poor grades, and long-term academic failure than non-television-watching adolescents. Adolescents who watched 3 or more hours of television daily were even more likely to experience these outcomes. However, two studies reported that these effects are not likely to be simple and straightforward because of evidence that showed educational television programming had positive effects on cognitive development during childhood.^{46,48} Both studies showed similar mediating effects of the "screen content"; entertainment content affected grades negatively while educational content improved them. Eventually, though, watching television had a net negative overall effect due to the more frequent watching of entertainment.^{46,48}

Secondly, playing video games and Internet use showed similar complex effects. Certain online behaviors (e-mailing) stimulated grades, whereas others (chatting)

negatively affected them.³⁸ Also, the overall hours of Internet use affected grades negatively, whereas playing video games online improved them. Parallel to screen content, what someone did online was the most important mediating factor in the effects of gaming and Internet use. Gaming improved one's grades when cooperation with friends in multiplayer games was required; this was hypothesized to facilitate the socialization and emotional development of adolescents³⁸: "most games require some level of literacy and critical thinking skills to successfully navigate fields within the game, and master progressive levels".³⁸ Similar effects were reported for Internet use; e-mail use, as a more formal use of correspondence with a more extensive use of vocabulary had positive effects on one's school grades, whereas chatting did not have these benefits: "*less critical thinking and grammatical skills are being practiced in this form of internet use. Incomplete sentences and abbreviated words are the norm, and often times this can translate into bad habits of proper writing.*".³⁸

Thus, effects of screen-time should be interpreted in lights of the media content/activity.^{45,47} Several studies reported that certain screen time exposures negatively affected grades by taking time away from school-related activities and by increasing sensation-seeking behavior and normalizing deviant behavior, while not providing a positive educational trade-off.^{45,47} Effect sizes were comparable with those of factors such as SES and parenting style, which have previously been found to strongly influence school performance.⁴⁷

Multi-behavioral effects

Some studies also investigated the effects of combinations of health-related behaviors on academic performance. One looked at the combined effects of physical exercise and substance use and found that high-school students who often participated in organized sports showed different patterns of academic performance than their non-athlete peers. In general, as adolescents progressed through high school, their academic performance declined as they drank, smoked, and used drugs more frequently. Being an athlete weakened this effect (i.e. it protected).¹⁹

Another example concerned the combined effects of bullying, Internet use and playing video games on academic performance.³⁸ "Just" being bullied did not have a direct significant effect but did when excessive Internet use was used as an intermediate variable in the association with school performance.³⁸

Discussion

This systematic review included 30 longitudinal studies on the effects of different health-related behaviors on the school grades of adolescents. In general, the studies were large and of high quality and many included nationally representative samples of adolescents. The main findings showed that healthy eating habits and team sports participation had positive effects on adolescents' school grades, whereas those of

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early sexual activity, alcohol use, smoking, bullying and screen time (playing video games, Internet use, and watching television) were more complex. However, in general, these effects were not straightforward but interacted with factors such as SES and psychosocial problems.

Only a healthy nutritional pattern was positively associated with higher grades in a straightforward way.³⁴ However, this study was also performed with the least sophisticated statistical analyses. In short, it only tested correlation analyses and did not correct for demographic factors or other potential confounders. This affects its validity, because other studies showed that eg SES and psychosocial problems often affect the association between health-related behaviors and academic performance. Therefore, Chen and Liao's findings should be interpreted with caution.

The effects of smoking and alcohol use were predominantly studied without much regard to incorporate an explanation via theory. However, most authors seemed to agree that these behaviors were not a direct cause of poorer school grades, but instead were a proxy for an underlying psychosocial context that caused both. While the studies of smoking were of comparable size, design, and analytic quality, and reported similar findings, the studies of alcohol use were less uniform, with most only correcting for age, gender, and SES. One study, though, used more comprehensive analyses that also included several psychosocial constructs to study causal paths.²¹ The effects of alcohol use were much weaker, and in some instances no longer statistically significant, in the two largest studies that used the most comprehensive, multi-behavioral analyses.^{14,21} This suggests that alcohol use might indeed be a proxy for certain underlying problems or social situations. Similar findings were reported with regard to the negative effects on school grades of early sexual activity, which provides additional confidence in these findings.^{42,43} Studies on early sexual activity also concluded that SES and social environment caused the effects on school grades, rather than that being sexually active had a direct effect. The largest study on the topic, with the most advanced statistical methods, showed the weakest direct effects of early sexual intercourse initiation on school grades, with most of the association being explained by social and socioeconomic factors.⁴² Even though marijuana use is widespread among adolescents and is a potential public health problem⁴⁹, no studies were identified that primarily investigated the effect of it on school performance.

The effects of bully behaviors, sports participation, and screen time on school performance were also complex and dependent on social context factors. The effects of bully behaviors for example were shown to be subject to interactions with gender and SES, and to be mediated by psychosocial problems (i.e., bullying affected academic performance only if it caused psychosocial problems); these effects were consistent across studies. Similarly, the effects of watching television, playing video games and using the Internet were also dependent on context, underlying

psychosocial situations, and, above all, "screen content". For example, two studies showed that playing video games alone or surfing the Web led to less socialization and impaired school performance, whereas strategic, multiplayer video games or e-mailing with friends significantly improved both socialization and school performance.^{38,45} Although watching television is different from the other two screen time behaviors in that it has less potential for socialization, several studies showed that watching television for educational purposes led to better grades, whereas its use for entertainment impaired students' grades.

Interpreting the findings on the effects of health-related behaviors on the school grades of adolescents through sociological theories

Most authors interpreted their findings quite uniformly, namely by use of Social Capital Theory (SCT) or Social Exchange Theory (SET). In the context of the current review these theories use a similar social cost-benefit explanation to explain the relation of a particular behavior with academic performance. Two studies illustrated this by showing that participation in team and school sports strengthened bonds with school personnel, it raised social status, provided entry into elite peer groups, and raised aspirations for college attendance, while individual sports were negatively associated with school grades.^{19,29} Therefore, they argued, that the socialization component of sports participation seemed to counter the negative effects of the loss of study time, providing a payoff with regard to students' grades. Another example was provided by authors arguing that alcohol use leads to worse school grades due to weakened interest in academic performance "in exchange" for a gain in social status.⁵⁰ Whether the trade-off is termed 'social capital' (SCT) or the process is described as a 'social exchange' (SET), most studies seemed to support the idea of this underlying mechanism.

However, certain "behaviors" befall one, rather than that they are one's "active doing", such as being bullied. In such instances SCT or SET do not seem to explain effects. The Social Bonds Theory (SBT) would better explain the effects in these cases. SBT states that in some instances, such as with juvenile delinquents or bullied teens, certain situations lead to one's detachment from social norms, values and goals. Originally SBT was defined as "*Elements of social bonding include attachment to families, commitment to social norms and institutions (school, employment), involvement in activities, and beliefs that these things are important*".⁵¹ Similar detachment from societal/group norms is thought to be the case in bullied teens; Hirschi emphasized that adolescence plays a critical role in one's life to form social bonds and that during that time peer bonds/relations are among the most vital to determine the outcome of one's normal socialization and functioning at school.⁵¹ Bullying may damage these processes and it can lead to a student not considering school as important. Overall, the effects of social interactions and health-related

behaviors on academic performance seem strongly connected. However, this theory was not explicitly used to explain these findings within the included studies on bully behaviors and academic performance. Therefore, it is only provided here as an illustrative example that more future research on the topic is needed.

The role Of mediating demographic factors

Instead of having a direct causal effect, the effects of early sexual intercourse, smoking, and alcohol use on the academic performance of adolescents were found to be mediated by demographic characteristics such as social environment and SES. This also mostly explained the interactions with gender and race that was sometimes found. What is considered “normal” behavior was concluded to differ by SES. This was especially apparent regarding the effects of early sexual intercourse or substance use on school grades. These studies showed that social factors such as what a student expects school to bring him/her in the future, having a supporting family environment, his/her acceptance and social status peer groups, and what he/she considers to be normal, were strong moderators of the relationship between health behavior and school grades; these factors differed across SES groups.⁴⁴ These effects were found both in studies with an ethnically restricted sample and in studies with large, nationally representative study populations. Thus, in students with a lower SES, unhealthy behaviors had less effect on school performance because these students “had less to lose”, whereas healthy behaviors, such as more team sports participation, had a larger effect in these same teenagers. This strengthens confidence in the overall findings and in the theoretical explanation of the described social theories.

Strengths and limitations

This review is the first to provide an overview of the longitudinal effects of the most important health-related behaviors on the school grades of adolescents. Strong points of the study are the different research fields investigated and the inclusion of only longitudinal studies. This provided the opportunity to report on causal effects, which would not have been possible if cross-sectional studies had been included. Although this inclusion criterion reduced the number of potentially suitable studies, it led to a synthesis of evidence from relatively strong studies. Regarding the methodological quality, the choice to use school grades as the single main measure of adolescents' academic performances is an ambiguous one. It narrows the focus of the study to one specific type of educational outcome measure, while others (such as truancy or dropout rates) might also be interesting. In addition, even taking a 'single measure' such as school grades does not guarantee completely unbiased results, since the relation between behaviors and school grades is likely to be affected by different social and school factors.⁵² However, the choice to include only this single outcome did allow for better cross-study comparisons than when other outcomes such as truancy or dropout rates would also have been included. This strengthens confidence in the

findings. A weak point is that only marijuana use was included as a drug use-related behavior. Despite that this is the most common drug used by adolescents worldwide, other drugs should also be investigated in future studies. Although the behaviors investigated are internationally recognized as important health-related behaviors, other behaviors may be important in certain specific countries/regions.

Directions for future research

Since only 30 longitudinal studies were retrieved that investigated the effects of health-related behaviors on adolescents' school grades, more research is vital to strengthen the knowledge base. Important health behaviors, such as eating habits, Internet use, and marijuana use, have rarely been studied in this context at all. Since public health professionals and researchers often target these variables in school health promotion projects, they should be included more in future studies. As shown in this review, it is important that such research will also include teenagers' psychosocial context in order to properly study causal mechanisms (e.g. via mediation analyses).

Also, most studies focused on single or small subsets of health-related behaviors instead of applying a comprehensive multi-behavioral approach. This review showed that such comprehensive multi-health behavioral studies are valuable, since it is increasingly recognized that many health-related behaviors cluster. Studies should include multi-behavioral models as well as apply multilevel models to account for the hierarchical data structure that is often present in large observational studies. This is important because simpler statistical tests reject the null-hypothesis too often than the nominal alpha level suggests; in other words, when not applying multilevel models when required causes false "significant" results simply because the estimates of standard errors will be too small.⁵³ An apparent positive trend in this respect was that the studies that used multilevel modeling approaches were almost all from the last 5 years.

In conclusion, many of the included studies in this review form examples of good practices research that should inspire future investigators to study the relationship between health-related behavior and academic achievements in adolescents. Because of the importance of social factors and SES, as well as psychosocial context, future studies should involve population samples of sufficient diversity in these factors. This should be combined with multi-behavioral measurements and multilevel analysis models. Taken together, this would make for promising research to unravel the causal mechanisms between health behavior and academic performance in teenagers.

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Chapter 6

Appendix Example of a Search String in PubMed*

	Index Terms	Search terms
Aspect 1: Target population: Adolescents	"adolescent"	"adolescent", "secondary school", "high school" "middle school"
Aspect 2: Study design: Longitudinal		"cohort", "prospective", "retrospective", "prospectively", "retrospectively", "prospect", "retrospect", "longitudinal", "ethnographic", "case study", "qualitative", "case series", "trial", "causal", "case-control", "case control", "time series", "follow-up", "follow up"
Aspect 3: Study focus: Health behavior	"Alcohol", "Alcohol Drinking", "Compulsive behavior", "behavior, addictive"	"alcohol drinking", "binge drinking", "alcohol", "drinking behavior". "drinking behaviour", "drinking behaviors", "drinking behaviours", "alcohol intoxication", "social drinking"
Aspect 4: Study focus: Academic performance		"school performances", "school performance", "educational performance", "school achievement", "educational performances", "academic performance", "school achievements", "educational achievement", "educational achievements", "GPA", "Grade Point average", "Grade"

* This example was simplified to show the search in PubMed on the search string to retrieve studies that focus on the longitudinal relation of alcohol use in adolescents on their academic performances.

CHAPTER 7

Busch V, Laninga-Wijnen L, Schrijvers AJP, de Leeuw JRJ. The association of health behaviors and school grades in adolescents, and its mediation by psychosocial problems. *Health Prom Int* (accepted with minor revisions, 2013)



ABSTRACT

School-based health promoting interventions show promising results in improving various health outcomes of adolescents. Unfortunately, much is still unknown about the effects of health behavior on school performances, while improving these performances would give schools a stronger incentive to be interested health promotion. Therefore, this paper presents the associations of several health behaviors with school performances, and quantifies the mediating effects of psychosocial problems. Self-report data on demographics and health behaviors were gathered from 905 Dutch high school students via an online survey, completed in-class. These data were matched with school records of the students' overall grade average on the three core subjects in Dutch high schools (Dutch, English and Math). Via a structural equation modeling approach, mixed-effects regression models were used to study the hypothesized associations of health behaviors with school performances, and the potentially mediating effects of psychosocial problems. Smoking, bullying, being bullied, compulsive and excessive internet use and low physical activity were all directly associated with lower school grades. Additionally, being bullied, smoking, excessive and compulsive internet use were associated with students' grades via mediation of psychosocial problems. This means that, in addition to possible direct effects, lower school grades were also associated with those behaviors through the effects of psychosocial problems in those students. Smoking, bullying, being bullied, physical exercise and internet use were associated with lower school grades among adolescents. Additionally, psychosocial problems mediated the associations of several behaviors with school performance, making it a potent target for future research.

Introduction

For years schools have been a popular setting for the promotion of health and a healthier lifestyle among adolescents, and with positive results.^{1,2} The most promising and effective model has been shown to be the eco-holistic whole school approach.^{1,3} This approach focuses on a broad integration of health promotion in the whole school, including the curriculum, the creation of supporting healthy school policies and environments, the forming of partnerships with students' social and home environment, and the focussing on life skills and competencies development.¹ This approach aims to create better schools that promote health in which the core focus remains on academic development while simultaneously improving health. Several recent studies have shown promising results with regard to the effects of this approach on the health of children and adolescents.⁴²⁻⁴⁴ Also, many past interventions had a narrow view with regard to health promotion by only aiming to improve the physical health of students while often ignoring the improvement of psychosocial health and behaviors related to that, such as bullying. This is different from the whole school approach, which treats health more comprehensively. However, this requires significant investments from schools, which makes it vital to get them interested, motivated and committed. Hence, school-based interventions should focus not only on health and health behaviors, but also on influencing educational outcomes.^{4,5} Unfortunately, much is still unknown about the effects that improving health behaviors might have on students' school performances, which demonstrates the need for more research on the topic.

Nowadays, research on the link between health behavior and school performance is growing.^{6,7} Significant associations were shown between school performance and nutrition⁸, smoking^{9,10}, alcohol use^{11,12}, bullying^{13,14}, and physical exercise.^{15,16} However, significant gaps still remain in the current evidence on the topic.

Firstly, due to their known relations to physical health, the six behaviors nutrition, smoking, drug use, physical activity, violence and unsafe sex have been the most targeted behaviors in school-based health promoting interventions.⁶ When we consider health more comprehensively, behaviors related to psychosocial health, such as bullying¹⁷, compulsive and excessive internet use¹⁸, videogame playing¹⁹, and watching television²⁰ should also be included more structurally.

Secondly, when studying the association between health behaviors and academic performance, the clustering of health behaviors should be taken into account more.^{21,22} Such clustering makes studies about the associations of individual health-related behaviors with e.g. school performance prone to inter-behavioral confounding.^{12,23} Therefore, researchers should more often consider whether to use multi-behavioral analyses to prevent such possible confounding.

Thirdly, since research on mechanisms behind the associations between different health behaviors and school performance is scarce and not conclusive, more studies on possible explaining factors are needed.^{11,12} Recent studies showed that one such explanation might be that psychosocial problems mediate the effects of health behaviors on school performance.^{13,24-26} Therefore, health behaviors and academic achievements might be associated in a straightforward way ("direct associations"). However, they might also be "indirectly associated" due increased psychosocial problems in students that partake in certain risky behaviors. In the latter situation psychosocial problems are referred to as a mediator. When such mediating effects are at play, the associations between certain behaviors and academic achievement might differ in students with psychosocial problems from those without such psychosocial problems. For example, being bullied might affect someone's school performances stronger when he/she has psychosocial problems than when this is not the case. Studying such mediation mechanisms might provide new insights into the role of psychosocial problems in the association of health behavior and academic achievement.

The current study

This paper presents the associations of several health behaviors with school performance in a sample of Dutch high school students. In addition, the hypothesized mediating role of psychosocial problems is investigated. Also, since boys and girls are known to exert different patterns of health behaviors, risk behaviors and coping strategies in adolescence, gender differences in the associations of health behavior and academic achievement are expected.^{27,28} Therefore, this study was performed separately for boys and girls.

Methods

Participants and procedures

Students from different educational levels, ethnic backgrounds and ages of five middle-large Dutch secondary schools (adolescents, 11-18 years old) received an online questionnaire in September 2011. Students and parents were informed on the nature of the survey in timely fashion via a letter, the school website and by teachers. The surveys were completed individually during class. Survey procedures allowed students to participate voluntarily and confidentially. Approximately 80% of the eligible respondents completed the survey. Only ill/absent students and those with conflicting course schedules did not participate. Since the survey was unannounced, selection bias was prevented. The participating schools form a convenience sample and no funds or other incentives were provided for participation. Schools were assisted with the questionnaire procedures by the research team. School performance information came from the school records and was provided by the schools. This study has been

approved by the Medical Ethics Committee of the University Medical Centre Utrecht, the Netherlands. METC-protocol number 11-397/C.

Measures

Demographic and health behavior data were collected from 905 students via the self-report survey. All survey items, unless explicitly stated otherwise, were measured in a similar way as in the Dutch Health Behavior in School-Aged Children (HBSC) survey.²⁹ However, this study is not a part of, or affiliated to the HBSC study.

Demographics. Demographic data consisted of students' gender, age, education level, socio-economic status (SES) and ethnicity. SES was measured with the Family Affluence Scale (FAS, from the HBSC Study), a 4-item, 5-point Likert scale that measures family wealth. Each item can provide 0 to 3 points, so the FAS score can consist of 0 to 9 points.³⁰

Alcohol use, cannabis use and smoking habits. Students were categorized as a smoker when he/she indicated to smoke cigarettes regularly. Drinkers were those that consumed alcohol at least once in the month prior to completing the survey; the same categorization was made with regard to binge drinking and marijuana use.

Screen time use. The behaviors of watching television, using the Internet and playing video games are referred to as "screen time behaviors". Both the time spent on these behaviors (i.e. "excessive use", >2 hours/day²⁹) and their compulsiveness was assessed; regarding watching television only excessive use was measured. Compulsive behaviors regarding Internet use and Gaming were assessed, respectively, via the Compulsive Internet Use Scale (CIUS)¹⁸ and the Videogame Addiction Test (VAT).¹⁹ Both instruments consist of 14 questions with a 5-point Likert scale. A mean score of 3.0 points was used as a cut-off; this was demonstrated to be a valid and reliable indicator for compulsive behavior.^{18,19}

Bullying/being bullied. Bully behavior was assessed in context of school-based bullying via self-report based on the Olweus Bully Score and the Olweus Bully Victim Score instruments.³¹ The two scores respectively distinguish bullies and victims from others with a validated cut-off of bullying/being bullied at least twice a month. These scores provide valid and reliable prevalence estimates of bullying and being bullied to be obtained conveniently, with a well-defined meaning, and they are easily and unambiguously understood by users and researchers.^{31,32}

Healthy Nutrition and physical activity (PA). The Dutch norm for Healthy Nutrition was used to indicate healthy nutrition; this is a joint measure of having breakfast, eating fruits and vegetables all at least five times per week.²⁹ The Dutch norm for Healthy Physical Activity was used to indicate healthy physical activity. This is a joint measure of at least

one hour of moderately intensive physical activity every day combined with at least twice a week physical activity aimed at improving or maintaining physical fitness.²⁹

Psychosocial problems (SDQ). Psychosocial problems were assessed via the Strengths and Difficulties Questionnaire (SDQ).³³ The SDQ measures behavioral characteristics on the topics emotional problems, hyperactivity, peer problems, conduct problems and pro-social behavior.³³ Subscales concerning emotional problems, hyperactivity, peer problems, conduct problems are composed of 20 items scored on a 3-point Likert-scale (0= "not true", 1="somewhat true" or 2="certainly true") and add up to a total SDO-score of maximum 40 points. A score of 0-15 points is considered a "normal" score, whereas a score higher than 15 is categorized as "(potentially) problematic". The SDQ's reliability and validity were demonstrated in a comparable sample of Dutch youth.³³

School performance. In the Netherlands, students' school performances are measured by grades that range from 1 to 10, with a 5.5 or higher to pass. The Grade Average (GA) of every student was collected via the school records and used as a composite measure of a student's overall school performance. This GA represents the average performance across the three basic high school subjects that are mandatory for students of all school levels in the Netherlands: English, Dutch and Math. The GA's per subject are determined by the average of students' four semester grades. This makes for a stable GA, as opposed to e.g. taking standardized test scores, which would be more prone to the influence of outliers.

Statistical Analyses

The current study makes use of multilevel data, i.e. students who are clustered (or nested) within classes within schools. This results a higher similarity between students from the same class or school than between those from different classes and schools. Therefore, the average correlation between variables (the intra-class correlation) that are measured on pupils from the same class will be higher than the average correlation between variables measured on pupils from different classes.³⁴ This results in a smaller standard deviation, and thus with more significant associations/effects, than should be the case. Applying a multilevel approach using mixed-effects regressions in all analyses corrected for this.

Firstly, the intercept only model was assessed, which shows only the intra-class correlation. Next, the association of each individual health-related behavior with academic achievement was performed via separate analyses, i.e. the "single behavior analyses". Finally, all significantly associated behaviors were simultaneously put in one final model, the "multi-behavior model", which corrects for the inter-behavioral confounding that might arise from correlations between behaviors.

The measures to assess the model-fit were the Root Mean Square Error of Approximation (RMSEA³⁵) and the Comparative Fit Index (CFI). The RMSEA assesses the approximate fit

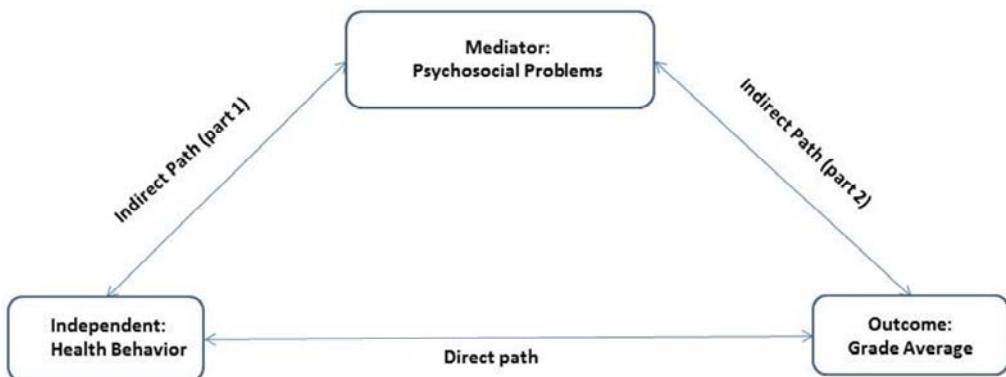
(proper fit, RMSEA < 0.08³⁶ pp. 113–114), while CFI values should be between 0.95 and 0.90.³⁷

Gender differences in the associations of health behavior and academic achievement are expected due to known differences in patterns of health behaviors, risk behaviors and coping strategies between adolescent boys and girls.^{23,27,28} Therefore, results are presented separately for boys and girls.

Mediation by psychosocial problems: a Structural Equation Modeling approach

Structural Equation Modeling (SEM) was used to analyze and differentiate between the direct and indirect paths of association between health behaviors and school performances. The goal of these mediation analyses was to better understand the underlying mechanisms of the relationships between different health-related behaviors and academic achievement for future studies. Mediation occurs when the effect of variable A (e.g. behavior) on outcome B (e.g. academic achievements) is partly or entirely transmitted by another variable C (e.g. psychosocial problems). Thus, variable A influences variable C, which in turn influences outcome variable B. For this, a distinction was made between a direct route of association of a certain behavior and school performances, and an indirect route in which such a behavior could influence students' psychosocial problem score (the mediator), and through that effect school performance would subsequently be influenced.

Figure 1. The hypothesized mediating mechanism by which psychosocial problems influence the associations of health behaviors and students' grade average.



For all analyses, Mplus³⁸, a latent variable modeling program, was used. Mplus allows examining a multilevel model with multiple predictors and mediating paths. All analyses were done within the same model run, averting the problem of multiple testing (and a possibly inflated P-value). All analyses were controlled for socioeconomic status and age. All analyses were presented with a 95% confidence interval.

Results

Students involved ($N = 905$; 41.3% boys) had a mean age of $M = 13.9$ years and a mean FAS score of $M = 7.38$ ($SD=1.35$). Further sample characteristics are described in Table 1.

Model fits of the final models

The intra-class correlation in the intercept-only model for boys was $p = .136$ and for girls $p = 0.122$, which implies that respectively 13.6% and 12.2% of the studied variance was explained by the grouping structure (classes).

Following the intercept-only model, the associations of health behaviors on GA were first assessed via single-behavior analyses, and thereafter via a multi-behavior analysis (the final model). For both boys and girls, the final model had excellent model fits; for boys $\chi^2(4) = 2.515$ $p = .642$, RMSEA = 0.000, CFI = 1.000; and for girls $\chi^2 (5) = 6.366$, $p = .272$, RMSEA = 0.024, CFI = .990. This indicates that the proposed model is in accordance with the observed data.

For girls, the R^2 of school performance is .267 at the individual level, which implies that 26.7% of the variance in school performance at the individual level was explained by age, smoking, bullying, being bullied, compulsive and excessive Internet use and physical exercise. Furthermore, the R^2 of school performance is .364 at the class-level, implying that 36.4% of the initial 12.2% intra-class correlation has been explained by the class and educational level of the pupils. In boys, 14.6% of the association between health-related behaviors and academic achievement was explained at the individual level by smoking, being bullied, bullying and compulsive Internet use. Furthermore, in boys, the 41.3% ($R^2 = 0.413$) of the initial 13.6% intra-class correlation has been explained by the education level of the boys.

Table 1 Student characteristics on demographic factors, health-related behavior and psychosocial problems.

Sample Characteristics	N= 905
Age in years	
11-12	150 (16.6%)
13-14	461 (51.0%)
15-16	239 (26.4%)
17-18	54 (6%)
Mean age in years	905 13.9, SD 1.50
Socio-economic status (Family Affluence Scale score, range 0-9)	
Low (0-2) – Medium (3-5)	73 (8.2%)
High (6-9)	819 (91.8%)
Excessively watching TV (>14h/week)	135 (15.2%)
Excessive internet use (>14/week)	190 (21.5%)
Excessively playing videogames (>14/week)	37 (4.1%)
Compulsive Internet Use Scale (CIUS) score (range, 1-5)	884 1.60, SD 0.58
Problematic Compulsive Internet Use Scale score (score >3.0)	57 (5.2%)
Videogame Addiction Test score (range, 1-5)	882 1.21, SD 0.44
Videogame Addiction Test score (score >3.0)	33 (3.6%)
Being bullied	82 (9.0%)
Bullying	66 (7.0%)
Binge drinker	138 (15.8%)
Marihuana user	81 (9.0%)
Smoker	84 (9.5%)
Sufficing to Dutch Norm Healthy Physical Activity ¹	657 (74.2%)
Sufficing to Dutch Norm Healthy Nutrition ²	191 (21.4%)
Grade Average	905 6.81, SD 0.60
Mean Strengths and Difficulties Questionnaire sum score (range 0-40)	755 9.35, SD 5.10
Strengths and Difficulties Questionnaire score >15	755 (89.0%)

1: Dutch Norm Healthy Physical Activity: at least one hour of moderately intensive physical activity every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness. **2: Dutch Norm Healthy Nutrition:** at least having breakfast, eating fruits and vegetables 5 times per week.

Table 2 Direct and indirect single-behavioral associations of health-related behaviors with students' grade average.

		Single-behavioral analyses		Girls		Boys	
			B	Beta	B	Beta	
Demographics-only model	Age > GA		-.14***	-.36***	-.10**	-.30**	
	SES > GA		.03	.02	.27	.12	
	Class > GA		.05***	.66***	.05	.56*	
SDQ ^{1,2}	Age > GA		-.14***	-.33***	-.09**	-.24**	
	SDQ > GA		-.02***	-.18***	-.02**	-.18**	
	Class > GA		.05**	.64***	.06***	.84***	
Being bullied	Being bullied > GA		-.33**	-.10*	-.02***	.27***	
	SDQ > Bullied		4.75***	.18***	6.18***	-.20**	
	Being bullied > SDQ > GA		-.10**	-.03**	-.13**	-.05**	
Bullying	Bullying > GA		-.28	-.04	-.05	-.02	
	Bullying > SDQ		5.50*	.10*	4.61***	.19***	
	Bullying > SDQ > GA		-.12*	-.02*	-.08*	-.03*	
Binge drinking	Binge drinking > GA		-.21**	-.13**	-.21*	-.15*	
	Bullying > SDQ		.55	.04	.56	.04	
	Binge drinking > SDQ > GA		-.01	-.01	-.01	-.01	
Smoking	Smoking > GA		-.57***	-.27***	-.34***	-.20**	
	Smoking > SDQ		2.59***	.15**	1.07	.06	
	Smoking > SDQ > GA		-.050**	-.02*	-.02	-.01	
TV ³	TV > GA		-.060	-.04	-.10	-.07	
	TV > SDQ		.40	.03	1.06	.08	
	TV > SDQ > GA		-.01	-.01	-.02	-.01	
PC ⁴	PC > GA		-.20***	-.14***	-.09	-.07	
	PC > SDQ		2.02***	.17***	1.19	.10	
	PC > SDQ > GA		-.04**	-.030**	-.02	-.02	
Marihuana use	Marihuana use > GA		-.27**	-.11*	-.15	-.10	
	Marihuana use > SDQ		.97	.05	-.58	-.04	
	Marihuana use > SDQ > GA		-.02	-.01	.01	.01	
Physical Activity ⁵	Physical exercise > SDQ		-.86	-.08	-.31	-.02	
	Physical exercise > GA		.11*	.09*	.12	.09	
	Physical exercise > SDQ > GA		.020	.02	.01	.00	
Healthy Nutrition ⁶	Healthy nutrition > SDQ		-.81	-.08	.04	.00	
	Healthy nutrition > GA		.13*	.10*	-.02	-.01	
	Healthy nutrition > SDQ > GA		.02	.01	-.00	-.00	
Compulsive gaming ⁷	Comp. gaming > SDQ				3.80	.06	
	Comp. gaming > GA		-	-	-.29	-.04	
	Comp. gaming > SDQ > GA				-.07	-.01	
Compulsive Internet use	Comp. Internet use > SDQ		3.31*	.10*	6.84***	.25***	
	Comp. Internet use > GA		-.33	-.08	.21	.07	
	Comp. Internet use > SDQ > GA		-.07	-.02	-.14**	-.05**	

1: Total SDQ score is used. Therefore, the regression co-efficient reflects the change in a dependent variable with a 1 point SDQ score (predictor) change; **2:** The variables from analysis 2 are included in all other analyses; **3:** **TV** = >14 hours per week; **4:** **PC** = >14 hours per week. **5: Dutch Norm Healthy Physical Activity:** at least one hour of moderately intensive physical activity every day, where at least twice a week the activity is aimed at improving or maintaining physical fitness; **6: Dutch Norm Healthy Nutrition:** at least having breakfast, eating fruits and vegetables 5 times per week; **7:** Too little variability too perform analyses.

Single-behavior models versus multi-behavior model

All behavioral variables that were significantly associated with students' GA in the single-behavioral analyses (Table 2) were integrated simultaneously into the multi-behavioral analysis (Table 3). These behaviors were bullying, being bullied, binge drinking, smoking, excessive PC use and gaming, marihuana use, physical exercise and nutrition. Nutrition, excessive television watching and binge drinking were not significantly associated with GA (Table 2) and therefore were not included in the final, multi-behavioral model (Table 3).

Behaviors that were associated with GA, independent of the effect of psychosocial problems (i.e. via the "direct path") were physical exercise, smoking, being bullied and excessive Internet use (Table 3). Bullying, being bullied, smoking and excessive and compulsive internet use were "indirectly associated" with grade average. In other words, these behaviors were associated with students' grade average through the mediation of psychosocial problems (Table 3). In the case of compulsive internet use (CIUS score), it was associated with school performances via the indirect path, while the direct path was not. This means that the influence on one's grade average by compulsive internet use only existed through the mediating effects of psychosocial problems and not as a direct relation (Table 3).

Mediation effects by the psychosocial problem-score SDQ

Some of the multi-behavioral associations were mediated by psychosocial problems (Figure 1). In girls sufficing to the physical activity norm (.13), smoking (-.54), being bullied (-.38), and excessively watching television (-.19) were associated via such a "direct path". In boys, the only behavior that was "directly" associated with GA was smoking (-.29) (Table 3).

The indirect (mediation) path, in which psychosocial problems served as an explaining mechanism for the relation between behavior and GA, was significant in girls for being bullied (-.60), excessive Internet use (-.03) and smoking (-.02) (Table 3). This means that for girls these unhealthy behaviors were associated with an increase in psychosocial problems, which in turn was associated with poorer academic achievements. In boys a similar indirect path was significant in regards to bullying (-.07), being bullied (-.11) and compulsive Internet use (-.11) (Table 3), meaning that in boys those specific behaviors were associated with poorer academic achievements due to more psychosocial problems in those students.

In regards to bullying, being bullied and compulsive Internet use in boys, the indirect path was the only significant path, indicating that the particular associations between those behaviors and GA only exist through the mediating effect of psychosocial problems.

Table 3 Direct and indirect multi-behavioral associations of health-related behaviors with GA.

	Multi-behavioral Analysis	Girls		Boys	
		B	Beta	B	Beta
Demographics	Age > GA	-.10***	-.26***	-.05	-.14
	Class > GA	.05**	.60***	.06***	.64***
	SDQ ¹ > GA	-.01**	-.10**	-.02**	-.19**
Direct paths	PC ² > GA	-.19***	-.13***	N.A.	N.A.
	Bullying > GA	N.A.	N.A.	-.08	-.03
	Being bullied > GA	-.38**	-.12**	.18	.08
	Binge drinking > GA	-.06	-.04	-.16	-.12
	Smoking > GA	-.54***	-.26***	-.29**	-.17**
	Marihuana use > GA	-.01	-.00	N.A.	N.A.
	Com. Internet use > GA	N.A.	N.A.	.19	.07
	Healthy nutrition c > GA	.10	.08	N.A.	N.A.
	Physical exercise d > GA	.13**	.10**	N.A.	N.A.
Behavior > SDQ	Being bullied > SDQ	4.61***	.17***	5.66***	.24***
	Bullying > SDQ	N.A.	N.A.	3.49**	.15***
	Comp. Internet use > SDQ	N.A.	N.A.	5.54***	.20***
	PC > SDQ	1.54**	.14***	N.A.	N.A.
	Smoking > SDQ	2.67***	.15***	N.A.	N.A.
Indirect paths	Bullying > SDQ > GA	N.A.	N.A.	-.07**	-.03*
	Being bullied > SDQ > GA	-.060*	-.02*	-.11*	-.05**
	Comp. Internet use > SDQ > GA	N.A.	N.A.	-.11*	-.04*
	PC > SDQ > GA	-.03*	-.02*	N.A.	N.A.
	Smoking > SDQ > GA	-.02*	-.02*	N.A.	N.A.

1: Variable for SDQ used here is the SDQ sum score. Therefore, the regression co-efficient reflects the change in a dependent variable with a 1 point SDQ score (predictor) change; **2:** PC= > 2 hours per day on average.

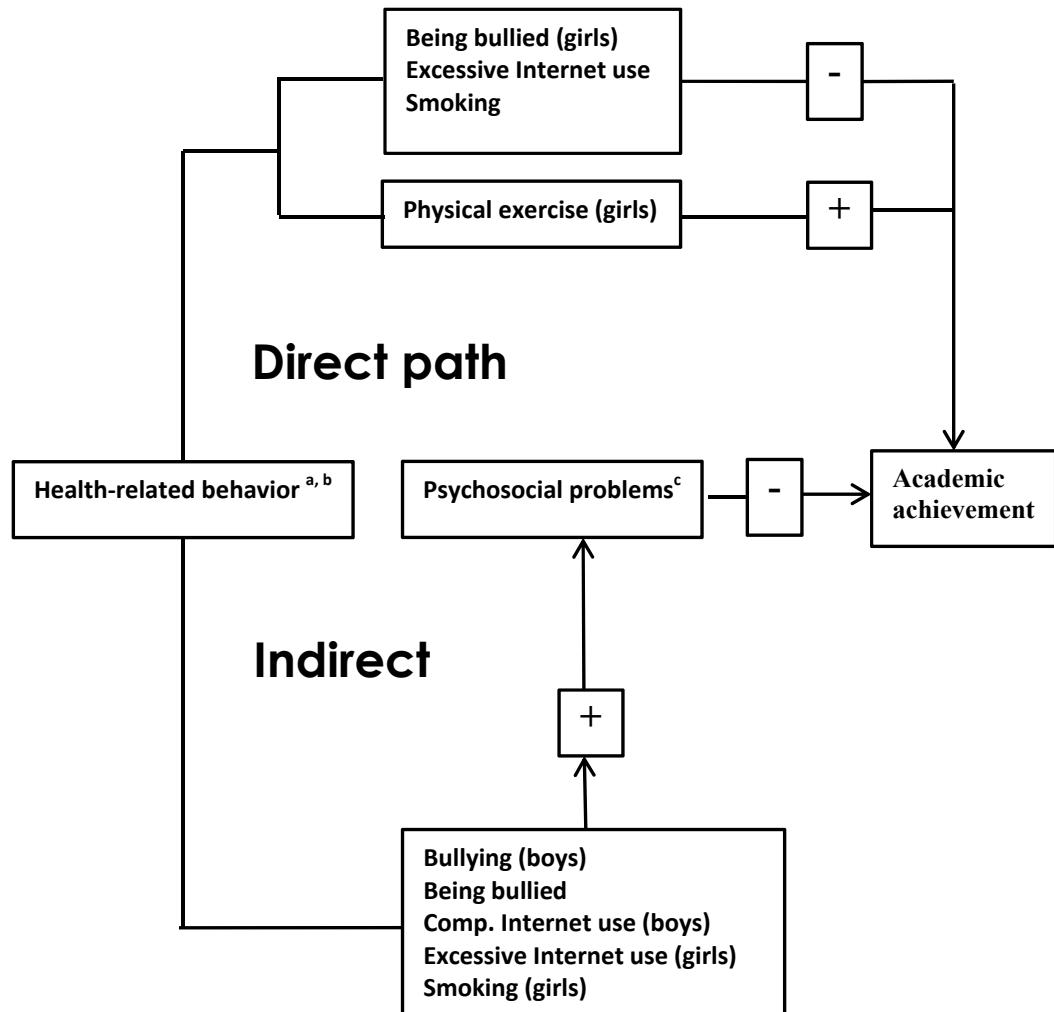
c Dutch Norm Healthy Nutrition: at least having breakfast, fruits and vegetables 5 times/week

d Dutch Norm Healthy Physical Activity: at least one hour of moderately intensive physical activity every day, which at least twice a week is aimed at improving or maintaining physical fitness.

Discussion

In this study the associations of a range of health behaviors and the academic achievement of adolescents were assessed via multi-behavioral, mixed-effects regression analyses. Smoking, peer bullying, being bullied by peers, compulsive and excessive Internet use and low physical exercise patterns were significantly associated with lower school grades. Behaviors that were not significantly associated with school grades were nutrition patterns, marihuana use and alcohol use (Figure 1).

Figure 1 Multi-behavioral analyses of the associations with students' grade average with integrated SEM mediation analyses through psychosocial problem among 905 Dutch high school adolescents.



A: All analyses were performed within the same model to account for both multiple testing and inter-behavioral confounding; **B:** Included health-related behaviors: excessive (>2hr/day) internet use, videogame playing and watching TV; smoking; unhealthy nutrition; insufficient physical exercise; smoking; recent cannabis use; recent alcohol use and binge drinking; bullying and being bullied; compulsive internet use (CIUS Score >3.0) and compulsive videogame playing (VAT score > 3.0); **C:** A continuous measure was used as an indicator of psychosocial problems, i.e. the SDQ sum score.

Furthermore, mediation analyses were used to distinguish between "direct" associations between health behaviors and academic achievement and "indirect" associations, in which those associations exist through the mediating effect of psychosocial problems. This means that specific behaviors were directly associated with academic achievement, while others were associated with it due to more psychosocial problems in those students. Physical activity, smoking, being bullied and excessively watching television were "directly" associated with school performance, while being bullied, excessive Internet use, smoking, bullying and compulsive Internet use were (also) "indirectly" associated via the mediation of psychosocial problems (Figure 1).

Several associations between health behaviors and school performance differed for boys and girls. In general, risky health-related behaviors were associated with academic problems stronger in girls than in boys. This suggests that risky behavior is less of an indicator for problems (either academic or psychosocial) for boys than girls, which is in line with previous research.^{23,27,39} When girls show such risky behavior (e.g. smoking) it is often a problem signal, whereas for boys such behaviors are more common, and therefore not a strong indicator for problems.^{27,28,39}

Value of multi-behavior analyses

Using a multi-behavior model in future studies prevents overestimating associations between health behaviors and school performance due to inter-behavioral confounding. However, few studies have thus far taken such confounding into account in practice, but those that did, demonstrate similar effects. For example Sabia¹² illustrated that, after correcting for related behaviors such as marihuana use, adolescent binge drinking had a smaller effect on teens' school performances than reported in previous studies. Martinez-Gomez et al showed comparable findings with regard to healthy nutrition, physical exercise and television viewing in relation to school performance in the AFINOS study.⁴⁰

The association of health behavior and school grades: mediation by psychosocial problems

Despite its cross-sectional nature, the results of the current study are valuable in generating hypotheses for research to explain why certain unhealthy behaviors might lead to impaired school performance in adolescents. Regarding bullying, for example, the mediation analyses showed that being bullied was both directly associated with GA as well as through the mediation of psychosocial problems (SDQ). Previous research¹³ stated that when teens are bullied, their sense of competence to function in social and school settings may be impaired only when it leads to them experiencing e.g. behavior problems or peer relation problems. Others that are bullied might perceive this more of a common school experience and are not impacted in their social and academic competences. So when a student for example has few friends or limited social skills (both two main parts of the SDQ) being bullied is more likely to impair their school

performance than when they would have such skills, i.e. not exhibit psychosocial problems.¹³ This illustrates how health behavioral problems might lead to poor school performance in an indirect way through mediation of psychosocial problems.

Findings from the mediation analyses were in line with other studies on the topic that used comparable analytic approaches.^{13,14,25,41} Those studies also showed reduced direct effects and significant mediation effects in the associations of certain health behaviors and school performance, indicating that at least parts of these associations were attributable to the mediating effects of psychosocial problems. The example above illustrated how being bullied might exert such effects, but similar modes of effect are imaginable for e.g. compulsive Internet use or video game playing given their effects on adolescents' psychosocial problems and their social and academic functioning.^{18,19,26}

Strengths and Limitations

A strong aspect of the current study is that it studied the associations of a broad range of health behaviors with academic achievements in adolescents simultaneously. This led to new insights, while overestimations of associations due to inter-behavioral confounding were averted due to the chosen analytic approach.

Another strong point of the current study is the use of valid, reliable survey instruments to assess health behaviors. Also a relatively reliable, valid outcome measure was chosen for school performance. Some U.S. studies have criticized using school grades for this purpose, since it may introduce bias due to performance scholarship systems in which students have to obtain a certain average grade to get a certain scholarship or grant.¹⁶ Students were hypothesized to simply pick easy classes, virtually independent of content, in order to get good grades. Since these structures are not present in the Netherlands, grades are a relatively reliable and stable indicator for school performance in Dutch settings.

Furthermore, using mixed-effects models accounted for the hierarchical structure of the data, which ensured more reliable and precise association estimates. These analyses proved valuable since they showed that this nested structure accounted for a significant part of the variability.

In addition, the mediation analyses demonstrated that adolescents who exhibit certain health-related behaviors experience poorer school achievement through the association with psychosocial problems. These findings add to the current literature.

A weak aspect of this study is its cross-sectional, non-experimental design, which prevents drawing conclusions on causal mechanisms.

Conclusions

The current study shows that many health behaviors are significantly associated with adolescents' school performance and that psychosocial problems may play an important role in these associations. These findings indicate that health, health behaviors, and academic developments should be viewed as part of a broader developmental context. Stimulating positive developments in these areas should be of interest to both the health and education sector. Such behavioral development should be stimulated by integrated, coherent programs that promote health, personal development and academic achievement, rather than via the fragmented approach as has often been the case in the past. The whole school approach vision entails the positive development of social contexts within and outside of school, by aiming to positively develop aspects such as school climate, teacher development and involvement of parents and communities with school. Health Promoting School literature shows the potential this has to improve youngsters' development, both academically and health-related. The current study adds to this by elaborating on the specific relations of health-related behaviors and academic performance. It does so by also including behaviors that significantly affect adolescents' psychosocial and academic development, such as bullying and compulsive internet use, and not just more traditional health topics with strong ties to physical health, such as smoking, alcohol use and physical exercise. These findings can be used to motivate teachers to be involved in health promotion via school. Furthermore, the strong gender differences in the relations of health-related behaviors and academic and psychosocial problems suggest different underlying behavioral and coping mechanisms that should be studied further in future research.

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Chapter 7

CHAPTER 8

Busch V, de Leeuw JRJ, de Harder A, Schrijvers AJP. Changing Multiple Adolescent Health Behaviors Through School-Based Interventions: A Review of the Literature. J Sch Health. 2013;83(7):514-523.



ABSTRACT

Background

In approaches to health promotion in adolescents, unhealthy behaviors are no longer regarded as independent processes. This article presents a systematic literature review of school-based interventions targeting multiple adolescent behaviors simultaneously.

Methods

A systematic literature search was performed in PubMed, Science Direct and PsycInfo. Only English papers and describing original research were included.

Results

Of 33 papers included, 23 focused on quantitative behavioral changes, and 10 on the evaluation of intervention development, implementation, and/or institutionalization. Parental and community involvement in the intervention seemed to be positively associated with effective changes in student health behaviors, whereas creating a healthy school environment and/or policies were less strongly associated with intervention effectiveness. Findings indicated that, for adequate implementation, an intervention should be integrated in pre-existent school settings, fine-tuned to its target population or environment, involve the family and community, and be led by the school itself, with there being a "*healthy school coordinator*" to coordinate the program.

Conclusion

A multi-behavior, multi-actor approach would appear to be the most effective way to promote, at school, healthy behavior among adolescents.

Introduction

About a half of all adolescents engage in one or more unhealthy behaviors,¹ behaviors that are important determinants of disease and mortality.^{2,3} These behaviors usually develop in adolescence and often adversely affect health later in life.⁴ In the past, interventions to improve these behaviors have tended to focus on individual behaviors, but in recent years unhealthy behaviors are increasingly believed to be interrelated, forming behavioral clusters,⁵⁻⁷ such that they pose a greater health risk together than individually.⁷⁻⁹ Many of these behaviors also share common determinants, which supports the development of interventions that tackle multiple behaviors simultaneously.^{9,10} Interesting findings on this approach have recently been published.^{7,9,11,12}

In the 1980s and 1990s the World Health Organization (WHO) introduced the concept of Health Promoting Schools via different health promotion charters, starting with the 1986 the Ottawa Charter.¹³ This model was expanded in the 1990s^{14,15} and comprehensive models were formed that addressed school-based health promotion, such as the "whole school approach" of the Schools for Health in Europe (SHE) (Figure 1).^{16,17} These models promote a comprehensive total-life-approach instead of merely focusing on a single dimension of child health, such as school- or family life. This entailed the development of a healthy public policy, the creation of supportive environments, the reinforcement of community action, the adaptation of school curricula on health education to focus on personal skills development, and the reorientation of health services toward the prevention of illness and promotion of health. As illustrated by Flay: "*problem/risky behaviors, unhealthy behaviors, anti-social behavior, poor mental health, and poor academic achievement should be addressed by a comprehensive, coherent, and integrated approach, rather than the disjointed approach to prevention and promotion taken by education today.*"^{6(p.4)} Several studies from different countries have evaluated the development, implementation, and/or effectiveness of health promoting school interventions.^{16,18-21}

This article presents a systematic literature review of empirical studies of multi-behavioral school based health interventions for adolescents, with emphasis on the effectiveness of tackling certain combinations of health-related behaviors simultaneously, the effectiveness of using the whole school approach, and aspects to be borne in mind when developing and implementing school based health interventions.

Methods

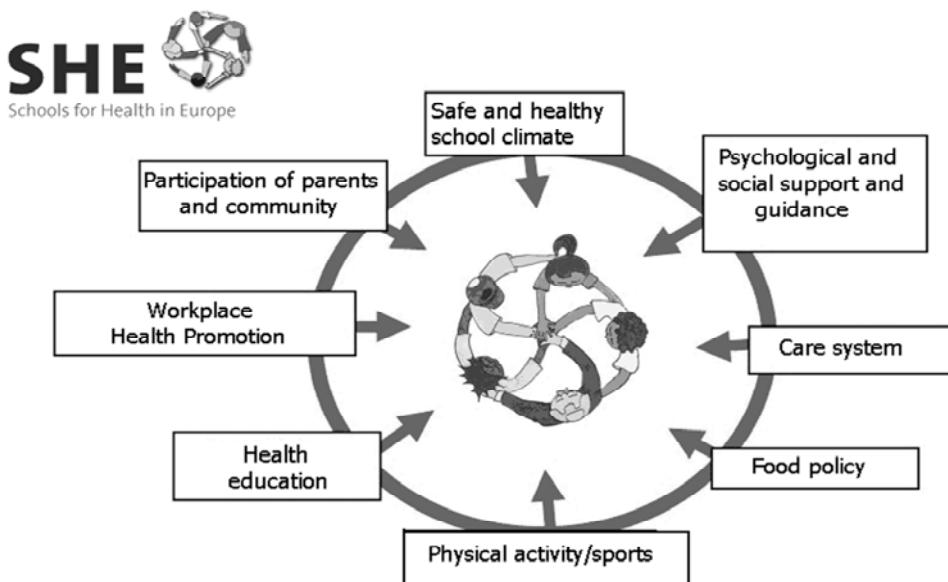
Search strategy

The databases of ScienceDirect, PubMed and PsycInfo were systematically searched by means of all combinations of the following search terms (in US and UK spelling): School based intervention (school based program), health (healthy, unhealthy, health-

related), behaviors (lifestyles, risk factors, facets), various (multiple, more, several, simultaneous, multifaceted, clustered, clustering), health promoting schools (healthy school approach). The reference lists of retrieved articles were searched for relevant studies. Studies that met the following criteria were included in the review: The title and/or abstract stated that the study entailed empirical research into a school-based intervention; the intervention targeted multiple health-related risk behaviors simultaneously; the intervention was designed for adolescents; and the article was written in English and published in a peer-reviewed journal.

Two researchers independently reviewed the literature and included studies that met the inclusion criteria. Both researchers had to agree about the inclusion of individual articles, if necessary after consensus was reached.

Figure 1 School for Health in Europe's Health Promoting School Model.^{16,17}



Results

Thirty-three studies of 30 different interventions were included, 23 of which evaluated the effectiveness of interventions in changing student health behaviors as their main outcomes,^{9,22-42} and 10 mainly evaluated the design and/or implementation of the intervention.^{18,19,43-50}

Of the 23 studies that quantitatively evaluated intervention effectiveness, 20 were (non)randomized controlled trials and 3 were cohort studies. The characteristics of the evaluated interventions were diverse in nature, ranging from interventions for a relatively large number of health behaviors and given in single 30-minute, online, in-class lessons⁴² to interventions for a smaller number of behaviors and which lasted for as

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long as three years.⁴¹ Study characteristics (e.g. population sizes, outcomes measures, and follow-up periods) also differed. This was also true for the 10 qualitative evaluation studies, which also had different study designs (2 cluster randomized controlled trials, 2 randomized controlled trials, 2 case control studies, 1 case study, 1 pilot trial, 2 descriptive studies). The studies and their main characteristics is presented below in Table 1.

Table 1 Overview of all included studies

Study/ Main Author	Study Design	Study Duration	Study Population (N,students)	Main effects measured
Prochaska et al. ⁴⁰	RCT	3 mnths	138	Physical activity; dietary intake
The HEALTHY Study Group ⁴¹	CRCT ¹	3 years	4.603	Combined prevalence of overweight and obesity
Haerens et al. ³¹	CRCT	2 years	2.287	Physical activity; fat, fruit, water and soft drink intake.
Eisen et al. ²³	CRCT	2 years	5.691	Self-reported tobacco use, alcohol use, illegal substance use
Ellickson/ Longshore et al. ^{8,24}	RCT	18 months	4.276	Self-reported tobacco use, alcohol use, illegal substance use
Gortmaker et al. ³⁰	RCT	2 years	1.295	Prevalence, incidence, and remission of obesity
Mauriello et al. ^{34,47}	RCT	14 mnths	1.182	Self-reported physical activity, fruit and vegetable consumption, television viewing
Peralta et al. ³⁸	RCT	6 mnths	33	BMI
Hansen et al ³²	RCT	1 year	2.863	Self-reported tobacco use, alcohol use, marijuana and other illegal substance use
Faggiano et al. ^{27,51}	CRCT	12 weeks	7.079	Self-reported tobacco use, alcohol use, marijuana use
Lennox and Cecchini. ³³	RCT	6 mnths	726	Self-reported recent tobacco use, alcohol-, marijuana- and other illegal substance use
O'Brien et al. ³⁶	Cohort study	5 years	80.428	Changes in tobacco-, nutrition- and physical activity-related school policies; Self-reported tobacco-, alcohol- and marijuana use, physical activity and dietary habits.
Werch et al. ⁹	RCT	1 year	604	Self-reported tobacco use, alcohol use, marijuana use, physical activity
Werch et al. ⁴²	RCT	3 mnths	479	Self-reported tobacco use, alcohol

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				use, marijuana use, physical activity, sleep behavior
Goldberg et al. ²⁹	Cohort study	2 years	3.207	Self-reported alcohol and illegal drug use
Perry et al. ²²	RCT	2 years	6.237	Self-reported tobacco, alcohol, and marijuana use; multidrug use; violence; and victimization
Piper et al. ⁴⁹	NRCT ²	1 year	22 schools	Qualitative implementation lessons learned
Piper et al. ³⁹	NRCT	4 years	2.483	Alcohol-, tobacco-, and marijuana use, nutrition and sexuality
Patton et al. ^{37,48}	CRCT	5 years	7.594	Qualitative design and implementation lessons learned; recent substance use, antisocial behavior, initiation of sexual intercourse, and depressive symptoms
Elliot et al. ^{25,26}	PCT ³	4 years	928	Substance use and dietary habits
Flay et al. ²⁸	CRCT	3 years	644	Student self-reports of violence, provocative behavior, school delinquency, substance use, and sexual behaviors (intercourse and condom use)
Aldinger et al. ¹⁸	Cohort study	18 mnths	191	Self-reported changes in attitudes, knowledge and behavior
MacDonald & Green ⁴⁶	Qual. study	4 years	19 Prevention Workers	Qualitative implementation lessons learned
Lynach et al. ⁴⁵	RCT	5 years	22 schools	Qualitative implementation lessons learned
Fagen and Flay ⁴⁴	Multiple Case Study	7 years	5 schools	Qualitative implementation and sustainability lessons learned; Self-reported violence, drug use, and risky sex-related behaviors
Cunningham & Henggeler ⁴³	Quasi-Experimental	3 years	2 schools	Youth violence, drug use, and psychosocial functioning
Bonell et al. ¹⁹	Exploratory /Pilot Trial	1 year	4 schools	Self-reported school ethos and substance use
Aldinger et al. ⁵⁰	Cohort study	18 mnths	51 schools	Qualitative lessons learned on pre-implementation, implementation, and monitoring and evaluation activities.

1: Cluster Randomized Controlled Trial; **2:** Non-Randomized Controlled Trial; **3:**Prospective Controlled Trial

Effectiveness of tackling multiple behaviors simultaneously

Eighteen of the 24 different interventions (1 study evaluated 2 different interventions) targeted at least 1 addiction-related behavior (smoking, drug use and alcohol use; Table 2). Interventions that included nutrition and physical activity were included in approximately half of the studies. The behaviors targeted the least were related to sedentary time (watching television, computer and Internet use, and playing computer games, referred to as gaming; N=4 interventions), antisocial behavior (N=5 interventions), and sexuality (N=5 interventions). The number of behaviors targeted was not associated with the effectiveness of an intervention, probably because many studies reported different effect sizes for different health behaviors in different combinations and used different study designs and outcome measures, or were of different size.

Effectiveness of tackling health behaviors simultaneously via specific super-domains

As multi-behavioral school based interventions are hypothesized to have a synergistic effect on health behavior, we investigated the effectiveness interventions targeting specific combinations of behaviors, or so-called super-domains. The first super-domain identified, termed addiction, included smoking, alcohol use and drug use. These addictions were tackled as one super-domain in 14 out of 19 studies that investigated one or more of these behaviors. Although 1 study reported on synergistic effectiveness,⁸ it was impossible to distinguish general trends in effectiveness.

The second set of clustered behaviors consisted of nutrition and physical activity. Interventions focusing on this energy balance super-domain were varying in effects to change health behavior and proved equally effective when targeting individual or combinations of behaviors. All interventions that targeted sedentary behaviors (watching television, playing computer games, etc.) together with nutrition and physical activity were effective in changing physical activity and nutrition. Gortmaker et al reported that interventions to reduce sedentary time were a potent predictor of a decrease in obesity if given in combination with interventions to improve nutrition and physical activity.³⁰ Just as Longshore et al recommended targeting substance abuse behaviors simultaneously,^{8,24} Gortmaker et al. made a plea to target nutrition, exercise, and sedentary behaviors in 1 intervention. in order to benefit from synergistic effects.³⁰

The remaining behaviors (sedentary behavior, sexual behavior, antisocial behavior) were not structurally combined into super-domains, and so we cannot report on their effectiveness in combination with other behavioral domains.

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Table 2 Studies that evaluated the behavioral changing effects of multi-behavioral school-based health interventions in adolescents

Intervention/Behaviors	Nutrition	Physical Activity	Alcohol use	Drug use	Smoking	Sexuality	Anti-social behavior	Screen time	Overall Effectiveness ^{1,2}
Physical Activity Nutrition (PAN) vs. Physical Activity (PA) ⁴⁰	Yes -	Yes +/-							-
HEALTHY Study Group ⁴¹	Yes -	Yes -							-
Physical activity and healthy eating intervention ³¹	Yes +	Yes +							+
Skills for Adolescents (SFA) ²³			Yes +/-	Yes +	Yes -				+/-
Revised Project ALERT8 ²⁴			Yes +/-	Yes +/-	Yes +				+
Planet Health ³⁰	Yes +/-	Yes +					Yes +		+
Health in motion ^{34,47}	Yes +	Yes +					Yes +		+
Fitness Improvement and Lifestyles Awareness Program(FILA) ³⁸	Yes +	Yes +					Yes +		+
SMART-1: Social Resistance training ³²			Yes +/-	Yes +/-	Yes +/-				+/-
SMART-2:Affective Education Approach ³²			Yes -	Yes -	Yes -				-
European Drug Abuse Prevention (EU-DAP): Unplugged ^{27,51}			Yes +/-	Yes -	Yes +				+/-
Narconon drug education curriculum ³³			Yes +	Yes +	Yes +				+
Healthy Maine Partnerships School Health Coordinator ³⁶	Yes +	Yes +			Yes +		Yes -		+
Project SPORT ⁹			Yes +/-	Yes +/-	Yes +/-				+/-
Project Active ⁴²	Yes +	Yes +	Yes +	Yes -	Yes -				+
Adolescents Training and Learning to Avoid Steroids (ATLAS) ²⁹	Yes +		Yes -	Yes +					+
Drug Abuse Resistance Education (DARE) ²²			Yes -	Yes -	Yes -		Yes -		-
Drug Abuse Resistance Education (DARE) PLUS ²²			Yes +	Yes +	Yes +		Yes +/-		+
Healthy for Life (HFL) Age Appropriate Version ^{39,49}	Yes +		Yes -	Yes -	Yes -				-
Healthy for Life (HFL) Intensive Version ^{39,49}	Yes +		Yes +	Yes +	Yes +				+
Gatehouse project ^{37,48}			Yes +	Yes +	Yes +	Yes +	Yes +		+

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Athletes Targeting Healthy Exercise and Nutrition Alternatives (ATHENA) ^{25,26}	Yes +	Yes +	Yes +	Yes +	Yes +		+
Social Developing Intervention ²⁸			Yes -	Yes +		Yes +	Yes +/-
Social Developing Curriculum ²⁸			Yes -	Yes +		Yes +	Yes +/-

+: Significant improvements were reported on more than half of the primary behavioral outcomes;

+/-: Significant improvements were reported in half of the primary behavioral outcomes; - : Significant improvements were reported in less than half of the primary behavioral outcomes;

Superscripts: '+, - and +/-' refer to whether the corresponding behavior significantly was improved by the intervention.

Effectiveness of a whole school approach

The whole school approach to health promotion involves schools, families, and communities.^{16,17} Twenty-five studies reported their intervention to be a curriculum-transcending, whole school approach to some degree.^{9, 22-35, 37-42, 47-49, 51} The involvement of families and communities ensures that the intervention is integrated into most aspects of the student's life. The Health Promoting Schools model recommends that the community and the family have an active role, such as being involved in prioritizing components of the interventions and in deciding on the main focus,⁴⁸ with the school collaborating with the surrounding community to implement the intervention.⁴⁴ Other characteristics of a whole school approach include the physical school environment (eg, creating a healthy school canteen or removing candy machines) and implementing healthy school policies (eg, a no-smoking school yard). Finally, the whole school approach predicts that interventions are more effective if they involve health care providers; for example, by involving public health policy makers in design of the intervention.⁴⁶ Different elements of the whole school approach are described below, in relation to effectiveness in changing student health behavior.

Although some studies reported that the creation of a healthy school environment was a vital for achieving successful behavioral change,^{31,35} findings presented in Table 4 do not bear this out. The Healthy Study Group extensively targeted nutritional intake by "targeting the quantity and nutritional quality of foods and beverages that were served throughout the school environment (cafeteria, vending machines, a la carte options, snack bars, school stores, fundraisers and classroom celebrations)",^{41(p.444)} without it leading to significant dietary changes in the targeted students. In contrast, Haerens et al³¹ attributed failure of their intervention involving healthy eating and increased physical activity to the lack of a healthy school environment (eg, a healthy canteen or vending machines). In general, however, the failure to ensure a healthy school environment, whether or not in combination with the introduction of healthy school policies, did not seem to have a negative effect on the success of an intervention. Of 21 studies that did not include a healthy school environment, 11 reported a significant

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change in student behavioral and 6 achieved some change in behavior, 3 studies failed to change students' behavior.

Table 3 The use of a whole school approach in studies and its effectiveness

Intervention/Health Promoting School aspects	Healthy school policies	Healthy school environment	Parental involvement	Community involvement	Focus on personal skills	Intervention effectiveness
Project Sport ⁹						+/-
Health in motion ^{34,47}						+
Physical Activity Nutrition vs. Physical Activity ⁴⁰						-
FILA ³⁸			Yes			+
The HEALTH Study ⁴¹		Yes				-
ATLAS ²⁹	Yes					+
ATHENA ^{25,26}				Yes		+
Project SMART				Yes		+/-
-1 Social Influences ³²						
Project SMART				Yes		-
-2: Affective Education ³²						
Project Active ⁴²				Yes		+
Skills for Adolescence ²³	Yes			Yes		+/-
Revised Project ALERT ^{8,24}	Yes		Yes			+
EU-DAP: Unplugged ^{27,51}		Yes		Yes		+/-
Social Developing Curriculum ²⁸	Yes			Yes		+
Gatehouse Project ^{37,48}			Yes			+
D.A.R.E. ²²	Yes			Yes		-
Planet Health ³⁰	Yes			Yes		+
Healthy For Life Project: Intensive Version ^{39,49}			Yes	Yes		+
Healthy For Life: Age Appropriate Version ^{39,49}			Yes	Yes	Yes	-
Physical activity and healthy eating intervention ³¹	Yes	Yes	Yes		No	+
Social Developing Intervention ²⁸	Yes		Yes	Yes	Yes	+
Narconon ³³	Yes		Yes	Yes	Yes	+
Healthy Maine Partnerships: Healthy School Coordinators ³⁶	Yes	Yes	Yes	Yes		+
D.A.R.E. Plus ²²	Yes		Yes	Yes	Yes	+

+: Significant improvements were reported on more than half of the primary behavioral outcomes;

+/-: Significant improvements were reported in half of the primary behavioral outcomes; - Significant improvements were reported in less than half of the primary behavioral outcomes.

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Nine of 10 studies that included parental involvement reported positive changes in behavior (Table 3). Moreover, several studies proposed that parents and teachers should be actively involved as behavioral role models.^{45,49}

The effect of community involvement and/or placing the educational focus on personal skill and competency development was less clear-cut (Table 3), although several studies stressed the need to improve community involvement in multi-behavioral school based health interventions. For example Lynagh et al.⁴⁵ and Piper et al.⁴⁹ stated that to facilitate community implementation of the interventions, community workshops should be organized to increase awareness, competence and commitment to the joint venture to improve adolescent health.^{45,49} Other studies emphasized the need to professionalize community involvement via a structured approach, combined with an empirical research basis.^{44,46} However, the embedding of an intervention in the community does not appear to be associated with the effectiveness of the intervention to bring about changes in health behaviors.

Lessons learned

The main points pertinent to the success of an intervention identified from the literature concerned the design, implementation, effective working, and/or institutionalization of intervention (Table 4).

Table 4 Primary lessons learned from multi-behavioral school based health interventions

Lesson learned	References
Integrate interventions within existing school parameters	31,35
Importance of school autonomy in running intervention	35,37,45,46,48
Importance of centralized program coordination	31,39,44,48
Importance of in-service training	25,26,29,31,39,47-49
Importance of school-tailoring interventions via a needs assessment	25,26,28,29,39,44-46,48,49
Importance of community embedding/institutionalization	30,31;35,39,44,46

Placing the intervention within the existing school parameters. The ATHENA study used existing school sports teams to implement the intervention,^{25,26} and other studies used pre-existing school organizational structures to aid successful intervention implementation.^{31,48} This is practical because it limits the likelihood of competing curricular interests, such as time-tabling, resource allocation, and competing demands on teacher time and energy. Lynagh et al underscored the importance of this in their Hunter Region Health Promoting Schools Project, stating that "staff would only consider involvement if they perceived that little work was required on their part".^{45(p.230)} Moreover, this approach overcomes the potential problems of a lack of support from

educational staff, which is a prerequisite for successful intervention implementation-teaching staff must feel that it is "their project".^{31,45}

Schools as independent program facilitators. A school's ability to run a comprehensive, complex intervention independently is important for the effective, long term promotion of healthy behavior. Yet, there are several potential pitfalls such as teacher in-service training to teach health promotion subjects, a lack of staff commitment to the program, or a perceived lack of administrative support and commitment, which can hamper schools in their ability to implement interventional programs.^{45,49} As Lynagh et al stated "the project team and liaison officers received frequent requests from schools for specific recommendations on what health promoting actions to take".^{45(p.230)} Creating confidence and commitment is especially crucial in the initial stages of the intervention. This set of concepts and conditions combined led MacDonald and Green⁴⁶ also proposed to achieve a smoother implementation by placing more emphasis on the need to establish credibility and making clear the necessity of the intervention with those working on it in the school. Yet, few studies have considered schools able to plan and implement a comprehensive, multi-health intervention structurally and independently themselves.

Centralized program coordination. Several studies stated that it was vital to have a health promoting school coordinator (also termed liaison officer, program champion, gatekeeper) in schools who could fine-tune intervention efforts internally, in-school. This person should be familiar with the content and organization of the intervention, as well as with internal school policies, and politics, in order to smooth the way for program implementation.⁴⁵ Such a coordinator plays an important part in schools becoming self-sustaining intervention facilitators.

In-service teacher training. Approximately half of the studies mentioned that structural teacher in-service training (Table 4) was an important determinant of the quality and successful implementation of an intervention. The importance of this issue is often underestimated: "Health Promoting School does not equal 'health education' in teacher's minds because it challenges many traditional approaches to teaching young adolescents"..."For many teachers, even giving HPS a fair hearing was a real leap of faith".^{49(p.176)} To underscore the importance of teacher commitment and proper in-service training further for HPS they continue "With a few exceptions, teachers still receive training that treats the subject of health like (a) other academic disciplines, focusing on a cognitive, knowledge-based approach, or (b) an impoverished, distant cousin of physical education".^{49(p.176)}

Fine-tuning and school-tailoring of an intervention via a needs assessment. For optimal effectiveness, interventions need to be tailored to the population or setting involved. For example, in the ATHENA, ATLAS and Planet Health studies, interventions were

tailored by gender^{25,26, 29,30} and in the study by Flay et al,²⁸ interventions were tailored by demographics (inner city) and ethnicity (African American youths). Interventions should not only be tailored on the basis of the study population, but also on the basis of specific problem behaviors in a school or group and on the school's organizational and policy structures.^{19,48} This can be done by carrying out a tailored needs assessment by means of a student questionnaire, to allow schools to prioritize their focus points.^{45,48} As Patton et al stated in their paper on the design and implementation of The Gatehouse Project: "*Development of standardized intervention process rather than a standardized, one-size-fits-all invention*".^{48(p.238)}

Piper et al.⁴⁹ tailored the curriculum content by creating an age appropriate version of the Healthy For Life intervention,⁴⁹ stating that program tailoring should not be limited to the curriculum content alone, but should also encompass existing policies, initiatives, resources, and organizational structures: "*Schools that run on 9-week quarters don't take kindly to 4-week programs*".^{49(p.177)}

Community embedding/institutionalization. In the Aban Aya Sustainability Project,²⁸ Fagen and Flay ensured the sustainability of their intervention by embedding it in the community to provide continuity after the "school phase". They developed a 9-stage theoretical framework that an intervention's community/surrounding goes through from the point of "*No awareness of the issue and ways to intervene*" to "*Professionalization in embedding the intervention in appropriate community systems*". To stabilize the intervention in community systems, it was stated necessary to assess the school's readiness for the parent-centered intervention and the parents' readiness to assume a significant and independent teaching role prior to their recruitment.

Discussion

There was relatively little evidence of a synergistic effect of multi-behavioral school-based health interventions. Two clusters of health-related behaviors were identified: addictive behaviors (smoking, alcohol use and drug use) and energy balance (sedentary leisure-time activities, nutrition, and physical activity). Recent Cochrane Reviews evaluated the effectiveness of interventions for smoking, drug use or alcohol use, and concluded that there were mixed effects and diversity in methodologies between studies, which made meta-analyses difficult. However, clustered behavior approaches were favored in several school-based preventive programs.⁵²⁻⁵⁴ To date, only 1 study of a multi-behavioral school-based health interventions investigated the synergistic effects of an intervention for these addiction behaviors.⁸ Although results in this study were positive and promising, more future studies are needed. The presence of such synergistic effects would facilitate the development of more effective interventions. Interventions targeting components of the energy balance cluster were also effective when the behaviors were targeted as a cluster, but results were more variable when these behaviors were targeted in different combinations. Again, only 1

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study specifically looked into the synergistic effects of these behaviors.³⁰ More studies are needed.

Different aspects are relevant to the success of the whole school approach to health behavior. For example, parental involvement is important to the success of interventions to change student behaviors. Results were less clear-cut about the role of community involvement and the development of students' personal skills and competencies; nor is it proven that creating a healthy school environment or applying healthy school policies has positive effects. It is conceivable that the presence of a healthy school environment or school policies would affect those behaviors that take place at school, such as eating, physical activity, smoking or bullying, more than others that do not usually take place at school, such as sex, alcohol use, drug use and/or sedentary time behaviors. However, this appears not to be the case as 14 of 21 interventions to change one or more at-school behaviors were still successful (and another 4 of 7 were partially successful) in achieving behavioral change despite the absence of a healthy school environment. No interventions thus far have focused on including (local) health services. These promising findings regarding the development of school-based interventions should be substantiated in further studies.

Several studies mentioned that in complex, comprehensive interventions, such as many multi-health behavioral school based programs, it is crucial to incorporate a process evaluation in the structure of the program, to enable an adequate interpretation of quantitative (behavioral) data.⁵⁵⁻⁵⁸ As stated by Campbell et al.: "*Unless the trials illuminate processes and mechanisms they often fail to provide useful information. If the result is negative, we are left wondering whether the intervention is inherently ineffective (either because the intervention was inadequately developed or because all similar interventions are ineffective), whether it was inadequately applied or applied in an inappropriate context, or whether the trial used an inappropriate design, comparison groups or outcomes. If there is a positive effect, it can be hard to judge how the results of the trial might be applied to a different context.*"^{56(p.455)}

For example Haerens et al.³¹ were unable to draw conclusions about whether the effectiveness of their physical activity and healthy eating intervention because of a lack of process evaluation.³¹ Therefore, we suggest that complex multi-behavioral school based health interventions should be studied via a comprehensive and context driven approach in combination with a thorough process evaluation. Process evaluation potentially increases feasibility and provides for a better in-context interpretation of quantitative results. Pawson et al.'s Realist Approach Model to evaluating complex interventions seems to be a more appropriate alternative than the classic randomized controlled trial approaches.⁵⁷

Limitations

The major limitation of this review is that there have been few empirical studies of school based interventions that targeted multiple behaviors in adolescents simultaneously. This made it difficult to analyze the suggested synergistic effects of targeting clusters of related behaviors. Despite this, a number of high-quality studies of the practicability, feasibility and implementation of school-based healthy interventions provided information about relevant aspects that should be incorporated in future studies and initiatives.

Conclusions

Tackling multiple unhealthy adolescent behaviors simultaneously via school based interventions and via a whole-school approach has become more popular in the last decade. Despite promising results regarding several individual aspects, such as involving parents and communities in school-based interventions, other aspects remain to be studied more thoroughly, such as the effects of creating a healthy school environment or introducing healthy behavior policies.

Two clusters of behaviors emerged as often being targeted simultaneously, namely, addiction (smoking, drug use and alcohol use) and energy balance domain (nutrition, physical activity, and screen time behaviors); however, there have been too few studies of adolescent and school health to be able to evaluate whether targeting these behaviors simultaneously has a synergistic effect. This remains to be investigated in future studies.

Implications for school health

School based interventions to promote healthy adolescent behavior are becoming increasingly comprehensive and complex. This review highlights the positive effect of involving parents and the community in health interventions and of targeting clusters of related behaviors. Other aspects of health promotion at schools, such as the introduction of behavioral policies for students (eg, zero tolerance for bullying policy or a non-smoking policy) or the creation of a healthy school environment (eg, no candy machines), require further investigation as data on the effectiveness of these aspects are limited.

The review also identified several important points to be borne in mind when developing school-based health interventions, namely, that interventions should be organized through existing school infrastructure; that they should be centrally organized within a school; that they should be fine-tuned to the target population (not a one-size-fits-all approach); and that they should be embedded in the family and neighborhood environment as well as in the school environment.

Human subjects approval statement

No human subjects' approval was required because of the review nature of the study.

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ABSTRACT

Background

Recent studies increasingly show adolescent health-related behaviors to be interrelated, interacting synergistically and sharing several common determinants. Therefore, research increasingly focuses on studying interventions that target a range of health behaviors simultaneously. This report describes the results of a pilot study of a secondary school-based, health promoting intervention that simultaneously targets a range of adolescent health behaviors via a whole-school approach.

Methods

We collected self-reported behavioral data via an annual online questionnaire to 336 students. We collected data before the intervention implementation and after the intervention's first completed, 3-year curriculum cycle on the fourth-grade students (15- to 16-year-olds). We analyzed differences between pre- and post-intervention groups.

Results

Significant behavioral changes were reported for extreme alcohol use, smoking, sedentary time, and bullying behaviors. Certain behaviors were significantly different only in girls: namely, weekly alcohol use, ever having used cannabis, compulsive Internet or computer use score, compulsive gaming score, and recent bully victimization. Differences in several sedentary time behaviors (television watching and Internet or computer use) were significant only in boys. No changes were reported regarding body mass index; physical activity; or the time spent on, or the compusliveness of, video game playing. In addition, the post-intervention group showed significantly fewer psychosocial problems.

Conclusions

The intervention successfully changed student health behaviors on many accounts. It remains largely unclear as to what causes the different effects for boys and girls. Further studies regarding multiple health behavior targeting interventions for adolescents are required.

Introduction

Unhealthy life style behaviors are important determinants of a large variety of diseases and problems and consequently of morbidity and mortality worldwide.^{1,2} In The Netherlands, worrisome trends in many health-related behaviors are becoming increasingly apparent; issues such as insufficient physical exercising, unhealthy dietary habits, excessive alcohol use, persistent smoking and increasing time spent "behind screens".^{3,4} Adolescents seem a particularly vulnerable subpopulation to develop such unhealthy habits, with half of all adolescents being involved in at least one or more risky behaviors.^{5,6} Such unhealthy behaviors are known to consequently pose a gateway to poor adult health.⁷

From 2007-2010, a comprehensive educational pilot program promoting adolescent health behavior (the Utrecht Healthy School (UHS)) was integrated on a secondary school in The Netherlands. It aimed to improve a wide range of health-related behaviors in young adolescents, since recent literature suggests that unhealthy behaviors act as being associated with, and influencing, each other in a synergistic fashion, instead of acting independently.^{4,8-11} It promotes healthy behavior in several aspects: (1) healthy nutrition; (2) physical exercise; (3) sexual health; (4) reducing alcohol use; (5) reducing drug use; (6) smoking; (7) bullying behaviors; (8) excessive sedentary behaviors (watching television, computer use and playing on a game; and (9) compulsive behavior related to internet use and gaming, via the whole school approach model, as described by the European Network of Health Promoting School's Schools for Health in Europe (SHE).¹²⁻¹⁴ The UHS integrated all five components that are noted in SHE's whole-school framework.

The SHE is an initiative that promotes pursuing health promotion via schools as a common meeting ground for the domains of children's health, education and social environment.^{12,13,15} In practice this means that the UHS, as advised by SHE for a Health Promoting School, mainly aims to give pupils tools that enable them to make healthy choices; to provide a healthier environment that engages pupils, teachers, and parents; to use interactive learning methods; to build better communication and seeking partners and allies in the community; to increase pupils' action competencies within the health field to empower them to take action; to make healthier choices easier for all members of the school community; and to promote the health and well-being of pupils and school staff. The full list of aims and targets was published by SHE in 2005.¹² The implementers of the UHS regarded these aims as building blocks of the intervention and shaped the Utrecht Healthy School according to the five principles shown in Figure 1.

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Gugleberger and Dür recommended several aspects necessary to facilitate the school infrastructure and measures needed to properly build and ensure these capacities¹⁶ (Table 1). These structures were similarly facilitated and implemented in the UHS.

In the pilot study, the intervention was tailored, which means that the evidence-based parts that the intervention consisted of were customized to the school in two ways: (1) by means of using the results of a baseline questionnaire that mapped all significant behaviors and health outcomes; and (2) by means of a healthy school steering group, consisting of representatives of the parents, students, teacher staff, school board, school policy makers, health science researchers and of several Dutch expert knowledge institutes. In this way the school prioritized what health-related behaviors and topics their healthy school should give priority to (such as in the Gatehouse Project of Patton et al¹⁷) and increased its chances of a feasible, fitting implementation strategy. The academic participants were involved with ensuring the evidence-based nature of the interventions that were selected and used, whereas the school participants were responsible for the tailoring of the intervention modules to fit their specific school context. No major decisions were made concerning the school without the parent council's and student council's approval.

Prioritizing involved the order in which the different topics were to be integrated into the school's curriculum, policy, and environment, not the intensity or approach with which the topics were to be addressed. The behaviors that were addressed immediately were bullying, alcohol use, smoking, sedentary behaviors (or screen time behaviors) and nutrition. Drug use, physical activity and sexual behaviors/health followed later in the second intervention year.

Table 1 A summary of the Utrecht Healthy School's infrastructural needs and the capacity building measures to acquire these needs for successful program implementation.¹⁶

Needs of schools	Capacity building measure (school)
Knowledge and skills	Teacher and school head training Networking with other schools Parent involvement
Commitment	Cooperation with experts/service providers School policy/climate that supports teachers'
Leadership	School head and teacher training Process/project management for the implementation of health promotion
Health promotion team	School policy/structure that allows health promotion team to work Allocation of teacher working time so additional hours can be devoted to health promotion
Health promotion resources (material, financial, time, personnel)	Sponsoring Networking with other schools Parent involvement Student participation Cooperation with experts/service providers Allocation of teacher working time so additional hours can be devoted to health promotion
Health promotion program	Teamwork to develop health promotion program Process/project management for the implementation of health promotion School head and teacher training
Institutionalization of health promotion	"Health in all policies" – school structures Health promotion decision-making Health promotion school culture Health promotion knowledge and skills

Figure 1 Application of the whole school principles in the Utrecht Healthy School pilot

The Utrecht Healthy School Pilot: a whole-school approach

Applied Health Promoting School principles¹⁵:

1. Applying a healthy school policy; for example, the UHS has a no-smoking/drinking/drugs policy or a zero tolerance-bullying policy in place.
2. Creating a healthy school environment Making the healthy choice the easy choice by, for example, creating a healthy school canteen, alcohol-free school parties, a smoke-free school yard, taking away candy machines from the hallways and facilitating proper sports facilities.
3. Involving the outside-of-school environment Actively involve parents, in curricular activities (at home) or invite parents to participate in shaping the UHS and share the responsibilities for creating healthy behaviors in the students with the parents.
4. Focusing on personal skills development Focus educational materials on personal skill development (e.g. concerning refusal skills or handling peer pressure) and let students be active participants.
5. Integrating public health authorities' services Fine-tune intervention content with the local/regional public health authorities to assure the evidence-based nature of the intervention components/lessons, fine-tune preventive services by e.g. creating fast-referral care pathways or cooperate to facilitate teacher in-service trainings.

Schools for Health in Europe aims to integrate health into schools and the social environment of children via the whole school approach.¹⁵ This integration should always be viewed in context and be handled more as a guideline than as an actual set of rigid rules. As Bruun Jensen and Simovska put it:

"Our (SHE) basic assumption is that it is not possible or desirable to create the model of a health promoting school. (...)The health promoting school is more a process of contextual interpretation than an outcome of the implementation of global principles".¹⁴

To optimize this contextual interpretation, the UHS added a sixth core principle to ensure optimally relevant health education, namely: active monitoring (via an annual student questionnaire to monitor health (behaviors)) and feedback to evaluate and adapt policies.

Utrecht Healthy School: Participating students, not attending students

As in the UHS steering group, students also participated in the UHS' curricular activities not as mere spectators, but as genuine participants. The differences between token participation and genuine participation, as illustrated for Health Promoting Schools by Simovska¹⁸, were taken into account comprehensively within the intervention. Several teaching modules especially focus on giving personal meaning to the educational materials, translating it to the student's world and on developing critical consciousness in-context, more than strongly focusing on only providing factual information. To this

purpose there are also several lessons that integrated peer education, in which the older students teach the younger students. An example of an educational module that underscores this genuine participation of the students is the final module in the intervention, called "Health is"; during which students get to pick a topic related to health and presented it to their classmates in any form they wished, at an annual symposium, explaining why they regarded this topic as being important to health in their world. This forced the students to think outside the box and to form a consciousness and critical reflection towards their own behavior and their world in relation to health. Over the years this has led, for instance, to students forming music bands, stage plays, and short documentaries and movies to deliver their message. The complete set of interventions was made available by the school on their Healthy School Website.¹⁹ Also, the participating Dutch knowledge institutes delivered some of the used evidence based modules that were used; information on this is available on their websites.^{20, 21}

The current study evaluates the effectiveness of the UHS in changing the targeted students' health-related behaviors and health outcomes within the first cycle of students to fully complete the intervention. In addition, it provides a comparing analysis to historical trends in The Netherlands over the same period of time (2007-2010).

Methods

Samples and procedures

Self-reported behavioral data were collected via an annual online questionnaire, completed by 336 students. Data were collected prior to the intervention implementation and after the intervention's first completed 3-year intervention run on the fourth-grade students (15- to 16-year olds). Thus, the two compared groups were both at similar points in their secondary school career, but one with (fourth graders in 2010) and the other group without the integrated UHS intervention (fourth graders in 2007, i.e., those who received their first 3 years of secondary school education prior to the implementation of the UHS). The questionnaire was completed group-wise in class, but individually. Survey procedures were designed to allow students to participate voluntarily and anonymously.

Student survey

The survey consisted mainly of items derived from the Dutch Health Behavior in School-aged Children questionnaire.^{22,23} Alcohol consumption, drug use, smoking, sexual behavior, bullying, sedentary time behaviors, physical activity and nutrition questions were similar (with similar operationalization and coding) to the validated Dutch conversion of the HBSC-survey²³, and similar to the Dutch HBSC study 2007.²²

The Family Affluence Scale (FAS)²⁴ and Strengths and Difficulties Questionnaire (SDQ) were part of the survey and of the Dutch HBSC questionnaire, although not part of the standard international HBSC. The FAS score measures socioeconomic status in children and adolescents (FAS-score: 0-2 = low, score 3-5, = medium, 6-9=high) and the SDQ measures psychosocial problems.²⁵ The SDQ consists of 25 items, all scored on a 3-point Likert scale, that are further grouped into five subdomains (emotional symptoms, conduct problems, hyperactivity-inattention, peer problems, and pro-social behaviors). The SDQ-scores are as follows: “normal” = SDQ-score<16; “potentially problematic” = 15≤SDQ-score≤20; and “problematic” = SDQ-score>19.²⁶

Other non-HBSC variables included were the Olweus Bully/Victim Questionnaire, the Compulsive Internet Use Scale (CIUS)²⁷ and the Videogame Addiction Test (VAT).²⁸

The Olweus Bully/Victim Questionnaire measures (different forms of) recent bullying or being bullied.²⁹ The CIUS measures compulsive computer and internet use and consists of 14 items, ratable on a 5-point Likert scale, to be summarized to acquire an average total CIUS score. Compulsive behavior is defined as the combination of excessive time spent per week (>7 hours per week) on the computer/internet, combined with a CIUS score of 3 or higher. To assess compulsive online gaming behavior the Videogame Addiction Test (VAT, a derivative of the CIUS), was used, which is analyzed similarly to the CIUS.

Data analysis

Data were analyzed with SPSS v17.0. Regression analyses were performed on normally or binary distributed data. Slopes, odds ratios (OR) and their according 95% confidence intervals are presented for these variables. A slope/OR higher than 1 indicates the added odds to a certain behavior of students having had the UHS as opposed to the pre-intervention group, whereas a slope/OR smaller than one indicates a reduction in those odds.

Non-normally distributed data were analyzed via the two-independent sample non-parametrical Mann-Whitney U-Test and thus no confidence intervals were presented for these variables; instead, the medians were presented, analyzed via sample stratification for the grouping-variable (have/have not received UHS education).

Owing to recent reports in the literature,³⁰⁻³² effects were tested for interaction effects for gender, either via an interaction term in the regression analyses or via significantly differing medians via Mann-Whitney U-Test. All statistical outcomes were tested with a significance level of $p=.05$, and a significance level between .05 and .10 was considered as a statistical trend.

Because of sample size issues, no effects could be presented with regard to unhealthy sexual behaviors.

Comparison to the Dutch Health Behavior in School-aged Children 2009-2010 study

Periodically, the Netherlands Institute for Mental Health and Addiction (Trimbos Institute) performs the HBSC study in the Netherlands. Given that our study adheres for the most part to the HBSC questionnaire and procedures, the Dutch HBSC 2009-2010²² was used to interpret the study results in light of present historical trends in The Netherlands over 2007-2010. The main outcomes that were not measured or that were measured differently in the HBSC were physical activity and the compulsive component of gaming and internet use. Thus these behaviors were not compared to the UHS outcomes.

Definitions

Drinkers. Students that drank alcohol at least once.

Binge drinking. Consuming more than five alcoholic beverages on one occasion.

Smokers. Students that ever smoked tobacco at least once.

Drug users. Students that ever used cannabis at least once.

Gamer. Students that indicated to (occasionally) played on a game console.

Dutch Norm for Healthy Physical Activity. >1 hours / day intense physical activity.

Results

This section presents the differences in behaviors and health outcomes between the pre-intervention group of 2007 and the post-intervention group of 2010. Both the 2007 and 2010 groups were on average 16 years of age and had a FAS score of 7.1. In 2007 there was a slightly higher percentage of girls (54%), whereas in 2010 this was 47%. In 2007 the response rate was 100% of the fourth graders (220 students), whereas in 2010 136 students filled in the questionnaire (60% of the total 199 fourth grade students). Afterwards, comparisons are made between the UHS pilot school students and the Dutch HBSC study students over the period of 2007 to 2010. In this results section the behaviors that were analyzed by means of non-parametric testing and via linear regressions are presented in Table 2. Thereafter, results from logistic regression analyses are presented in Table 3.

Addiction-related behaviors

In 2010 approximately 76% of the students indicated to have ever used alcohol versus 91% in 2007 (Table 3). Of these "drinkers" 49% had recently been binge-drinking versus 63% in 2007 (Table 3). The total number of times that students had ever been drunk was also reduced (statistical trend). Interactions were observed for gender with regard to the quantity of alcohol use per week, with a decreased consumption for girls from five

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to three consumptions per week, whereas boys still drank five consumptions per week (Table 2).

A reduction of ever having used cannabis was also observed, but only in girls. Ever having used cannabis and the frequency of recent use were significantly reduced. No differences were reported regarding recent use (Table 3).

A statistical trend was detected for a reduction in ever having smoked, but only in girls (Table 3). The 2010 group smoked less frequently, with smokers in 2007 indicating to smoke "at least once a week, but not daily" and those in 2010 to "smoke less than once a week" (Table 2). The percentage of students ever having smoked to follow to be daily smokers remained unchanged, as did the quantity of weekly smoking (Table 3).

Sedentary time

For boys, weekly screen time (computer and television) hours were significantly lower in 2010 than to 2007. No significant changes were noted in girls. Conversely, CIUS and VAT scores were significantly different for girls, but not for boys, respectively 1.50 in 2007 to 1.37 in 2010 for CIUS and 1.00 in 2007 to 1.49 in 2010 for the VAT. With regard to weekly hours of gaming no significant changes were reported with boys still gaming approximately 3 hours/week versus half an hour/week on average for girls (Table 2).

Physical activity and nutrition

A positive statistical trend was detected for students' sufficing to the Dutch Norm for Healthy Physical Activity (Table 3). Both eating vegetables and eating fruits (the dietary habits) remained unchanged (Table 2).

Bullying

The 2010 group reported significantly lower percentages of most bullying-related variables. The percentages of students having bullied recently and having been bullied recently (both incidentally and frequently) were lower in the 2010 group (Table 2). Also, the bully-score of boys and girls and the being-bullied score of only girls were also lower in the 2010 group. The only aspect regarding bullying that was not changed was the number of times per month that boys were being bullied (Table 3).

Health outcomes

In 2010 significantly less students reported psychosocial problems (OR: 0.48, C.I. 0.24-0.98) and a significantly lowered average SDQ score was reported (Median 2007: 13, Median 2010: 10). The students' BMI remained unchanged.

Table 2 Behaviors of students who received no UHS intervention (2007 group) compared to those who have received the UHS intervention (2010 group).

Behavior	Median of 2007-group	Median of 2010-group	P-value
Number of weekly alcohol consumptions, among drinkers (Boys)	5	5	0.26
Number of weekly alcohol consumptions, among drinkers (Girls)	5	3	<0.01
Quantity of binge-drinking, among drinkers	2 ("once a month")	1 ("No bingeing")	0.03
Number of times ever been drunk, among drinkers	4	3	0.08
Drunk in recent month, among drinkers	50.5% at least once	42.8% at least once	0.10
Quantity of smoking, among smokers	1 ("Only on occasion")	1 ("Only on occasion")	0.28
Frequency of smoking, among smokers	2 ("at least weekly, but not daily")	1 ("less than once a week")	<0.01
Cannabis use, among drug users (number of times recent use)	2	1	0.06
Cannabis use, among drug users (Boys) (number of times ever used)	6	4	0.33
Cannabis use, among drug users (Girls) (number of times ever used)	5	2	0.05
Hours of watching television (Boys)	19	9	<0.01
Hours of watching television (Girls)	15	14	0.16
Hours of computer use (Boys)	20	15	0.04
Hours of computer use (Girls)	13	12	0.20
Hours of (online) gaming (Boys)	2.5	3	0.66
Hours of (online) gaming (Girls)	0.5	0.5	0.48
CIUS score (Boys)	1.83	1.33	0.32
CIUS score (Girls)	1.50	1.37	<0.01
VAT-score, among gamers (Boys)	1.61	1.71	0.44
VAT-score, among gamers (Girls)	1.00	1.49	<0.01
Days per week eating vegetables	7	7	0.37
Days per week eating fruits	6	6	0.01
SDQ-score	13	10	<0.01
Bully-score (Boys)	6	4	<0.01
Bully-score (Girls)	4	4	<0.01
Being bullied-score (Boys)	4	4	0.31
Being bullied-score (Girls)	4	4	<0.01

Note: 1: Adjusted for confounding by socio-economic status, ethnicity, school level and age; 2: Median values are presented, due to non-parametric testing on non-normally distributed data.

Table 3 Behaviors of students who received no UHS intervention (2007 group) compared to those who have received the UHS intervention (2010 group).

Behavior ¹	Odds ratio ²	95% Confidence Interval (C.I.)	P-value
Ever drank alcohol	0.26	C.I. 0.13 - 0.50	<0.05
Binge drank in last month, among drinkers	0.59	C.I. 0.59 – 1.04	0.07
Drunk in recent month, among drinkers	0.80	C.I. 0.49 – 1.31	0.38
Ever smoked (Boys)	1.05	C.I. 0.52 – 2.13	0.89
Ever smoked (Girls)	0.57	C.I. 0.28 – 1.14	0.11
Daily smoking, among smokers	0.35	C.I. 0.07 – 1.80	0.20
Ever used cannabis	0.64	C.I. 0.38 – 1.10	0.11
Recently used cannabis, among drug users	1.57	C.I. 0.62 – 3.94	0.34
Sufficing to Dutch Norm Healthy Physical Activity	1.53	C.I. 0.93 – 2.51	0.09
Bullying recently	0.38	C.I. 0.23 – 0.65	<0.01
Being bullied recently	0.38	C.I. 0.21 – 0.68	<0.01
Frequently being bullied	0.38	C.I. 0.07 – 0.63	<0.01
Frequent bullying (Boys)	0.30	C.I. 0.13 – 0.68	<0.01
Frequent bullying (Girls)	0.22	C.I. 0.06 – 0.76	0.02

1: Adjusted for confounding by socio-economic status, ethnicity, school level and age; 2:Odds ratios were calculated with the 2007 non-intervention group as a reference category as opposed to the 2010 intervention group; 3: Linear regression analyses were performed were performed for this variable; the presented value therefore represents the regression slope value (B).

Comparisons with the Dutch Health Behavior in School-aged Children study

Owing to the lack of a direct control group in the current study, behavioral changes of the UHS-students were compared with trends over the same period of time (2007-2010) in peers participating in the Dutch HBSC 2009-2010²² (N=5.642, Table 4). In 2007, the UHS and HBSC students both reported similar behaviors with regard to alcohol use behaviors, screen time-related behaviors and physical activity. In 2010, the UHS students show a significant reduction in all of these unhealthy behaviors, whereas the HBSC students show no such changes. By contrast, the UHS students reported a higher baseline level for cannabis use, bullying and being bullied, than did the Dutch HBSC students. For those behaviors, positive statistical trends or even significant effects were reported for the UHS students, whereas the HBSC students did not show significant changes.

At baseline, a smaller percentage of UHS students smoked or had ever smoked, compared to the HBSC students. Only statistical trend reductions were noted at the pilot school in this aspect, whereas in the HBSC students no reduction was apparent. Also, the frequency of smoking was significantly lower in the UHS students. However, comparisons to the HBSC study were impossible, because data were not present in their report.²² The situations were similar for compulsive gaming and internet/computer use. Weekly fruit and vegetable consumption did not change significantly in either the UHS students or the HBSC students from 2007 to 2010.

Table 4 Compared historical trends between early UHS-effects in studied fourth graders and their peers in The Netherlands in the Dutch HBSC study²² in the period of 2007-2010.

Behaviors	Dutch HBSC 2007-2010 ^{1,2}	UHS-students
Ever used alcohol	90.8%-84.6%	91%-76%*
Recent binge-drinking	78.3%-77.4%	63%-49%*
Ever used cannabis	24%-21%	35%-27%
Ever smoked	54.6%-53.8%	48%-43%
Daily smokers	25.9%-19.2%	33%-13%
Frequently being bullied	Boys: 8.1%-8.0% Girls: 6.0%-4.6%*	Boys: 22%-6%* Girls: 10%-2%
Frequent bullying	Boys: 12.3%-9.4%* Girls: 5.8%-4.2%	Boys: 48%-20%* Girls: 25%-7%*
Daily vegetable consumption	45.3%-45.1%	59.5%-59.6%*
Hours of television per week	21.0 – 18.9	Boys: 19 hrs – 14 hrs* Girls: 15 hrs – 14 hrs*
Hours of gaming per week	Boys: 17.5 – 16.8 Girls: 6.3 – 7.0	Boys: 3 hrs – 3 hrs Girls: 0.5 hrs – 0.5 hrs
Hours of computer use per week	18.2 – 18.9	Boys: 20 hrs – 15 hrs* Girls: 14 hrs – 13 hrs*
BMI: % overweight	8.1%-9.0%	Boys: 5.2%-6.1% Girls: 4.4%-4.5%
SDQ-score	Boys: 18.1 – 14.6* Girls: 20.4-14.6*	13.0 – 10.0 *

*p ≤ .05

1: Comparisons are made with data on similar age groups, in similar settings with similar questionnaires used; 2: Trend-reports were often not corrected for SES and school-level; therefore, the exact height of percentages will often be lower for comparable groups as the UHS students; however, trends were still treated as applicable.

Discussion

In this discussion the intervention effects of the UHS pilot are interpreted in light of recent international literature. Then the notable differences in UHS effects between boys and girls are specifically highlighted and discussed. Thereafter, the strengths and limitations and the contributions to adolescent health are highlighted.

Comparisons to examples in the international literature

Positive results were shown comparing the (un)healthy behaviors of the UHS students to the Dutch HBSC study students. Recent literature offers several recent studies that aid to interpret these UHS pilot results and possibly explain the positive results by comparing these to other studies. First, it is increasingly reported that careful implementation, structured process evaluation and school-tailoring are crucial aspects to the success of a Health Promoting School. As Parsons and Stears stated: “*Experimental, outcome-focused studies will be misleading if they do not examine process also and therefore address the issue of various Type III errors.*”³³ By these type III errors they mean for example when prerequisites are not satisfied, in terms of accommodation, equipment or teacher development; when the project is partially implemented with only some of the objectives pursued and experiences provided; when there is too “poor practice” (...) to effectively implement the scheme; when the project is not consonant with other principles by which the school is run.³³ The UHS study adhered to these criteria fully on all accounts, with the only two points of critique remaining: (1) the curricular topics concerning drug use, physical activity and sexual behaviors/health were implemented at a later stage (after the first year of intervention); and (2) stimulating teachers to behave more healthfully at school was more difficult than was foreseen., mainly with regard to the no-smoking policy. The UHS was designed and implemented over the course of an entire year to ensure proper implementation and infrastructure creation for long-term institutionalization. Taking into account Parsons and Stears, the UHS’ design and implementation approach should provide confidence in that the positive changes in student health (behaviors) are indeed the results of the intervention.

Several recent other studies that evaluated Health Promoting School interventions by whole school approach also reported successes, which even more strengthen the plausibility that this type of school-customized, whole school Health Promoting School intervention such as the UHS should be the type of health promoting initiative to study in the upcoming years. Previously, Lee et al. also strongly underscored the importance of applying the whole school approach to Health Promoting Schools, as was done in the UHS. When schools in their study adhered to a certain degree to “*the six core elements of a Health Promoting School by whole school approach*” they received a special award: the Hong Kong Healthy School Award. As Lee et al. stated:

"Those schools without awards had fallen short in certain criteria in comparison with those schools with award. Their school health policies were found to lack comprehensiveness. They needed further development in staff health education training, health promotion activities for family members, management of health education resources and broader coverage of health content in their school health education curriculum."³⁴

The arguments that were presented by Parsons and Stears and those of Lee et al. provide confidence in that the chosen whole school approach of the UHS was a promising approach and an explanation why this initiative was relatively successful. Furthermore, to apply this manner of comparison to the effectiveness of the UHS purely with regard to the specific spectrum of targeted health behaviors is very difficult. Most previous studies with a comparable whole school approach and implementation strategy, in similar cultural circumstances, mainly targeted diet and nutrition^{35, 36} and/or substance use behaviors.^{31, 32, 37} Studies that tackled both those two groups of behaviors as well as the screen time / sedentary behaviors (watching television, computer use and gaming) were not found in the current literature, despite promising examples in the field of Health-Promoting Schools.^{12, 38}

Boys versus girls

The UHS seemed to have affected boys and girls differently on account of several behaviors. Several previous studies on school-based interventions that focus on multiple health behaviors have reported similar historical trends. However, the number of studies that were performed with similar scopes is limited and effects varied, with some noting more effects on girls^{39,40} and others on boys.³⁵ No conclusions can yet be deduced from the literature on this account; more studies are needed on these possible interaction effects. A second notable historical trend in the UHS is that the behaviors with the unhealthiest scores seem to be reduced most significantly (eg, television time) (Table 3). This suggests the possibility of a plateau in health behavior promotion. Previous recent studies of evaluating multi-health behavioral interventions for adolescents have also touched upon this interesting phenomenon.^{31,32} However, quantifying and/or testing this theory was not an aim of this study. The authors consider this phenomenon an issue for future research.

Strengths and limitations of the study

The UHS pilot closely adhered to the whole school approach of the SHE, while taking into account a broad spectrum of relevant health-related behaviors; the authors mark this as a strength of this study. However, this pilot study entailed only one intervention school, without a direct control group, which limits the potential for generalization of

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the results. Therefore, further research on a larger sample of schools is required to be able to more thoroughly evaluate the effects of the UHS.

Implications and contributions

The positive results of the Utrecht Healthy School pilot study, especially on account of the prioritized behaviors, seem to emphasize the importance of school-tailoring Health Promoting School interventions, tackling a range of health related behaviors simultaneously and applying a comprehensive whole school approach to school-based adolescent health promotion.

Ethics approval

This study has been approved by the Institutional Review Board of the University Medical Center Utrecht, The Netherlands. METC-protocol number 11-397 / C.

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CHAPTER 10

Busch V, de Leeuw JRJ, Schrijvers AJP. Development and implementation of a tailored Health Promoting School in The Netherlands: Lessons learned. Int J Res Studies Educ, 2014;3(2).



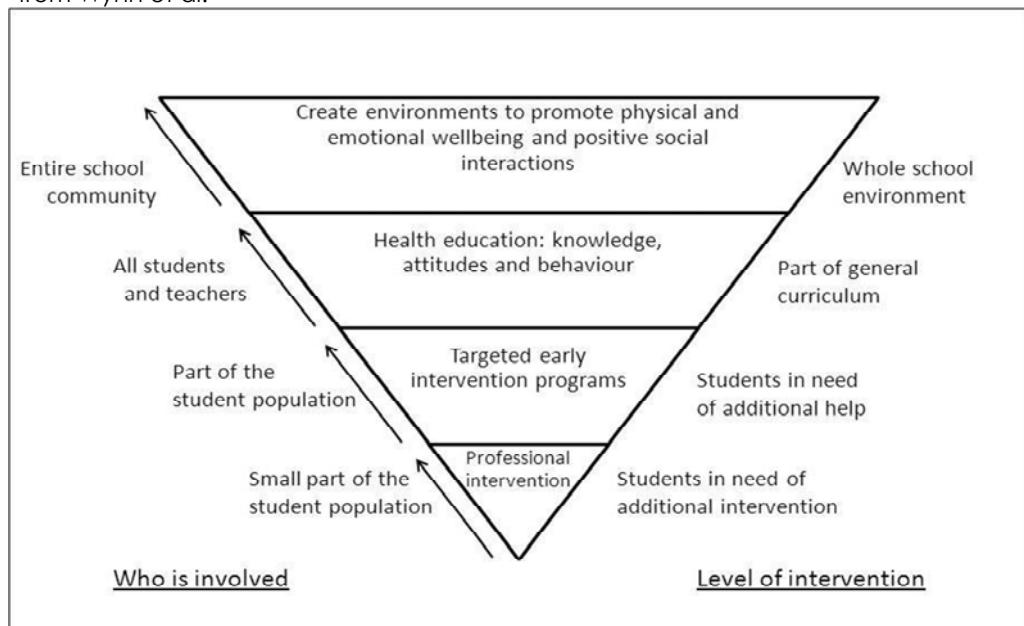
ABSTRACT

This paper presents the lessons learned from the design and implementation of a whole school Health Promoting School (HPS) pilot on a high school in The Netherlands. This pilot aims to improve a range of health behaviors in adolescents via the Whole School Approach of Health Promoting Schools framework of the WHO-supported Schools for Health in Europe initiative (SHE). Eleven semi-structured interviews were held with key stakeholders in the intervention's design and implementation. Results showed that becoming a HPS should be considered a comprehensive curriculum change that requires significant organizational investments. By integrating the intervention instead of implementing it "as is" into school's existing infrastructure the additional burden to the curriculum was minimized; this was important for intervention relevance and it strengthens feelings of intervention ownership and motivation among teachers. Also, implementation should be led by a steering group of professionals from health sciences and education as well as parents, students and teachers from the school to combine knowledge on practical feasibility and evidence based practices. Teachers should be further educated to increase competence in their new role. Lastly, a central coordinator with proper personal competencies and power to get things done is necessary to steer these developments. Since not all schools are able to make the necessary investments, successfully becoming a HPS is not feasible for just any school at any point in time; it has to be considered a well-planned comprehensive system change. Schools with competing problems such as school violence or organizational struggles should postpone HPS developments.

Introduction

Since children spend most of their time at school, it forms the ideal place for health promotion.¹⁻³ Therefore, the Schools for Health in Europe (SHE) initiative has been developed to promote the active crossover of education and health to create more effective, sustainable and feasible health promotion initiatives targeting children and adolescents: the Health Promoting School (HPS) (see Figure 1).⁴ SHE advocates this by promoting the integration of health promotion and education both into school and into the social environment of children simultaneously via five main principles of the guiding framework of the whole school approach.⁴ These five principles entail 1- building healthy public policy; 2- create supportive environments; 3- strengthening community action; 4- developing personal skills and 5- re-orientating health care services towards prevention of illness and promotion of health.

Figure 1 World Health Organization model of the whole school approach, adapted from Wynn et al.⁵



In addition, accumulating evidence shows many health behaviors in adolescents to cluster.⁶⁻⁹ Increasingly studies show such clustered behaviors to be most effectively tackled via interventions that address these behaviors simultaneously via a multi-behavioral approach instead of by single-behavior initiatives.^{10,11} This could lead to even more comprehensive future HPS initiatives.

As previous research illustrated, intervening via a whole school approach is quite demanding for a school in terms of planning and organization.¹² Parsons and Stears

added to this with their summary of specific goals and aims needed to properly fine-tune comprehensive HPS interventions.¹³ To date only a modest number of studies described lessons learned on designing and implementing HPS initiatives operationalized via the whole school approach from a practical education perspective.¹⁴⁻²¹

This paper presents the lessons learned from the development and implementation of a whole-school HPS pilot intervention in The Netherlands (the Utrecht Healthy School Pilot (UHSP)). Special focus will be placed on the crossover of the domains of health and education in these processes, since these are believed to be of significant value to future initiatives, and to have been problematic according to evaluations of past HPS initiatives.¹⁹⁻²¹

Methodology

Semi-structured, in-depth interviews (structured by means of a preset topic list) were performed with key stakeholders in the development and implementation processes of the UHSP (N=11). The whole school approach' main characteristics served as source for the interviews' sensitizing topics or themes to structure the interviews. These interview themes were summarized and elaborated upon in Table I. The order in which the topics were addressed was not preset, and no response options were provided. This process of interviewing was standardized to increase data reliability.

The interviewees were representatives of the school's teachers, school policy makers, school board, parents and public health practice and research professionals. These represent stakeholders from most parties that worked together to design and implement the UHSP. Due to their relatively large role in the intervention's implementation of the stakeholder groups of teachers and school members, multiple interviews were performed among them. The variety of perspectives among the interviewees added to the validity of the data and provided confidence that data saturation took place and all major lessons were identified. Qualitative analysis program WinMax 97 Professional²² was used to analyze the interviews. In addition, policy- and research documents, related to the UHSP, were analyzed and integrated into the lessons learned.

Table 1 Main questions from the interviews with the Utrecht Healthy School Pilot multidisciplinary steering committee.

Interview Themes	
1	The origination and set-up of the steering group. Examples of questions: What led to the school's urge to get involved with health promoting school efforts? How did those involved decided to compose the steering committee?
2	The coordinating efforts to develop the HPSP. Example of questions: What did the novel education add/change with regard to the existing curriculum? How was the novel educational content integrated into the existing curriculum, and how were these efforts coordinated at school? What was done so that both teachers and students were enthusiastic about the UHSP and implementation went smooth?
3	The function and composition of the steering group in the initial Utrecht Healthy School Pilot development. Examples of questions: How were the different members of the steering committee involved with the UHSP? What were their fields of expertise and what did each participant add? How often did you meet? How were decisions made?
4	The possibilities for teacher input during the implementation phase. Examples of questions: Were teachers actively involved in the steering group's process of designing the UHSP and if so, how? How was their input processed?
5	The undertaken efforts to institutionalize the HPSP into the school to ensure the program's durability. Examples of questions: How was the future stability of the UHSP "ensured"? How, if so, did the steering group try to let the UHSP be more than a temporary "project"?
6	The lessons that future schools can deduct from the experiences on this pilot school. Examples of questions: What would future schools need to learn from the UHSP when wanting to be involved with health promoting school efforts? What would schools need to ensure in terms of school infrastructure to optimize their chances of successful implementation and institutionalization?

Results

The Utrecht Healthy School pilot: the whole school approach in practice

The UHSP is a HPS initiative that aimed to promote health and healthy behavior on a range of the most predominant health-related behaviors in Western adolescents.²³ It was operationalized according to SHE's whole school approach with the added aspect of tailoring the intervention to the school's needs in form and content.

The UHSP changed the curriculum by providing students with two weekly hours of health education. These were integrated in the first three years of the curriculum. The educational content consisted of evidence based components that underwent a

(minor) degree of tailoring to be optimally relevant and feasible for the school to implement. It was implemented as a complement to the existing curriculum, instead of replacing original curricular methods/structures, thereby minimizing the additional burden. For further details we refer readers to the UHS website.²⁴

Lesson 1: Tailor HPS interventions in content and format.

The UHSP was tailored in two ways to facilitate relevance and implementation. Firstly, the content was tailored: each year a self-report survey (based on the WHO's HBSC survey²³) was completed by the school's students. These results were used by the school to prioritize relevant topics of the UHSP. This decision was based on the relative prevalence of certain unhealthy behaviors and health problems/situations. This ensured the school specific relevance of the UHSP's content to them.

Secondly, the educational format was tailored: instead of implementing standardized evidence based methods/modules and treating them as "one size fits all", the intervention modules underwent (minor) school tailoring to fit into the existing curriculum.

The interviewees felt it to be a strength of their approach compared to other school-based interventions that their efforts were "demand-driven", i.e. it tackled the topics that were relevant to their school in a fashion that suited their school instead of replacing pre-existing policies and curricular structures by implementing a standardized regardless of school context.

"After agreement on the educational content and goals, the practical details were worked out by the teaching staff in collaboration with the steering committee in order to integrate the content into the existing curriculum without altering the core of the novel modules" [Teacher]

Lesson 2: Design and implementation should be led by a steering group of health professionals, educational professionals and representatives of the teachers, parents and students.

The UHSP was designed and implemented by a steering group of representatives of the school's parents, students, teaching staff, school board and of health researchers and professionals. This allowed the steering group to oversee the intervention's school-specific practical relevance and feasibility while preserving its evidence based nature. The interviewees stated that researchers too often only focus on what has been shown effective without affiliation for school specific appropriateness and feasibility, while schools often thrive too much on good intentions without regard for evidence based practices. Therefore, both academic experts as well as professionals from the school worked together to create a feasible and effective intervention.

This mix of perspectives was said to have enabled them to better understand and motivate teachers to be part of the HPS. They recognized the value for schools of societal recognition. For example, media attention showed to be significantly motivating for teachers.

"Schools love good publicity. They enjoy the appreciation of their work enormously. We did not fully anticipate how strong an effect the involvement of all those "important organizations" such as the public health authorities or a University Medical Center would have, but it turned out to be very stimulating; a factor surely not to be underestimated when endeavoring in something like this in the future at other schools" [Steering group member]

Another example of this was shown by the steering group's focus on identifying mutual benefits for both education and health. While most HPS efforts predominantly focus on health benefits the UHSP was also aimed to improve educational outcomes, e.g. improving school grades or reducing absenteeism. This was hypothesized to result in more motivated teachers and eventually more sustainable initiatives.

Lesson 3: Centralize coordination and communication efforts via one main HPS coordinator.

"The teachers, the real implementers, they need to know where to go to and be assisted quickly when they have questions or issues (...) their motivation and confidence in the UHSP are vital for its success" [School board member]

The interviewees stated that to ensure smooth implementation and clarity of communication with regard to tasks, expectations and responsibilities for the teaching staff a central coordinating figure is needed. Besides being a committed motivator he/she requires in-depth knowledge of, and familiarity with, the UHSP topics. However, since personal competencies were often stated to be insufficient to achieve the desired change, this coordinator also must be facilitated with the executive power to make decisions and to force compliance, if needed, to get things done.

"getting a young biology teacher with only a great deal of enthusiasm and commitment is just not enough. A proper HPS coordinator also needs to be an in-school authority figure, to have in-depth subject knowledge and he/she is to be facilitated with sufficient resources by the school board and -policy makers. This was one of our most important lessons and it was, unfortunately, learned the hard way" [Steering group member]

Lesson 4: Involve parents, teachers and neighborhood to achieve a broader social embedding of the HPS.

The steering group reached out to the parents and neighborhood/community to ensure relevance and to help embed the HPS in the students' social environment. The interviewees stated that these efforts were partly successful.

Involving parents was found to be fruitful; the school's parent council for example aided in shaping the intervention as part of the steering group. The interviewees stated that such collaborations are too scarce, while schools could use the human resources to make such comprehensive interventions feasible and many parents are often enthusiastic about being involved in school affairs.

Conversely, school efforts to involve the neighborhood via local shop owners were less successful; they indicated that to stop selling e.g. cigarettes and soda to students would harm their livelihood.

"...and since you have no leverage to force compliance in such situations, we just had to deal with that" [HPS Coordinator]

Interviewees stated that new subsidy structures or innovations seem essential in order to progress.

Furthermore, teachers were also involved outside of the class room to serve as role models with their behavior. This was part of serious debate. Some felt it was a natural part of their role as teachers:

"just as I feel it is ridiculous to have doctors and nurses smoking just outside the hospital I feel that way about teachers smoking on a school yard (...) The credibility of the sender of a preventive health promotion message such as this is almost just as crucial as the content of the message." [Steering group member]

However, others felt it invaded their privacy e.g. to be restricted where to smoke or what not to eat at school. Most interviewees concluded that this issue should not be a priority during initial implementation, but rather of a follow-up development. They stated it will lead to less motivated teachers, which cannot be afforded in the early, fragile developmental stages.

Lastly, partnerships were formed with public health promotion and research organizations to ensure the use of evidence based (or best practices) methods. It was said that without such help it would be difficult to assure such quality, since schools often lack the time and knowledge to design such materials themselves.

Lesson 5: Teach the teachers in order to ensure health education quality

Given their relative unfamiliarity with several UHSP topics, school organized in-service trainings for teachers to develop the necessary competencies and confidence to function in their new work setting.

"Teachers were structurally offered in-service trainings to ensure that they were and felt competent to teach the new lessons. It is important that this is not something to improvise along the way; this needs to be planned and facilitated carefully. (...) To not

do this will impair educational quality and reduce teacher motivation" [School board member]

Teachers generally had a positive attitude towards these in-service trainings and appreciated the topic-specific knowledge and to be taught how to integrate these topics in class. The UHSP-coordinator and the steering group spent a full year of planning, organizing and developing the totality of UHSP efforts and a significant part of this constituted these in-service trainings.

Lesson 6: Health Promoting Schools: not for every school at any given time

Several interviewees stated that not every school can afford to undertake a comprehensive investment as becoming a HPS at any given moment.

"For something like this to be feasible it is to be treated like a curriculum change, not a project" [Teacher]

Certain circumstances were stated to be prerequisites for innovations of this kind to be feasible. When dealing with more basic issues, such as school violence, organizational mergers or financial struggles, improving students' health behaviors will not be a priority. Therefore, the steering group pressed the issue that timing is a very important aspect with regard to the feasibility and implementation success of HPS innovations. Schools need to be in a phase of advanced development, instead of dealing with basic organizational and/or survival issues, to be able and willing to spend time and resources to becoming a healthy school. Only then will such developments be granted priority and be practically feasible.

Discussion

Several lessons were learned about the processes of designing and implementing a whole school HPS. In summary, these entailed that schools should view becoming a HPS as a comprehensive system change, not a project done alongside the regular curricular activities. To become a HPS means doing significant organizational investments such as educating the teaching staff and creating a steering group with experts from academics as well as teachers, students and parents from school. When such organizational infrastructures are taken care of, schools should properly tailor new educational materials in form and content to suit their particular school and student population and these developments should ideally be led by one central HPS coordinator. For purpose of discussion these lessons are embedded in, and compared to, a broader international HPS-developmental context.

Lesson 1: Tailor HPS interventions in both content and form.

It was stated that tailoring of the intervention should make for a more feasible and relevant HPS. This is hardly a novel aspect in public health science or in education.²⁵⁻²⁷ However, in practice too often standardized interventions are implemented without

regard for context, while (minor) tailoring might result in more feasible implementation processes, more appropriate practices and less costly initiatives.²⁸ Also, teachers are more likely to experience more psychological ownership and responsibility which aids proper implementation.²⁹ Flaspoehler and colleagues further elaborated on this tailoring process:

*"key ingredient to an effective prevention support system is the emphasis on best practice process over best practice program (...) "best practice process" refers to a systematic decision-making process and set of strategies that can be used to drive implementation of evidence-based practices. That is, a best practice process offers a guide for how evidence-based practices should be implemented rather than what or which evidence-based practices should be implemented."*¹⁷

Since schools have limited time and room to integrate health education and promotion into their curriculum, they should prioritize topics to be tackled. Therefore, a second tailoring aspect was integrated regarding which health-related topics to be tackled. These were fine-tuned to the student population, ensuring that the topics addressed were actually relevant for them. This also likely resulted in more appropriate practices and stronger feelings of psychological ownership than targeting a preset collection of topics.

The UHSP's comprehensive, tailored, multi-behavioral approach is increasingly seen as a proper approach to HPS design^{17,30,31} with well-known examples such the Gatehouse Project³¹ and the Irish Mind Out project.³² However, this approach still leads to significant practical roadblocks such as in a recent Russian HPS case study in which the schools generally did not take on such a comprehensive approach. This was mostly due to their vision of to what extent certain health promotion tasks are still within the scope of what a school should tackle.³³ Including topics such as psychosocial health, bullying or internet use was not seen a task for school, but rather something that parents and students' social environment should pay attention to. In this still lays a challenge in shaping the perceptions of what a HPS is among teachers and schools.

Lesson 2: Design and implementation should be led by a steering group of health professionals, educational professionals and representatives of the teachers, parents and students

The value of integrating a combination of backgrounds and competencies in the design and implementation process as done in the UHSP was also recognized in previous research^{17,34,35}:

*"There is a lack of effective interactions between schools and the health sector. (...) Inadequate flow of information and experiences about Health Promoting Schools between schools and between schools and health sector"*³⁶

A HPS pilot in The Netherlands: lessons learned

Several positive aspects resulted from this multidisciplinary, participatory approach. Firstly, it made school tailoring of the intervention more feasible. Hereby the implementation took place without replacing existing initiatives, thereby strengthening feelings of ownership among teachers and parents.^{37,38}

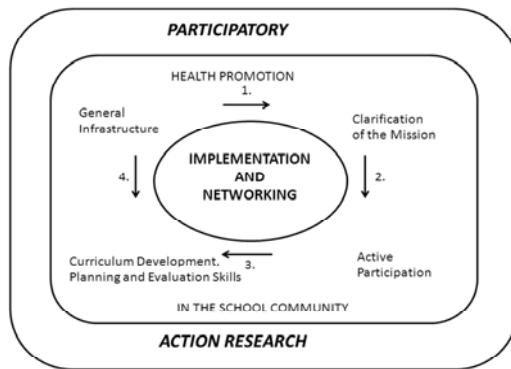
It also led to the realization that just assuming that teachers and parents were intrinsically motivated enough to undertake such a comprehensive curriculum would be too naïve. Therefore, a research aspect was added to study whether students' school achievements could be positively influenced by healthier behavior. This was used to convince teachers that the HPS was not "merely another health project", but something that aims to benefit both education as well as health outcomes. As stated by St Leger³⁹, and extensively advocated by Flay later⁴⁰, HPS's should aim to make better schools (not health centers) that improve youngsters' health. The association with academic performance therefore seemed vital to take up as one of the intervention's goals to get teachers enthusiastic about the HPS.

This participatory approach, comparable to Figure 2, offers promising opportunities. It has even been stated crucial in order to create a suitable, relevant and tailored HPS.^{29,31,32} However, little is known on how to structurally involve, especially, students and parents in such developments. They are traditionally not familiar with such an active participatory approach, as illustrated in a Swedish HPS case study:

"Some pupils are dubious about participation and about taking more responsibility. It is much easier and more secure when the teacher lectures and takes all the responsibility and makes all of the decisions"^{41p260}

Fairly equivalent arguments were made with respect to involving and giving teachers and parents more responsibilities in some processes. In this might play an important lesson for schools with HPS ambitions, namely to proactively involve students and parents earlier in the development process and share decision making and responsibilities.

Figure 2 The Model of Health Promotion in the Finnish ENHPS Schools.²⁹



Lesson 3: Centralize coordination and communication efforts via one main HPS coordinator.

The central communication and organization to steer implementation was also deemed important in previous studies.^{20,31,35,42} O'Brien et al. for example demonstrated the importance of having a central HPS coordinator at the school to strategically implement enforce and coordinate new HPS policies in their study of Maine's Coordinated School Health Program (CSHP).⁴² An important part of having a HPS coordinator for this purpose seems to be that someone has this as a main task to do instead of it being something that a teacher does aside from his/her "real" job. This was somewhat easier to achieve in the CSHP, because there the schools hired someone especially for the purpose of being a HPS coordinator. However, many schools will not have the financial room for this, which makes it important that the school board appoints someone with the proper personal competencies, as well as granting him/her with the executive power to get things done. In other studies fairly comparable lessons were presented, providing confidence in these practical lessons and advices.^{20,31,35}

Lesson 4: Involve parents, teachers and neighborhood to achieve a broader social embedding of the HPS.

Schools, by themselves, cannot, and should not be expected to, address the nation's most serious health and social problems.⁴³ To achieve this, collaborative relationships with the community should be initiated, and partners should be systematically involved.⁴⁴ Although the (potential) value of this collaborative approach was stated in the current study and also in other literature, practical roadblocks in the execution often lead to mixed experiences in terms of its feasibility.^{35,38,40,45-49} Experiences with involving parents to design the intervention and aid in involving the home environment were positive in the UHSP. However, in this respect the UHSP presents a biased image, since here the HPS was a bottom up intervention that was initiated by the parents to demand that the school should spend more attention to structural health education. Therefore, the UHSP offers limited lessons on this topic.

Conversely, involving teachers as role models, as a HPS element known to be effective⁴⁶, turned out to be much more of a struggle. Some teachers felt that such involvement in the HPS was an obvious part of their role as teachers, while others felt it invaded their privacy when e.g. they were not allowed to smoke in the school yard during breaks. In order to keep the teachers motivated and invested in the new UHPS developments the steering group and HPS coordinator decided to put these plans on hold, so that it would not jeopardize the total process of becoming a HPS. Whether to integrate teachers' behavior within HPSs varies per school and/or region; no one clear perception or consensus seems to exist. In a Russian HPS example teachers were positive about changing their own behavior as part of the HPS initiative.⁵⁰ Their encountered roadblocks were practical, e.g. too low wages to join fitness clubs or eat

healthy, whereas in the Dutch UHSP roadblocks were more on principle. The need for more structural efforts, such as teacher in-service trainings, to change teachers' perceptions on the necessity of being role models in the HPS seem to be a general trend across countries throughout Europe. With it, it might become more accepted to include teachers and they will learn how to change their behavior in practice. However, on the question of how to achieve this, no consensus yet exists. Findings of the UHSP evaluation suggest that timing seems vital in this and that involving teachers as role models should be initiated when the remaining structural parts have been embedded in the school statutes.

"*To lift the HPS out of the school benches*" via a neighborhood embedding turned out to be problematic in case of the UHSP; interests differed and shop owners perceived the HPS as a threat to their sales and livelihood. However, Turunen and colleagues stated that the issue is often more complex than merely unwilling surroundings that inhibit the practical embedding of HPSs within neighborhood communities and fruitful collaborations with external partners. An important aspect that also plays part is the awareness and knowledge of teachers to what a HPS constitutes and how this could be optimized in practice.

"*Teachers appear to acknowledge the rhetoric, but see community partnerships more in terms of resource acquisition, such as visiting speakers and information kits than working collaboratively to improve the opportunities for pupils' health (...) the development of links with the community has received little attention in the ENHPS schools, for example, in England, and it is the most problematic area for progress*"⁵¹ p. 424

This was also confirmed in context of an American HPS study: "see their relationship with parents as being one-sided; in other words, they want parents to support them in their educational role, whereas parents are more interested in carrying on a reciprocal relationship with teachers"¹⁶ p. 391

Overall, much still remains to be learned with regard to the optimal practical workings of involving the environment in shaping a HPS: "*The current literature is anything but clear on how to make this partnership a reality.*"¹⁶ p. 391

Lesson 5: Teach the teachers in order to ensure health education quality

It is important to realize that the real implementers of any school-based intervention are the teachers; it has to become their program.^{20,52,53} With the variety of added health-related topics within a new HPS curriculum it is not realistic to assume that teachers will naturally be (and feel) competent and confident enough to teach in a HPS setting. Teacher in-service trainings showed to be a welcome and needed addition to the teachers' competencies for them to be able to tackle these relatively unfamiliar topics in class. By providing teachers with appropriate competencies and understanding on

what a HPS constitutes, the health education component will be professionalized.^{35,38,53} This was also illustrated in HPS case study from Russia:

*"It is important to understand that the health promoting school is not only medical, but includes psychological and emotional health. We previously thought it was about doctors and dentists. We now think it is more about self-esteem."*⁵⁰

Since schools have been known to lack the expertise, time and resources to take on such initiatives by themselves, they should actively seek out collaborations for this. Via the relatively strong ties of public health authorities and schools in The Netherlands the UHPS demonstrated a practically feasible approach to the organization of such teacher education efforts.

Lesson 6: Health Promoting Schools: not for every school at any given time

Schools should realize that becoming a HPS should not be seen as a mere "project", but rather as a curricular systems change with according consequences for professional practice and needed investments (e.g. in teacher competencies and curricular developments). Therefore, HPS initiatives as comprehensive as the UHSP are unlikely to succeed at just any school. A rough comparison to Maslow's Pyramid of self-development can be made: only when a school has no other, more basic problems to attend to, such as reorganizations, financial stress or prominent problems such as school violence, self-development innovations such as becoming a HPS should be undertaken.⁵⁴ It is therefore important for schools to adapt a long-term vision with regard to their development and carefully plan when to integrate such efforts. In another recent study Flaspohler and colleagues stated that certain schools that were deemed "ready" to become a HPS had a much better chance at succeeding at this and that such indicators should be used to decide whether a school at a given time would be wise to endeavor in a HPS development.¹⁷ However, as Flaspohler also hypothesized

"working with the ready may have drawbacks. Strategies that focus on eliminating schools without sufficient preliminary readiness may lead to the allocation of resources outside the highest areas of need. Schools and communities with the highest need are likely to experience lower levels of initial capacity and readiness and may not be selected to participate. However, the limited research available on supporting implementation of evidence-based programs suggests that a minimum level of initial capacity must be present to assure successful uptake".^{17p. 440}

Overall, schools seem best to initiate HPS developments once certain basic prerequisite conditions are met.

Strengths and limitations

A strong point of the current study is its qualitative methodology that allowed for an in-depth study of the lessons learned from the most relevant, practical stakeholder perspectives in HPS development. This practical focus shaped these lessons to be optimally useful for schools and education professionals. Weak points in the current study were the relatively low ethnic diversity and high socioeconomic status on the pilot school; this may have resulted in a school environment in which innovative practices would be somewhat more feasible. Also, the lessons learned from involving parents might be biased to be too positive, since at the UHSP the parents were the ones demanding the school to pay more attention to structural health education. In more regular situations in high schools in The Netherlands, parents are less involved with daily school practices and it will be more difficult to get parents enthusiastic and committed to via a similar approach.

Conclusion

This study showed that it is feasible to integrate a comprehensive, whole-school intervention that targets a range of different health behaviors as a complement to the pre-existing curriculum and school infrastructure. For schools it is important to realize that this development entails a comprehensive system change, it is not a project. Becoming a HPS is a development that requires significant investments in terms of organization and commitment in order to tailor the educational content to fit the school in question specifically and to properly educate the teaching staff, so that they possess the proper competencies and confidence to function in their new role. Since not all schools are able to make these necessary investments, successfully becoming a HPS is not feasible for just any school at any point in time; it has to be considered a well-planned comprehensive investment. Schools with more pressing problems to attend to such as school violence, financial stress or management changes should not (yet) aim to become a HPS. Schools that wish to endeavor in becoming a HPS should take into account the lessons learned and experiences from our study.

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CHAPTER 11

Busch V, de Leeuw JRJ, Schrijvers AJP. Study protocol—an exploratory trial on health promoting schools at Dutch secondary schools. Int J Integr Care, 2012;12(3).



ABSTRACT

Background

Recent studies show adolescent health-related behaviors to co-occur synergistically. This paper describes the study design for an exploratory trial on the effects of a comprehensive, whole-school health promoting school intervention. This intervention tackles seven different behavioral domains simultaneously via a combination of education, creating a healthy environment and introducing healthy behavioral policies. Additionally, extensive partnerships are formed between schools, parents, neighborhoods and youth health authorities to coordinate health promotion efforts.

Study design and data collection methods

The intervention will be implemented at two secondary schools. Results will be compared with two control schools ($n=1500$). The intervention's effectiveness in changing student behaviors as well as physical and psychosocial health status along with qualitative lessons learned on the integration of youth health care services and school health education practices are the main aimed outcomes of this study. Data are collected via a mixed methods design combining an annual youth health (behavior) monitor with a qualitative process evaluation via interviews with key stakeholders.

Data analysis

A multilevel analysis is performed combined with a systematic analysis of qualitative interview data.

Conclusions

This study will produce an evaluation of a comprehensive health promoting school intervention that combines an integrated approach of schools, neighborhoods, families and youth health services to improve adolescent health.

Introduction

Unhealthy behaviors such as alcohol use, smoking, unhealthy nutrition or excessive time spent behind screens (e.g. the television, computer or game console) show alarming trends in The Netherlands and the rest of the developed world.^{1,2} Children and adolescents are a particularly vulnerable subpopulation in this respect, with half of all adolescents being involved in at least one or more unhealthy behaviors.³ Many of these unhealthy behaviors are known to originate in adolescence and consequently pose a gateway to poor adult health.⁴ Moreover, recent literature suggests that these behaviors act as being associated with each other instead of acting independently. In several recent studies this clustering is hypothesized to act on one's health interactively, i.e. individual behaviors yield greater effects when present together than their individual sums would be expected to.^{1,5-8}

Therefore, research increasingly suggests that multi-behavioral targeting interventions hold the most promising future perspectives when it comes to influencing unhealthy behaviors via preventive action.⁷⁻¹⁰ It is suggested that these interventions hold the advantage of also simultaneously influencing behaviors outside primarily targeted ones; for example, intervening in adolescents' smoking behavior, while then simultaneously also affecting their alcohol consuming behavior. Several recent studies have shown promising examples of this principle and they show interesting developments for their practical implications.^{7,8,11} However, unfortunately, most empirical intervention studies still focus on targeting one single risk factor or behavior at a time, which often causes failure to take into account much of the real world relevance that is crucial to gaining valuable insights into evaluating such interventions in a real-life educational setting.^{9,12-15} They do not sufficiently assess the intervention's effects in a comprehensive fashion. Therefore, several recent papers of different types of studies, such as those by James Prochaska¹⁰, Judith Prochaska et al.^{13,16-19} and Morabia and Costanza^{20,21}, have recently pressed the importance of persisting to study health (interventions) in real world settings to achieve the needed meaningful progress in (school) health promotion research. Also among them are several (trial) studies by Brian Flay²²⁻²⁴, who states that: "problem/risky behaviors, unhealthy behaviors, anti-social behavior, poor mental health, and poor academic achievement should be addressed by a comprehensive, coherent, and integrated approach, rather than the disjointed approach to prevention and promotion taken by education today".^{22,p. 407}

Pilot study

In 2006 a health promoting school pilot was developed and implemented on a secondary school in The Netherlands (see Figure 1). It targeted young adolescents of the first three grades of a Dutch secondary school (approx. 11–16 year olds). The desire to pursue a more comprehensive, evidence-based health promoting school concept drove the development of this pilot; a desire that originated due to persistent

complaints from parental and teachers' about the students' unhealthy lifestyle. These complaints were a result of persisting problems with, among other things, students' (extreme) alcohol use and bullying. Therefore, this particular group of young adolescents was chosen as target population for this pilot, although the authors realize that much progressive research has been performed on intervening in younger children by pioneers in the field, such as Lawrence St. Leger.²⁵

The pilot was inspired by the Schools for Health in Europe's (SHE) Whole School Approach (WSA).²⁶⁻²⁸ This model promotes a comprehensive total-life-approach instead of focusing on a single dimension of child health, such as school life or family life. Following the WSA's framework, the pilot consisted of several components.²⁹ First, several evidence-based curricular components were integrated into the pre-existing curriculum, instead of simply replacing or adding to it. These curricular changes brought about that: 1) health education constituted a significantly larger portion of the school's curriculum targeting several topics more in-depth than is common in Dutch secondary schools, 2) health education topics were structurally embedded into the curriculum, instead of being disjointed, sporadic projects, 3) certain topics were targeted in a clustered fashion, such as substance use behaviors or screen time behaviors, 4) evidence-based methods were used in health education, which is also uncommon practice in Dutch secondary schools, 5) a strong focus was placed on students' personal skill development, refusal skills training, peer education and genuine, active participation³⁰, and 6) annual monitoring of student health behaviors and health status took place via a self-report questionnaire to fine-tune school policy and create annual spear points.

In total, seven health related behaviors were simultaneously targeted in the pilot, selected based on academic literature, namely nutrition, physical exercise, substance use (alcohol and marijuana), smoking, bullying, sexual behavior and screen time behaviors [watching television, pc/internet use and (online) gaming]. The most notable 'newcomers' in this group of behaviors are the screen time behaviors. They were chosen due to their addictive potential and their importance to both physical and psychosocial adolescent health, as stated in recent studies.³¹

In addition to the curriculum changes, different (health) behavioral school policies (e.g. no smoking policy) were implemented, together with the creation of a healthy, supportive school environment (e.g. no candy machines at school, a healthy school canteen). Also, extensive partnerships with the students' social environment (with parents, the local police, local supermarkets, etc.) were formed to facilitate the development of a healthy environment for the students outside of school. In addition, the municipal health services were re-oriented towards school and prevention by e.g. creating a faster referral service to local primary health care services. Therefore, the municipal health services form close partnerships with the school to be involved with

the format and content of the pilot in order to fine-tune it to recent evidence-based or best practices.

Implementation of the pilot on the school. Instead of standardizing the pilot, the school adopted a tailored, school-specific implementation approach, based on theory and literature. To achieve this, the school first prioritized what health-related behaviors and topics a health promoting school should focus on by applying a baseline student-questionnaire/monitor to map all relevant behaviors and issues. Afterwards, these outcomes were discussed with the parents, via the parent council, in order to place emphasis on appropriate topics and to initialize the process of installing a health promoting school steering group to guide the prioritizing and further implementation. This steering group consisted of a representative of the student council, the parent council, of the teaching staff, of the school board, of the school policy makers and several researchers and policy-makers from Dutch knowledge/academic institutes and the regional public health authorities. The 'academic' participants were involved to ensure the evidence-based nature of the incorporated materials/intervention parts, while the 'school' participants were responsible for the tailoring of these materials/intervention parts to fit the specific school context.

First results of the pilot study. Recently, several papers have been published about the pilot study and student behaviors on the school.^{11,32} First, De Leeuw and colleagues reported on the (online) gaming and internet/pc use behaviors.¹¹ In addition, Sterkenburg and colleagues recently described the relationship between bullying, psychosocial health and happiness at the school.³² Furthermore, other preliminary results suggest positive effects with regard to smoking, alcohol use, binge drinking and cannabis use.

Lessons learned during the pilot study. The pilot study's most notable lessons learned mainly regarded the novel multi-actor nature of the intervention, involving school, parents, neighborhood and municipal health services. It was shown to be important to 1) assess the feasibility of close cooperation with the students' parents, 2) to facilitate a close cooperation with the municipal/regional health services in order to keep the educational modules and methods evidence-based and up to date, 3) fine-tune initiatives within the school's neighborhood (e.g. surrounding supermarkets), and 4) to provide the teaching staff with in-service trainings, in order to provide them with the necessary tools and competencies to optimally function in this 'new' curriculum and context. During the pilot study, the municipal health services showed great willingness to provide schools with such help e.g. by means of delivering evidence-based educational materials and teacher in-service trainings. All these partnerships facilitated an integral, more intensified approach to local health promotion, through integration of school, local environments and primary health care services.

After viewing the positive effects of the pilot on the school, the current, follow-up study was initiated to determine the feasibility of the intervention at more regular secondary schools with more 'standard' student demographics and school conditions. This study protocol presents the rationale and methodology for the exploratory trial study³³ of the pilot, named and from here on referred to in relation to the follow-up study as the Utrecht Healthy School (UHS).

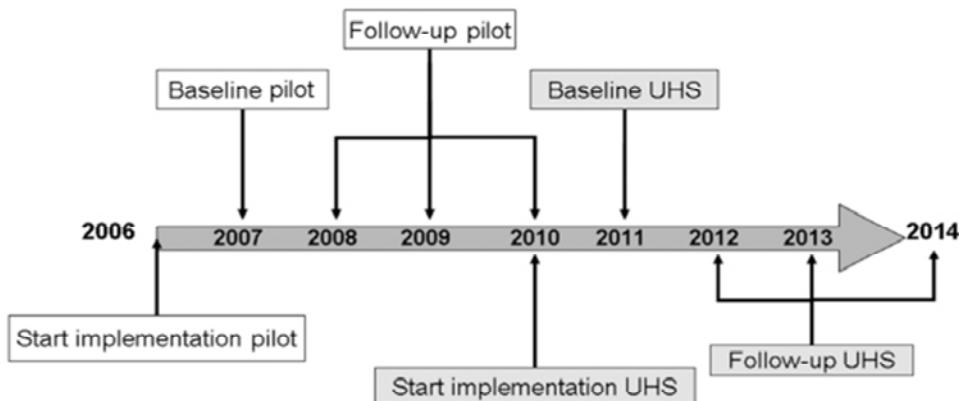
Methods

Study design: an exploratory trial

The UHS remains similar in terms of format, content and implementation as the pilot, only targeting different schools in a different study setting. It will be implemented on two Dutch secondary schools, with two comparable schools serving as controls ($n \approx 1500$ students) in an exploratory trial study design.³³

The main outcomes of the study will be the (health) behavioral change effects in students. In addition, the qualitative process evaluation components serve to optimally interpret the quantitative student behavioral change data in their proper context and to evaluate the UHS' feasibility for implementation on relatively 'standard' schools in The Netherlands, selected as a convenience sample. Afterwards, comparable control schools were selected and incorporated in the study. Campbell et al. underscore the value of such a mixed methods approach, due to the complexity of the UHS.³⁴ Their model of "continuum of evidence for complex interventions" applies well to the current study, which resides in its Second Phase. In Phase II, the UHS study resides between a randomized controlled trial phase (Phase III) and the pilot phase (Phase I).³³ During this phase the UHS' effects and implementation processes are evaluated under more regular circumstances in an exploratory fashion via a small-scale, controlled intervention-control study. The main issues to take into account in such studies, according to Campbell et al.³³, are 1) ensuring a sound theoretical understanding of the problem, 2) realizing that a lack of intervention effect may reflect implementation failure rather than a genuine lack of program effectiveness, 3) the variability in individual level outcomes may reflect upon higher processes, 4) a single primary outcome may not make the best use of the data, which means that e.g. quantitative data can better be interpreted when accompanied by related qualitative data that may provide the necessary context, and 5) realizing that ensuring strict standardization may be inappropriate in this context. The UHS may work better when a certain degree of adaptation to local settings is permitted. As the model by Parsons and Stears illustrates (Figure 2), such processes are suggested to accompany the according goals of Health Promoting School interventions. During the implementation at the two intervention schools, an entire year has been spent to fine-tuning these processes. Flay also provides similar recommendations, specifically for these kinds of complex interventions, naming this phase/type of study a prototype evaluation study.³⁶

Figure 1 Utrecht Healthy School timeline.



Sample and procedures

Students from grade one to three (11–16 year olds) are questioned via an annual online questionnaire, completed individually, in-class. Survey procedures are designed to allow students to participate voluntarily and confidentially; prior to the survey students are extensively informed of this. These procedures were similar in the pilot project.

Student survey

The survey assesses a range of health behaviors, health outcomes and socio-demographic characteristics. Most items were derived from the validated Dutch conversion of the HBSC-survey.^{37,38} (see Table 1). Non-HBSC items are the Compulsive Internet Use Scale⁴⁵ and the Videogame Addiction Test.⁴⁰

Process evaluation

Periodic, semi-structured interviews are performed with the Healthy School Coordinator to gain insight into the (progress of the) implementation process. S/he is a central coordinating figure in each participating school. S/he forms the link between school-related health promotion activities, parents, neighborhoods and the municipal health services. S/he assures that the SHE's whole-school approach^{26,28} is followed. This level of cooperation between the education and primary health care sector on such an individual school level is uncommon in The Netherlands. Similar interviews are performed at the control schools with the central contact person to account for any changes in related curricular activities to allow for better data-interpretation. The process evaluation is thematically analyzed by means of the qualitative data analysis program NVIVO.⁴⁴

Data analysis

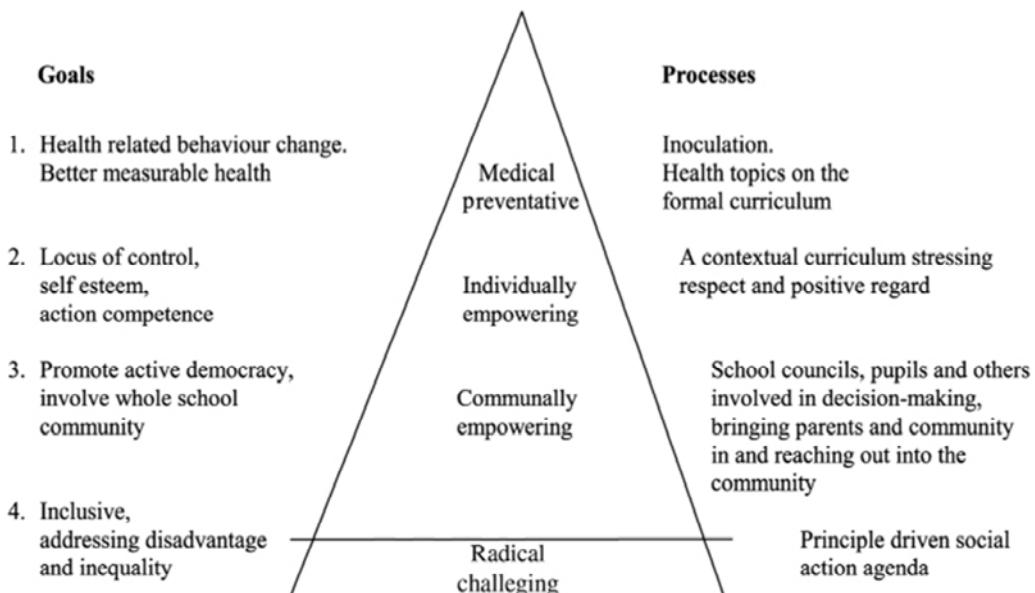
Main outcomes: student behavioral changes

Multilevel regression analyses and ANCOVA analyses will be performed to analyze changes in student health behaviors and health outcomes. The multilevel analyses will contain two levels: the school level and the individual student level.

Power calculations

Prior to this exploratory trial, the means and standard deviations of the main behavioral outcomes were estimated in the pilot study, based on previous Dutch studies to perform a power analysis for determining the study's required sample size. As stated in literature, a 'generic' target of 10–15% points of detectable change suits a program such as this UHS-exploratory trial.⁴⁶ As stated by Babyak, for multiple regression analyses 15 persons/observations per parameter are to be included in the measurements for conservative power calculations.⁴⁷ With an expected response rate of >90% and 30 included parameters to be measured, a sample size of approximately 500 observations is required for a power of 0.80 at an alpha-level of 0.05 for statistical significance, whilst approximately 1.500 students are expected to participate in the study. The sample size thus exceeds the needed requirements, but was chosen to guarantee the study results being sufficiently representative and to allow for sub-group analyses.

Figure 2 Health Promoting School hierarchy of goals and processes.³⁵



Discussion

Recently several studies advocated the use of a total life approach, as promoted by SHE's whole school approach. This approach aims to reach out beyond the borders of an adolescent's 'school life' by incorporating the social environment(s), parents and the community.^{25,27,28} Another aspect of this approach that is included in this approach is to make use of comprehensive interventions (including the creation of a healthy school environment and accordingly re-shaping behavioral policies) in contrast to 'merely' adding a standardized portion of health education to a given school curriculum/setting. The inclusion of a Healthy School Coordinator ensured that all whole school approach aspects were fine-tuned to and integrated within the school as well as with external parties. The most important aspect of this coordinating function is to steer the implementation and to guide the 'tailoring process' instead of implementing a highly standardized UHS. Both in the pilot study as well as in the current study the prioritization of the main behaviors to tackle and outcomes to pursue should be tackled by means of a questionnaire before and yearly after the start of the study. A recent successful large-scale example of such an approach was provided by Patton and all in their Gatehouse Project.⁴⁸

To stimulate the sustainability of the UHS, the schools did not receive external financial or organizational support and kept their complete autonomy and own internal structures. Taking into account the lessons learned from Flay³⁶, Campbell et al.³³, Pawson et al.⁴⁹, Campbell et al.³⁴ and Parsons and Stears³⁵ the first full year of the intervention was spent on internal organization and integrating the intervention into the pre-existing school practices and curriculum. A summary of the capacities that are needed for successful implementation of such a comprehensive health promoting school program as the UHS, a summary of Gugleberger and Dür's recommendations on this account is presented below (Figure 3).

The aspect that creates the intervention's potential success (its comprehensiveness) also creates potentially difficulties in analyzing its effectiveness. The variety of factors that make up the equation of the student's health in the intervention schools makes it challenging to clearly distinguish between successful and unsuccessful characteristics of the program. The authors have tried to signal possible confounding effects by a thorough process evaluation on both intervention and control schools. Another limitation is the dependence upon self-reported student data. It proved infeasible to also collect parent/teacher data with respect to student health behavioral changes.

Figure 3 A summary of Guggeberger and Dür's needs of schools and the capacity building measures for schools for Health Promoting School implementation.⁵⁰

Needs of schools	Capacity building measure (school)
Knowledge and skills	Teacher and school head training Networking with other schools Parent involvement
Commitment	Cooperation with experts/service providers School policy/climate that supports teachers'
Leadership	School head and teacher training Process/project management for the implementation of health
Health promotion team	School policy/structure that allows health promotion team to work Allocation of teacher working time so additional hours can be devoted to health promotion
Health promotion resources (material, financial, time, personnel)	Sponsoring Networking with other schools Parent involvement Student participation Cooperation with experts/service providers Allocation of teacher working time so additional hours can be devoted to health promotion
Health promotion program	Teamwork to develop health promotion program Process/project management for the implementation of health promotion School head and teacher training
Institutionalization of health promotion	"Health in all policies" – school structures Health promotion decision-making Health promotion school culture Health promotion knowledge and skills

Strengths of the study are that within the intervention adolescent health is taken into account in a comprehensive manner, meaning that the focus was not placed merely upon one or two health topics, but on the understanding meaningful health promotion and education should entail the whole of health related behaviors in an integrated fashion. This differs significantly from the way health promotion and health education is commonly integrated into secondary schools in The Netherlands, namely via a disjointed, sporadic and non-evidence-based manner. Furthermore, the monitoring and annual feedback function of the student questionnaire aids to provide the schools with specific, tailored health promoting school policies.

Study protocol of the Utrecht Healthy School study

Table 1 Variables measured in the questionnaire.

Factor	Operational variable
School level	
School	Coded: 1, 2, 3 or 4
Individual/student level	
Socio-demographic characteristics	
Ethnicity*	Dutch, Moroccan, Turkish, Surinamese, Netherlands Antilles, other.
Socio-economic status*	Family affluence scale (FAS) [37]
School level*	Level 1 ('VMBO') to level 3 ('VWO')
Age*	
Gender*	M/F
Behavior	
Ever alcohol use*	Yes/No
Recent alcohol use*	Yes/No
Frequency of recent alcohol use*	'Number of times ever'/'Number of times per month'
Ever smoked*	Yes/No
Active smoker*	Yes/No
Frequency of smoking*	'Number of times per week'/'Quantity per week'
Ever cannabis use*	Yes/No
Recent cannabis use*	Yes/No
Frequency of cannabis use*	'Number of times ever'/'Number of times per month'
Breakfast habits*	Number of days per week
Fruit consumption*	Portions per week
Vegetable consumption*	Number of days per week
Physical activity*	At least on average one hour a day moderate to intense physical activity
Recent bullying*	More than once per month
Recent, frequent bullying*	More than once per week
Recent being bullied*	More than once per month
Recent, frequent being bullied*	More than once per week
Ever had intercourse*	Yes/No
Age of first intercourse debut*	Age of student
Contraceptive use behavior*	Range from 'Always' to 'Never' (5 point Likert scale)
Ever had STD*	Yes/No/Unsure
Time spent watching television*	Hours per week
Time spent on pc/internet*	Hours per week
Compulsive pc/internet use	Compulsive internet use scale (CIUS) [45]
Time spent (online) gaming*	Hours per week
Compulsive (online) gaming	Videogame addition test (VAT) [40]
Health outcome	
Physical health*	Body mass index (BMI)
Psychosocial health	Strengths and difficulties questionnaire (SDQ)* [41, 42] Self-efficacy measure [38]

*Variables directly based on the Dutch HBSC questionnaire

Ethics approval

This study has been cleared of a need for review by the Institutional Review Board of the University Medical Centre Utrecht, The Netherlands. METC-protocol number 11-397/C.

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CHAPTER 12

Busch V, de Leeuw JRJ, van Yperen TA, Schrijvers AJP. Effects of the Utrecht Healthy School after two years of intervention. Health Prom Pract (submitted).



ABSTRACT

Purpose

Many unhealthy behaviors such as smoking and poor nutritional habits often originate in adolescence. Literature states that the most effective model to improve these behaviors is via the school-based whole school approach. Herein, health promotion efforts are evidence based, structurally integrated into the curriculum, while embedded in complementary healthy school policies with a supporting healthy school environment and a participating community. This study evaluates the effects of such an intervention on Dutch high schools.

Methods

Two Dutch high schools and two controls were followed to evaluate the Utrecht Healthy School's effects on students' health behavior, BMI and psychosocial problems after 1 year (N= 969) and 2 years (N= 605) of intervention. Outcomes were measured via self-report surveys and analyzed with mixed methods regression analyses. Additionally, 28 in-depth interviews with teachers were held to evaluate implementation processes.

Results

After two years one intervention school showed significant improvements on several priority targets (reducing BMI and excessive screen time use) compared to the controls. In the other school, priority targets did not significantly improve. These findings reflected their respective success in intervention implementation, e.g. differences in structural embedding in the curriculum, school-tailoring, and having one central, empowered coordinator.

Conclusions

This study shows that it is feasible for schools to implement a comprehensive Health Promoting School (HPS) intervention themselves and that, when successful, effects in terms of improving behaviors and health outcomes are promising. The process evaluation showed valuable in better understanding the quantitative findings in context of implementation efforts.

Implications and contributions

This study provides the evaluation of a controlled Health Promoting School (HPS) intervention experiment in the Netherlands, presenting the effects on both students' health-related behavior and health outcomes. By combining results of quantitative evaluation with results of qualitative process evaluation lessons learned are provided for future HPS interventions.

Introduction

Many present-day diseases such as diabetes, cardiovascular disease and psychiatric disorders partly find their origin in behavioral components. Unhealthy behaviors, such as smoking, nutritional habits or physical exercise patterns often originate in adolescence and lead to an unhealthy adult lifestyle.^{1,2} Therefore, since the 1990s, the WHO has promoted schools as the optimal setting for health promotion, because children spend a great deal of their time there learning and developing.^{3,4} This led to the promotion and development of new school health promotion models and programs.⁵⁻⁷ Schools for Health in Europe (SHE), for example, promotes pursuing health promotion via Health Promoting Schools (HPS) as a common meeting ground for the domains of children's health, education and social environment.^{5,8} They pursue this via a comprehensive total-life-approach referred to as the Whole School Approach (WSA).^{5,6,8} New in this approach is that school health promotion efforts are no longer 'projects', but rather an integrated, structural part of the curriculum. This approach is stated to be most effective when (1) complementary healthy school policies support health education, e.g. a zero tolerance for bullying, (2) a supporting healthy school environment is present, e.g. a healthy school canteen and smoke free schoolyard, (3) parents and the surrounding community are actively involved in a participatory way, (4) health education is focused on the development of personal skills and competencies to enable pupils to make their own (healthy) choices themselves instead of focusing on the simple transfer of information, and, (5) when health education and health promotion activities are designed by the joint efforts of schools and (public) health professionals to ensure evidence based methods and practices when possible.⁶

Such comprehensive interventions make it complex to adequately evaluate their effects. Purely quantitative evaluations seem deficient, because when effects are lacking it is practically impossible to distinguish whether this is the result of a failing intervention or whether its implementation (partly) failed. Therefore, several studies, some specifically in lights of HPSs, advocated the value of complementing such quantitative effects from complex interventions with a structured, comprehensive process evaluation.⁹⁻¹³

From 2007 to 2011 a pilot HPS intervention, integrating all WSA aspects, ran on one pilot school. In short, this intervention targeted a tailored set of prominent health-related behaviors among Dutch youth.¹⁴ It also aimed to improve students' psychosocial- and physical health. Since schools have limited time and room in their curriculum, they should prioritize topics to tackle. Therefore, the relevant health-related topics were fine-tuned to the specific student population of the school, ensuring relevance for them. This, as expected, resulted in an appropriate and relevant intervention with strong feelings of ownership, likely more so than when a pre-set collection of topics would have been targeted.¹⁵ Almost all 'priority targets' were significantly improved by the

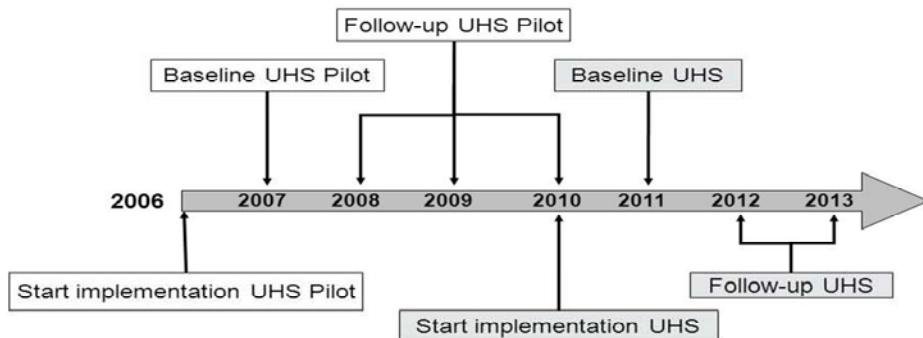
intervention (i.e. a reduction in the prevalence of extreme alcohol use, smoking, sedentary time, and bullying behaviors and psychosocial problems).¹⁴ However, this study did not include a control sample in an experimental design, which limits making inferences on its effects. Therefore, the current study aims to evaluate the effects of this intervention (the Utrecht Healthy School, UHS) on the health behaviors, physical health and psychosocial health of a representative sample of Dutch high school students via an experimental, controlled study.

Methods

Design

During the school year 2010-2011 the UHS was implemented at two regular Dutch high schools (from here on referred to as the intervention schools), with two other schools serving as controls. The schools were given a year to structurally embed it into the school's curriculum and statutes (see Figure 1). Besides measuring effects on students' behaviors and health outcomes, evaluating whether regular schools can tailor and implement such a comprehensive HPS intervention themselves was another aim of this study. The schools were only provided with information on the pilot that was freely available online to ensure that the lessons from the two intervention schools were still representative for future schools with HPS ambitions that will also have to organize such efforts by themselves. Also, this approach would be more likely to result in stronger feelings of ownership among the schools, since it would be 'their' intervention.^{12,16} The two intervention schools will be referred to as 'School A' and 'School B'. Both schools are situated in suburban areas of middle-large cities and have a relatively standard SES; they have a middle-large size for Dutch high schools (≈ 700 students each). School B has a relatively high percentage of students from non-Dutch origins, as is more common in urban areas of cities, whereas at School A most students are of Dutch origin. The two controls had similar characteristics, one resembling School A and the other resembled School B.

Figure 1: Utrecht Healthy School study timeline



Study sample

In September 2011 (baseline), 2012 (wave1) and 2013 (wave 2) students from all four participating schools were asked to fill in an online survey. The survey was completed by 1.716 students in 2011, by 1.692 students in 2012 and by 2.393 students in 2013. Each year the students from the highest grades graduated, and were thus lost from follow-up. Also, the youngest students would be newly introduced. This explains the different number of students at measurement times. After one year of intervention, the group of students that completed the survey at both T0 (2011) and T1 (2012) was used to assess the intervention's effectiveness (N = 969 students). After two years of intervention the students that completed the survey at T0 (2011) and T2 (2013) were the study sample (N = 605).

Survey procedures

The survey was completed individually, in class under teacher supervision. Survey procedures were designed to allow students to participate voluntarily. Also, the students were made aware that all data would be handled confidentially, stored in a password protected database that was only assessed by the direct researchers and processed anonymously. Students and parents were made aware of the survey and its content prior to participation. At all waves approximately 80% of the eligible students completed the survey. Only students with conflicting course schedules or those that were ill or otherwise absent on the day of the survey did not participate. Since the day and timing of each survey was unannounced, selection bias was prevented.

Student survey

The self-report student survey was based on the Dutch version of the Health Behavior in School-Aged Children (HBSC) questionnaire.¹⁷ The measures for alcohol and marijuana use, smoking, nutrition habits, physical exercise, weekly time spent watching television and using the Internet, socio-demographic factors (SES, ethnicity, gender, age, school level) and BMI were questioned as in the HBSC survey. For a detailed overview of the operationalization of all analyzed behaviors, see this study's published protocol.¹⁸

With regard to nutrition and physical exercise special composite norms were applied; healthy nutrition was considered sufficing to a combined norm of eating breakfast and fruits and vegetables at least five times per week on average (Dutch Norm Healthy Nutrition). Healthy physical exercise meant at least one hour of moderately intensive physical activity every day combined with at least twice a week physical activity aimed to improve or maintain physical fitness (Dutch Norm Healthy Physical Exercise).¹⁹ Some behaviors were measured more extensively than in the HBSC; these are elaborated upon below.

Screen time. Two different aspects of screen time-related behavior were measured. The first refers to the time spent on "screens" (i.e. watching television, using the Internet and

playing videogames) per week, that is defined to be problematic (or excessive) when occurring on average more than 2 hours per day.¹⁹⁻²¹ The second screen time-related component refers to its addictive or compulsive aspect. Compulsive videogame playing and compulsive internet use were respectively measured via the Videogame Addiction Test (VAT)²⁰ and the Compulsive Internet Use Scale (CIUS).²¹ Both these scales contain 12 similar questions with a 5-point Likert scale and a pathological score was defined as a mean score higher than three points. Recent studies showed that these two distinct behaviors are related to different problematic health outcomes and should therefore be viewed apart from each other.²²

Bullying. Olweus' conceptual definition of bullying was used, defining it as a combination of (1) physically harming, making fun of, excluding and/or spreading rumors (gossiping) about someone, (2) carrying this behavior on over time repeatedly, and (3) the bully and victim do not possess equal strength or power in the interactions.²³ The operationalization of bully behavior was based on the Olweus Bully Score and the Olweus Bully Victim Score.²⁴ These scores distinguish bullies and bullied children from non-bullies and non-bullied children with a validated cut-off of at least two times a month. These measures' validity and reliability were demonstrated in previous research.^{24,25}

Psychosocial problems. Psychosocial problems were measured as in the HBSC, with the Strengths and Difficulties Questionnaire (SDQ).²⁶ Recent studies showed the SDQ to be valid and reliable to measure behavioral characteristics on the topics emotional symptoms, inattention-hyperactivity, peer relationship problems, conduct problems and prosocial behavior.^{26,27} The subscales emotional problems, hyperactivity, peer problems, conduct problems are composed of 20 items in total (each separate subscale consists of 5 items) scored on a 3-point Likert scale and add up to a total SDO-score of maximum 40 points. A score of higher than 15 points is categorized as "(potentially) problematic".

Statistical analyses

The main quantitative study outcomes are the changes in health behaviors (alcohol use, smoking, cannabis use, healthy nutrition, healthy physical exercise, being a bully, being bullied, and excessive and compulsive gaming, Internet use and watching television), BMI and psychosocial problems. These were analyzed by means of regression analyses. In all analyses standard correction for confounding by socio-economic status, gender, age, school level and ethnicity was applied.

In addition, due to the hierachal data structure (students within classes within schools) multilevel models were used in all regression analyses.²⁸ Since individuals are nested in classes, individual observations of pupils within the same class are more alike than pupils from different classes. As a result, the average correlation between variables measured

on pupils from the same class may be higher than the average correlation between variables measured on pupils from different classes, which might affect overall effect estimates and significance.²⁸ Therefore, mixed-effects regression models were applied with classes and schools forming the levels of clustering for the main unit of analyses, the individual student. These analyses were performed using the GLMER package and LME4 of statistical analysis software R.²⁹

Lastly, sensitivity analyses were performed by comparing the current model to a standard regression model without multilevel parameters and to multilevel models that included random effects for baseline behavior within school class (level 2) and/or within schools (level 1). However, these did not yield significant model improvements (results not shown). Thus, the final model used included random intercepts for school class and school with addition of correcting for baseline behavior.

Process evaluation

To aid interpretation of the quantitative findings, a thorough process evaluation was performed to assess the implementation processes. This process evaluation consisted of 28 in-depth interviews with a sample of teachers from both intervention schools. It was ensured that a representative sample teachers was interviewed, aiming to prevent selection bias, in a process called "*purpose sampling with maximal variation*".³⁰ From both schools the healthy school coordinator selected such a representative sample to interview. The interviews were semi-structured with a preset topic list, based on whether the school implemented the five WSA characteristics and several additional aspects learned from the UHS's preceding pilot.³¹ These added aspects regard (1) Having a central coordinator to communicate with, steer and motivate teachers, who is familiar with the HPS topics and has the executive power to implement and execute policies³¹⁻³³; (2) Tailor HPS content in order to prioritize topics and ensure school-specific relevance^{12,14,31,34} as well as HPS format instead of implementing it as "*one size fits all*". The process of intervention is what should be standardized, not the intervention itself^{12,31,33}; (3) Invest in teacher competency development via in-service trainings so that they become competent and confident to teach in HPS settings and serve as health promoters^{31,33-38}; and (4) whether school treats HPS developments as structural curriculum changes, not as a temporary project.^{31,33}

The interview structure was jointly composed by two main researchers (VB and RdL). The interviews were held by one of the main researchers and thereafter transcribed and analyzed in NVIVO 7³⁹ by that researcher. Afterwards, both main researchers jointly interpreted these findings.

Results

Effects on health behavior, BMI and psychosocial health

Both schools started with different priority topics, based on a pre-baseline measurement via the annual student survey. This survey was held one year prior to baseline (T-1) to allow the schools to identify priority topics; the time from T-1 to T0 was used by the schools to design, tailor and implement their HPS. School A prioritized stimulating physical activity patterns and a less sedentary lifestyle (i.e. reduce excessive screen time use), a healthy weight, healthy nutrition habits, and to prevent and reduce smoking. A main goal that was reached at School A after 1 year was a reduction of students' average weight by 0.48 BMI points, while their psychosocial problems increased. After 1 year of intervening, excessive internet use was also significantly reduced (OR 0.63, 95% CI 0.44-0.98), while all other behaviors did not change significantly compared to that on the control schools (Table 1). This remained the same in the second year of intervention, although the effects on BMI (0.58 point reduction) and excessive Internet use (OR 0.49, 95% CI 0.26-0.91) were stronger than they were after the first year.

On School B no outcomes changed significantly during the first year of intervention (Table 1). This remained the same in the second year of intervention, although alcohol use was significantly less prevalent than on the control schools (Table 1).

Table 1 The effects on health-related behaviors and health outcomes on the two UHS intervention schools compared to the control schools.

	School A (OR) ¹ compared to controls		School B (OR) compared to controls	
	1-year vs. baseline	2-years vs. baseline	1-year vs. baseline	2-years vs. baseline
Alcohol user	0.86 (0.50-1.49)	0.55 (0.17-1.69)	0.59 (0.21-1.71)	0.23 (0.07-0.78)*
Binge drinking	1.17 (0.67-2.04)	0.85 (0.29-2.45)	0.33 (0.08-1.29)	0.50 (0.03-9.07)
Smoker ³	2.02 (0.93-4.42)	2.45 (0.99-6.39)	1.84 (0.39-8.64)	0.16 (0.02-1.22)
Ever used marijuana	1.33 (0.57-3.15)	1.39 (0.45-4.32)	1.54 (0.47-5.12)	0.48 (0.11-2.15)
Sufficing to DNHN ³	0.79 (0.48-1.29)	1.08 (0.64-1.84)	0.61 (0.27-1.34)	1.03 (0.41-2.59)
Sufficing to DNHPE ^{3,4}	0.83 (0.48-1.44)	0.96 (0.41-2.26)	1.09 (0.51-2.34)	0.65 (0.27-1.57)
Being bullied ^{3,4}	2.01 (0.74-5.96)	1.33 (0.40-4.44)	1.09 (0.33-3.57)	2.01 (0.47-9.00)
Bullying ^{3,4}	2.39 (0.88-6.46)	1.66 (0.49-5.64)	0.44 (0.07-2.72)	0.60 (1.97-6.01)
Excessive TV	0.80 (0.49-1.31)	0.87 (0.51-1.51)	0.92 (0.46-1.83)	1.18 (0.53-2.60)
Excessive Internet	0.63 (0.44-0.98)*	0.49 (0.26-0.91)*	0.75 (0.37-1.52)	0.67 (0.31-1.47)
Compulsive Internet	1.22 (0.58-2.58)	1.65 (0.44-6.17)	1.73 (0.31-9.03)	0.98 (0.15-6.64)
Excessive Gaming	0.67 (0.30-1.54)	0.51 (0.20-1.34)	0.51 (0.16-1.62)	0.93 (0.30-2.83)
Compulsive Gaming	1.04 (0.50-2.14)	0.47 (0.11-2.03)	1.32 (0.55-8.08)	0.56 (0.11-2.90)
BMI ^{2,3}	B -0.48*	B -0.58*	B -0.05	-0.43
SDQ score ²	B 1.27*	B 1.00	B -0.12	0.44

* P ≤ 0.05, ** P ≤ 0.01

1: All ORs are corrected for age, SES, gender, ethnicity, educational level; 2:These values represent B-values from linear regressions, not ORs; 3: Priority topic for School A.⁴ Priority topic for School B.

Intervention implementation

The details on the implementation of the UHS intervention on both intervention schools are summarized in Table 2. On School A the implementation of the intervention was more successful than on School B, while all procedures in regards to the information that was provided and the assistance offered by the research team were similar. In both cases the research team only provided the freely accessible information on the pilot project. Also, the schools were facilitated with an annual student survey that they could use as a tool to fine-tune the intervention during the design, implementation and annual evaluation of the intervention its focus points. School A managed to implement the UHS intervention successfully on most aspects, except for structurally organizing teacher in-service trainings to professionalize teachers' competencies. School B, conversely, scored poorly on most aspects of implementation except for creating healthy school policies and ensuring a centralized coordination and communication structure via a HPS coordinator, which were both implemented with average success.

Discussion

This study evaluated the effects of a controlled, experimental double case study of a whole school health promoting intervention. The two intervention schools tailored healthy school policies, the curriculum and other parts of the intervention to their own specific priority topics after the outcomes of an annual student survey. After two years one of the intervention schools showed significant improvements compared to the controls on several of the priority targets (reducing BMI and excessive screen time use), while not improving on other domains (eating habits and exercise patterns). The second school did not report any significant changes with regard to their set priority targets compared to the control schools. In order to optimally interpret these effects in context, a structured process evaluation was included. The differences in effects in health outcomes and health behaviors reflected their respective success in implementing the intervention. On the first school this process was mostly successful; the intervention was embedded in the school curriculum instead of treated as a temporary endeavor, a central coordinator structured and guided all changes and efforts, priority topics were set based on the annual student survey's outcomes, and evidence based teaching modules were implemented in cooperation with the local public health authorities. All this was done on top of the described five whole school approach aspects.⁶ This success stood in contrast to the second school where, despite having an enthusiastic, willing teaching staff, implementation efforts were far less successful.

Table 2 Implementation success of the UHS intervention on both intervention schools.

Topic	Status on School A	Status on School B
1- Create healthy school policies.	Succeeded: All priority topics were complemented with healthy school policies.	Neutral: Some policies were implemented, but not coordinated to complement priority topics.
2- Create a healthy school environment.	Succeeded: Healthy environment changes were realized in regards to the priority topics (smoke-free school yard and a healthy school canteen).	Failed: No environment changes were made as part of the UHS.
3- Involve parents, teachers and neighborhood.	Succeeded: Parents were informed and actively involved. For teachers to serve as role models was met with resistance. However, HPS policies were implemented nonetheless.	Failed: Parents and neighborhood were only informed, as were most teachers that were less 'directly' involved.
4- Focus health education on skill and competency development.	Succeeded: Cooperation with public health professionals realized curricular changes on this aspect in regards to several priority topics.	Failed: No structural change in teaching methods was realized.
5- Integrate health professionals, services and evidence based methods.	Succeeded: The HPS coordinator set up and maintained contact with professionals of the local public health services in context of the UHS.	Failed: Minimal contact existed with public health professionals, which limited use of evidence based practices.
6- Tailor intervention content and format.	Succeeded: Teachers, school board, student and parent councils and public health professionals were jointly involved in tailoring the UHS to ensure relevant, feasible and evidence based initiatives. The student survey played a crucial informative role in this process.	Failed: The student survey was only used to inform involved teachers and limitedly to create priority topics stimulating physical exercise and reduce bullying.
7- The HPS coordinator.	Succeeded: A HPS coordinator was present and facilitated with the executive power to get things done. He had a vast teaching experience and a background in health-related education.	Neutral: A HPS coordinator with a background in health-related education was present. However, necessary power structures lacked, which hampered implementation.
8- Teacher competency development and in-service trainings.	Neutral: In-service trainings were spuriously, not structurally organized.	Failed: Teachers were not additionally educated in lights of the intervention.
9- Treating a HPS as a comprehensive system change.	Succeeded: All HPS efforts and changes were embedded in the school curriculum, so that the UHS would not be seen as a 'project'. Also, circumstances in terms of organizational stability and competing problems favored HPS implementation.	Failed: The HPS coordinator treated the UHS as a project in which few responsibilities were shared and few institutionalization efforts were undertaken.

The value of combining qualitative process evaluations with quantitative effect assessments

In the current study quantitative effects on students' health and health behaviors were complemented by a structured process evaluation. This process evaluation provided a detailed context of the successes and struggles of the different aspects of implementing the HPS on both intervention schools. It provided valuable lessons that otherwise would not have been learned; e.g. the annual survey measured whether students were eating healthier (i.e. more fruit, more vegetables and more healthy breakfast patterns), while from the process evaluation interviews and contact with the Healthy School Coordinator it became clear that the interventions that were undertaken had focused mainly on getting students not to eat junk food and other unhealthy foods such as candy and potato chips. Another example regarded the lacking effects on physical exercise, while this was one of the priority targets of School A. It turned out that the annual survey focuses on exercising outside of schools (e.g. at a sport club, whether one takes the bike to school or the bus, etc.), while school introduced additional gym classes to improve students' exercise patterns. Although both these examples do not help to provide direct evidence for or against the effectiveness of the intervention, they do provide valuable ideas for future research.

Strengths and limitations

A strong aspect of this study is its controlled, experimental design, the use of validated survey instruments to assess students' behavioral changes and effects on their psychosocial and physical health outcomes, and the use of a mixed models approach in the data analysis. Also a strength of the current study is the combining of quantitative data with a structural process evaluation to better understand measured effects. Furthermore, the schools in this study were two relatively standard Dutch high schools that tailored, designed and integrated their own HPS program and vision into their curriculum without external financing or organizational aid. This double case study provides insights into the generalization of such an approach for future schools.

A notable weakness of the current study is that control schools, being a convenience sample, were likely to bias effects to the null, because they are more likely to 'perform' better than random controls would have, which makes the found effects likely to be underestimations and less significant than with a random control sample. Also, the quantitative effects were modest due to the small sample size of the study.

Conclusions

This study evaluated the effects of a controlled, experimental double case study of a whole school HPS intervention. After two years one intervention school showed significant improvements compared to the controls on several of the priority targets (reducing BMI and excessive screen time use), while other behaviors (improving eating

habits and exercise patterns) did not change significantly. The other school did not show any significant changes in their priority targets.

Complementary to the quantitative outcomes, a process evaluation was performed to assess how standard schools would do in designing, tailoring and implementing their own HPS. The changes in health behaviors and outcomes were reflected in the respective implementation successes. Although School B had motivated teachers and implemented some HPS aspects, e.g. a healthy canteen, their policy was hardly different from Dutch school standards.⁴⁰ The key differences between the two schools were that on School A HPS efforts were structurally embedded in the curriculum, were tailored to the school's specific needs, and were organized by a central, empowered HPS coordinator, both internally at school as well as with external partners.

The complementary process evaluation showed valuable to better interpret the quantitative findings. Therefore, this study's comprehensive HPS evaluation is more informative than one with a mere quantitative assessment, because it helps to understand why an intervention might or might not work.¹³ This approach should be repeated in larger studies in the future to more accurately determine the effects of school-level factors and to better understand how to effectively intervene in complex systems such as schools.

Ethics approval

This study has been approved by the Institutional Review Board of the University Medical Center Utrecht, The Netherlands. METC-protocol number 11-397 / C.

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CHAPTER 13

GENERAL DISCUSSION

General discussion

This thesis consists of three parts that together aim to answer the main research question "How do health related behaviors cluster, how are they related to the psychosocial health, physical health and school performances of adolescents, and are they positively influenced by the Health Promoting School innovation the Utrecht Healthy School?". In Part I the focus is on how different health-related behaviors cluster in adolescents, and how they are related to their health. Bullying and screen time behaviors were especially highlighted because of the relative novelty of those behaviors in being perceived as health-related and studied in the context of Health Promoting Schools. As such, knowledge about their associations with health outcomes and other health behaviors is currently lacking in the literature. In Part II, the effects are presented of a range of health-related behaviors on adolescents' school performances with special attention for potential causal mechanisms. In Part III, the implementation and effects of the Utrecht Healthy School Pilot and its follow-up experimental study, the Utrecht Healthy School, were presented. This included chapters on lessons learned about the design, implementation and institutionalization of future whole school approach initiatives. In this general discussion, the main findings are interpreted in lights of developments in the current literature and placed in a broader context. To conclude, recommendations for future research are provided.

Part I: Adolescent health, health behavior and multi-behavioral approaches to prevention

Interrelated behaviors have been shown to be most effectively targeted by multimodal interventions addressing wider-ranging improvements in lifestyle instead of via separate interventions targeting individual behaviors. For example, when alcohol use and smoking are tackled, it is expected that an integrated approach is more effective than two separate per-behavior interventions. Conversely, no such synergistic effects are expected when the behaviors in question are unrelated, i.e. do not cluster and/or share common determinants, such as alcohol use and bullying.¹⁻³ Hence, identifying specific clustering patterns of health-related behaviors is important when aiming to design more appropriate and effective interventions. In Part I of this thesis an aim was to identify clusters of health-related behaviors in adolescents, and groups of adolescents with similar (combinations of) behaviors and health outcomes. Four distinct behavioral patterns were found:

1. Risk-prone behavior: alcohol use, drug use, being sexually active and smoking
2. Bully behavior: bullying, being bullied and compulsive internet use
3. Problematic screen time use: compulsive and excessive screen time use
4. Sedentary behavior: low physical exercise, unhealthy nutrition habits and excessive screen time use.

General Discussion

These behavioral patterns were integrated in a cluster analysis together with several demographic factors and health-related outcomes. From that analysis, four clusters of adolescents were distinguished. In one distinct group of adolescents, poor scores on multiple health-related behaviors are associated with poor psychosocial and physical health-related outcomes. Thus, unhealthy behavior on account of multiple health-related behaviors showed to be indicative of negative psychosocial and physical health outcomes, fairly regardless of gender, socioeconomic status or education level.

The results show that many health-related behaviors cluster in adolescents, and that specific behavioral patterns underlie individual health behaviors. These findings should be used to design future interventions. Such knowledge can for example be used to design more effective and feasible school based interventions by use of Transfer-oriented Learning.⁴ Transfer-oriented Learning takes place when students apply what they have learned in a context different to that in which they learned it.⁴ This means for example that, if resisting peer pressure would be an important tool to prevent youth from starting smoking, such a skill can also be taught to be applied in a different context, e.g. when teaching students to resist drug use or to partake in unprotected sex. This way, certain common determinants can be transferred to teachings on different topics. Although a specific behavioral context is still needed to teach knowledge, attitudes and skills, Transfer Learning does facilitate more feasible school based interventions, because topics can be integrated, which lightens the load on the curriculum. Also, it would increase the outreach that school based interventions could have when multiple behaviors are targeted simultaneously. It would allow for more effective intervening with a relatively lighter load on the curriculum. Given these developments, it is a positive development to see school based interventions move towards a comprehensive, whole school approach that would facilitate a clustered approach to improve health behaviors among children and adolescents.⁵ To improve current practices in this area, research on the clustering of health behaviors is vital, since it is necessary to identify common determinants across different types of health behaviors.

In addition, researchers should also take these specific clustering patterns into account in their statistical analyses and methodological considerations. As demonstrated, the associations between health-related behaviors and psychosocial problems (chapter 3) or academic achievement (chapter 7) was subject to significant inter-behavioral confounding. This means that when a single, specific health behavior is taken into account, without regard to the mentioned specific clustering patterns of such behaviors, this is likely to introduce confounding and to overestimate true associations or effects.

As stated, this was especially highlighted in chapter 3, in which the associations between different health-related behaviors and psychosocial problems were studied.

General Discussion

After adjustment only for demographic characteristics, nearly all unhealthy behaviors were found to be significantly associated with psychosocial problems. However, after correction for confounding by other behaviors, psychosocial problems were associated only with compulsive internet use and videogame playing, smoking, cannabis use, and being bullied. This should be taken into account in future research and interventions.

Excessive and compulsive screen time use

Due to their novelty, the so-called screen time behaviors (i.e. watching television, using the internet and playing videogames) are among the highlighted behaviors of interest in this thesis. More screen time was associated with increased bullying, being bullied, skipping school, alcohol use, unhealthy eating habits and less physical activity (Chapter 4). Interestingly, the different screen time aspects, i.e. the time spent (excessive use) and the obsessive nature of the behavior (compulsive behavior), were related in different ways to health-related behaviors and outcomes. Compulsive screen time was associated with psychosocial problems, whereas excessive screen time was associated with being overweight. With technology rapidly evolving, the use of internet, smart phones and video games will intensify and their potential for causing harmful effects in case of excessive and/or compulsive use will grow. Hence, researchers and intervention designers should pay more attention to these screen time behaviors.

Another important aspect of screen time, as illustrated in chapter 4 and in the review of chapter 6, was the content of the screen time behaviors. What adolescents watch, do, and play on screens was shown to be an important factor in determining the effects on health and school outcomes.⁶⁻⁸ For example, watching entertainment television only took up time that could have otherwise been spent on homework, but playing videogames with friends (online) showed to be beneficial for students' school performances. A given explanation was that such games strengthen ties between students, causing them to like school, which in turn leads to more commitment and better performances. Although much remains to be unraveled regarding screen time behaviors and their potential to influence adolescents' development, it was demonstrated in this thesis that the significance and complexity of their associations with adolescents' health (both positive and negative) should not be underestimated. Therefore, they should be included more in future research and Health Promoting School interventions.

Bullying and psychosocial problems

In addition to screen time, special attention was also given to the consequences of bullying and being bullied on adolescents' psychosocial health. Behaviors such as alcohol use, smoking and nutrition have commonly been topics of interest in public health research. This is much less the case for bullying, while that has also been shown to significantly affect psychosocial health and happiness. Despite advances in current

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research on the causes and consequences of bullying, contradicting findings exist with regard to whether existing psychosocial problems make adolescents prone to being bullied or to become bullies themselves and/or that these effects work vice versa. Therefore, the bidirectional effects of bullying and bully victimization on psychosocial problems were studied in chapter 5. It was shown that both bullying and bully victimization led to more future psychosocial problems. Conversely, the opposite also showed to be true, meaning that psychosocial problems put adolescents at higher risk of being a bully or to be bullied in the future.

These findings implicate that bullying, being bullied and psychosocial problem development form a vicious circle once started. Past studies showed that these consequences can be serious and long-lasting.⁹⁻¹¹ Interventions to break this downward spiral are therefore crucial.¹² The whole-school approach has been hypothesized to be the most effective approach to tackling school bullying,¹³ since school-level factors, such as classroom climate, school ethos, and the quality of student-teacher relationships have been shown to strongly affect prevalence of school bullying. As Woods, Done and Kalsi stated: "*bullying is very much a group process bolsters the argument for a systemic approach to its correction*".¹⁴ The Whole School Approach presents such an approach and more studies should therefore aim to assess its effectiveness to reduce bullying and bully victimization prevalence. This means that a proven effective intervention, such as the Finnish KIVA anti-bullying program⁴⁰, would be integrated in a systemic approach by e.g. complementary healthy school policies such as a zero tolerance bullying policy to be optimally effective.

Part II: Adolescent health behavior and academic achievement

Whether students that behave healthier also perform better in school than those behaving less healthy was the main research question of Part II of this thesis. Motivating schools and teachers to invest in health education and in becoming a Health Promoting School has proven to be a challenge, yet also a crucial factor for its implementation and institutionalization in schools.¹⁵⁻²² Schools are first and foremost expected to educate adolescents and not primarily serve as a place for health promotion. Therefore, without direct benefits to students' school performances it is unlikely that schools will adapt to the Health Promoting School on a large scale. Thus, studying if and how improving health behavior leads to improved school performances is vital to get schools willing to invest in Health Promoting Schools.

In Chapter 6 the longitudinal evidence on the effects of several health-related behaviors of adolescents on their academic performance was systematically reviewed. It showed that these were significant for most of the included behaviors. Much of these associations were not straightforward; they were often significantly affected by students' socioeconomic status and related health behaviors. Also, they were often mediated by psychosocial problems and social backgrounds. Several included studies

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concluded that this mediation by psychosocial problems was a viable mechanism to explain the effects of unhealthy behaviors on academic performances. The review illustrated that, thus far, research on the effects of health-related behavior on school performance in adolescents has been limited: Only 30 longitudinal studies on the topic were published in the last 20 years. None at all were found that assessed the effects of cannabis use or compulsive screen time, and only a few investigated the effects of nutrition or smoking. Thus, in order to build a solid basis of empirical evidence more research on the topic is needed. The main conclusions from Flay's systematic review in the American Journal of Health Behavior (2002) still hold true¹⁹, namely that we need more comprehensive programs that focus on both educational and health outcomes, and that in order to achieve this we need to clarify the crosslinks between health behavior, health outcomes and academic achievement and actively involve both domains.

Given the findings of chapter 6, the associations between health behaviors and academic achievements, with special regard for the mediating effects of psychosocial problems, were the topics of interest in chapter 7. The Utrecht Healthy School data was used to assess these associations. Smoking, bullying, being bullied, compulsive and excessive internet use and low physical activity were all shown to be directly associated with lower school grades. Additionally, being bullied, smoking, compulsive and excessive internet use were (also) associated with students' grades via mediation of psychosocial problems. This means that a distinction was made between a direct route of association of a certain behavior and academic achievement, and an indirect route. In the latter situation, a behavior would influence students' psychosocial problems, and through that effect, students' school performances would subsequently be influenced. These findings provide new ideas for future research into the mechanisms behind these effects.

Explaining the associations between health behaviors and academic achievement

In the systematic literature review of chapter 6, the effects of health behaviors on academic achievements were interpreted quite uniformly across most included studies, namely either by use of Social Capital Theory or by Social Exchange Theory. In context, these theories present a relatively similar social cost-benefit explanation. Whereas e.g. participation in team sports positively affected academic achievement, individual sports were shown to negatively influence it.^{23,24} Team sports showed to strengthen bonds with school personnel, raise social status, provide entry into elite peer groups, and to raise aspirations for college attendance, whereas individual sports such as fitness only took up time that could have been spent on school work. Therefore, the socialization component of sports participation countered the negative effects of the loss of study time, providing a payoff with regard to students' achievements. Similarly it was shown how alcohol use might lead to impaired academic achievements due to

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weakened interest in academic performance "in exchange" for a gain in social status²⁵, similar to how for example watching TV or using the Internet for entertainment purposes took up time from school and thus led to poorer school performances. Overall, the social interactions and causes of certain health-related behaviors and their effects on the academic performance of adolescents was strongly connected and more longitudinal research might provide more of the needed clarity on underlying mechanisms.

For certain behaviors, often those that are not someone's 'active doing', such as being bullied, Hirschi's Social Bonds Theory was used to explain the effects on school grades.²⁶ Similar to how certain situations lead to detachment from social norms, values and goals²⁶, detachment from societal/group norms is also thought to overcome bullied adolescents. Hirschi emphasized that adolescence plays a critical role in life at which time social bonds are formed and that during that time peer relationships are among the most vital to determine the outcome of someone's normal socialization and functioning at school.²⁶ Bullying damages this and leads to an increased risk of a student not considering the usual goal (academic development) as important. In addition to these explanations most of these associations also showed to be affected by more complex underlying social mechanisms rather than simple, direct (biological) effects of the particular behaviors in question.

Gender differences

Special attention was given to potential gender differences in the effects of health-related behaviors on school performances. In general, the association between unhealthy risk behaviors and school performances as well as the association to (and via) psychosocial problems were less prominent for boys than for girls. This indicated that risky behavior is less an indicator for problems (either academic or psychosocial) for boys than for girls. In other words, for boys certain behaviors might be less deviating from what is considered normal than for girls. Girls that exert unhealthy risk behaviors such as smoking more often show a significant association with such problems, whereas for boys such behavior may be more prevalent or common and therefore not a strong indicator for problems. Such gender differences are robust and boys have been shown to have a more positive attitude towards risky behavior such as smoking or risky sex than girls.^{27,28} This could explain the lack of association of certain health-related behaviors with problematic outcomes such as psychosocial problems (chapter 3) or low school performances (chapter 6) in this thesis. These findings are useful in designing new health promotion initiatives in which it might be deemed more appropriate to target boys and girls differently; for example for boys a more general approach might be more appropriate, since their standard behavior is somewhat more risky, while for girls it might be more effective to identify and target risk groups to tackle.

Part III: The Utrecht Healthy School

The last part of this thesis was dedicated to evaluating the effectiveness and lessons learned of the Utrecht Healthy School Pilot study and the controlled follow-up study. The systematic literature review of chapter 8 first provided contextual information on what is currently known about the effectiveness and feasibility of comparable interventions. The final chapters 9 through 12 jointly answer the third main research question of this thesis: "*How feasible and effective is the Utrecht Healthy School intervention to improve adolescents' health and health behavior?*"

A tailored approach to Health Promoting Schools

In this thesis it was shown that implementing comprehensive health promotion interventions that address multiple health-behaviors simultaneously comes with significant organizational demands for a school. For instance, schools have limited time, means and room to integrate health education and promotion into their curriculum. Hence, schools should tailor a Health Promoting School to fit their specific situation and needs and integrate it in their curriculum, instead of adding a highly standardized intervention to it. This way, they lighten the curricular load, tackle only relevant topics and likely create broader support for the intervention at school. The Utrecht Healthy School pilot and follow-up demonstrated how such fine-tuning can take place. Through the use of a student questionnaire as an assessment tool for the status of health outcomes and health behaviors, schools can identify which health-related topics should be addressed in their specific situation. This ensures that topics are addressed that are actually relevant for the receiving school. This should result in more appropriate and relevant interventions that create stronger feelings of psychological ownership than when a pre-set collection of topics would have been targeted. A few other studies exist that took a similar approach and performed a tailored needs assessment via student survey to prioritize focus points.^{29,30} As Patton et al. stated in context of the Whole School Approach intervention The Gatehouse Project: "*Development of standardized intervention process rather than a standardized, one-size-fits-all invention*".³⁰ Even when interventions would not be as comprehensive as in the Whole School Approach, a proper assessment of health behaviors and health problems per school would allow for more appropriate, relevant interventions.

However, schools often have little experience and expertise in performing such surveys and analyzing their data. In the Netherlands schools could be assisted by e.g. local public health authorities, which often do have a vast experience with this. When such collaborative efforts would be more structurally undertaken, and school health promotion would become a joint effort, its further professionalization would be possible. This would allow for tailored Health Promoting School efforts that are both appropriate and evidence based. Via fairly simple collaborations and use of existing competencies

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and knowledge, important steps in professionalizing preventive health promotion should be feasible.

Evaluating Health Promoting Schools

Tackling multiple unhealthy adolescent behaviors simultaneously via whole-school approach has become increasingly popular in the last decade.^{5,31,32-34} Involving parents and communities in school based interventions positively affects their effectiveness to improve health and health behaviors. The value of other school-level aspects (e.g. specific policies or teaching methods) remains to be studied more thoroughly (chapter 8). Incorporating lessons learned about intervention design and implementation from qualitative studies is therefore valuable to the literature in its current state. This approach led to several learnt lessons (chapter 10). Firstly, it was shown that schools should realize that becoming a Health Promoting School entails a comprehensive systems change. It should not be seen as a temporary "project". It requires significant investments in terms of organization and commitment to tailor the educational content to fit the school. The teaching staff also has to be properly educated, so that they possess the competencies and confidence necessary for their new role. Since not all schools are able to make these necessary investments, successfully becoming a Health Promoting School is not feasible for just any school at any point in time. It has to be considered a well-planned comprehensive investment. Schools with more pressing problems like mergers, financial stress or management changes should not (yet) aim to become a Health Promoting School. Also, integrating an intervention into a school's existing infrastructure instead of implementing it "one size fits all" minimizes the additional burden to the curriculum, which creates a more relevant intervention and strengthens feelings of intervention ownership and motivation among teachers. Furthermore, implementation should be led by a steering group of professionals from health sciences and education as well as "local stakeholders" (i.e. parents, students and teachers from the school) to combine knowledge on practical feasibility and evidence based practices. Lastly, a central coordinator with proper personal competencies and power to get things done is necessary to steer the tailoring and development of the program.

These practical lessons on Health Promoting School implementation should be taken into account when evaluating an intervention's effectiveness, instead of pursuing a purely quantitative approach. Embedding a structural process evaluation in complex, comprehensive interventions helps to more adequately interpret quantitative (behavioral) effects.³⁵⁻³⁹

The Utrecht Healthy School Pilot

Both quantitative behavioral changes as well as the lessons learned from the design and implementation processes of the Utrecht Healthy School pilot were assessed.

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Significant behavioral improvements were reported for extreme alcohol use, smoking, sedentary time, and bullying in the pilot study. Prior to the intervention, a baseline survey was performed among the pilot school's students to map the relative prevalence of certain health-related behaviors and –problems compared to their peers in the rest of the country. The main targets of intervention, which were deemed most pressing at baseline when the intervention was started, were peer bullying, alcohol use and smoking. With regard to these behaviors the first two significantly improved ($\approx 20\%$ reduction in bullying and being bullied, and 14% reduction in binge drinking) and the third modestly (5% reduction in smoking). This success was much quicker and stronger than in most other multi-behavioral interventions (chapter 8).³⁵⁻³⁷ The use of evidence based practices, the involvement of parents and local public health professionals, having a committed teaching staff that was properly facilitated, and having a good internal organization was perceived by the school's teachers and other staff to have added to this success.

The qualitative assessment of the implementation provided potential explanations as to why some behaviors did not significantly improve. Firstly, with regard to physical activity the school's students scored quite positively at baseline, so this was deemed a low priority, which might explain the lack of significant improvements on this aspect. Concerning smoking, the educational materials were taught properly, but teachers refused to serve as role models e.g. they did not want to give up being able to smoke at the schoolyard during breaks. Also, the "environment aspect" of the whole school approach had limited success; students could still smoke in the schoolyard and the local nearby shop still remained an easy access point for the students to get cigarettes. Access to this nearby shop was also thought to have limited the effects of the school's efforts to improve upon the students' nutrition habits. The students could easily get cheap, unhealthy things like potato chips or candy there, while the healthier products from their own school cafeteria were more expensive. With regard to the behaviors that were most successfully improved (bullying, alcohol use, excessive screen time use) the whole school approach' principles were also most successfully implemented: parents were actively involved, healthy school policies were implemented alongside using evidence based practices. This reflection on the results would not have been possible with only a quantitative evaluation.

The Utrecht Healthy School: the controlled experiment study

In the controlled Utrecht Healthy School experiment (chapter 12) a similar approach to evaluate effects was used as in the pilot study. The quantitative effects assessment regarded measuring health behaviors and outcomes via self-report survey one and two years after the start of the intervention. Its qualitative assessment consisted of semi-structured interviews with a representative sample of teachers from each intervention

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school. Implementation differed between the two intervention schools, with the school that most successfully implemented the program showing the most positive results.

Both schools started with different priority topics to tackle. At Intervention School A it was a priority to stimulate physical activity patterns and a less sedentary lifestyle (i.e. reduce screen time use), a healthy weight, healthy nutrition habits, and to prevent and reduce smoking. A main goal that was reached at Intervention School A after 1 year was a reduction of students' average weight by approximately 1/2 BMI point. After 1 year of intervening, excessive internet use was also significantly reduced, but all remaining behaviors did not change significantly compared to those on the control schools. This remained the same in the second year of intervention, although the effects on BMI and excessive Internet use were slightly stronger compared to the first year.

At Intervention School B no priority targets changed significantly during the first year of intervention. The annual questionnaire did not lead to concrete policies and structural HPS efforts as was the case on Intervention School A. Intervention School B was motivated, but lacked the sense of urgency that Intervention School A showed. This remained the same in the second year of intervention, although alcohol use was significantly less prevalent than on the control schools.

The differences in effects in health outcomes and health behaviors reflected the schools respective success in intervention implementation. Intervention School A implemented the UHS mostly successful: it was embedded in the curriculum and not treated as a temporary endeavor; it had a central coordinator who structured and guided all efforts; it had priority topics that were based on the outcomes of the annual student survey; and implemented teaching modules were as much as possible evidence based due to cooperation with the local public health authorities. All this was done on top of the described five whole school approach aspects. This success stood in contrast to Intervention School B where, despite having an enthusiastic and willing teaching staff, implementation efforts were less successful due to internal reorganizations they had to handle during the study period.

Although Intervention School A did show significant effects after 2 years of intervention, the effects were relatively modest. This might be explained by several factors other than the implementation success. They could be a result of the short follow-up period; perhaps comprehensive interventions like this need more time to completely be embedded in school. Also, the use of a convenience sample for the controls might have biased effects to the null. This means that because they are more likely to 'perform' better than random controls would have, the found effects are more likely to be underestimations and less significant than with a random control sample. Also, the quantitative effects might have been modest due to the small sample size of the study. Whatever the reasons, when considering the relatively modest effects on students'

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health and health behavior in the Utrecht Healthy School, one should reflect upon whether the comprehensive investments are worth the benefits.

Recommendations for future research

Several interesting evaluation studies exist on the topic of Health Promoting School interventions. However, larger evaluation studies than thus far performed would allow for more between-school characteristics to be analyzed, which might shed more light on what may constitute a successful Health Promoting School. Based on the findings of this thesis, future Health Promoting School studies should preferably take the following recommendations into account:

- Prospective, experimental studies of Health Promoting Schools are needed with a sufficient sample size to investigate the influence of school characteristics on the success of implementation and on the effects to improve health and health behavior.
- Future studies should utilize knowledge on the clustering of health-related behavior in order to identify common determinants to design more effective interventions via e.g. Transfer Learning.
- Future studies should combine a qualitative evaluation of an intervention's implementation simultaneously with a quantitative assessment of its potential to improve health and health behavior.
- Future studies that evaluate Health Promoting School interventions should also aim to improve education-related outcomes (e.g. school grades, drop-out rates, truancy) instead of only focusing on health-related outcomes in order to be optimally relevant to schools.
- Future studies should focus more on evaluating the effects of tailored interventions versus standardized interventions with preset topics and format.

Conclusions

In this thesis it was shown that tailored Health Promoting School interventions pose a viable way to improve the health behaviors and psychosocial and physical health of adolescents. Promising developments with regard to Health Promoting Schools were shown from the literature, from the Utrecht Healthy School Pilot and from the Utrecht Healthy School follow-up study. In the Utrecht Healthy School Pilot, most of the priority targets were significantly improved. In the follow-up study one of the two intervention schools also showed promising effects. Complementary process evaluations, undertaken to optimally understand the changes in health and health behaviors, showed valuable in understanding and interpreting intervention effects. In addition, the annual student survey showed to be a valuable instrument to aid the intervention

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schools to tailor and evaluate their Health Promoting School efforts each year. Generalizations about the effectiveness of the Utrecht Healthy School should not be made from this thesis given its modest size, yet both at the pilot school as well as on Intervention School A in the controlled experimental study results were promising. However, given the small effects on students' health and health behavior, one might wonder whether the comprehensive systems changes that entail creating a Health Promoting School as the Utrecht Healthy School are worth the effort at this time.

In the current thesis it was also shown that close associations exist between health behaviors and school performances. The importance of clarifying the connections between school outcomes, health behaviors and health outcomes to both the health promotion and the education sectors was demonstrated in this thesis. It was shown that health promoters need to better understand that health promoting schools are not meant to be health centers, but primarily schools where health is actively promoted. Conversely, the education sector could benefit from taking notice of the close crosslinks between health and education that were demonstrated in this thesis. This could lead to making better informed decisions on whether or not to engage in Health Promoting School undertakings.

Lessons learned about the intervention's feasibility can help schools with future Health Promoting School plans. Taking into account those lessons, tailoring and implementing a Health Promoting School intervention via a whole school approach is feasible for schools under usual circumstances.

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English summary

Health-related behaviors such as smoking, peer bullying, alcohol use and unhealthy nutritional habits contribute significantly to the public health burden of major illnesses such as diabetes, cardiovascular disease and psychiatric and psychosocial disorders. Most often, these health-related behaviors originate in adolescence and then pose a gateway to impaired adult health. Since children spend much of their time at school, the World Health Organization (WHO) states this to be the ideal place for health promotion. This led to the development of the Whole School Approach model to Health Promoting Schools (HPS). In short, this method focuses on combining evidence-based health education methods (with a strong focus on personal skill development) with healthy school policies, a healthy school environment and cooperation with community stakeholders such as the family and neighborhood.

In the introduction (**chapter 1**) it is explained how in this thesis three interrelated topics are discussed with regard to health-related behavior in adolescents in light of Health Promoting School developments. The first part of the thesis focuses on how different health-related behaviors cluster within adolescents and what the implications of that are for school health promotion practice (**chapter 2**). The health-related behaviors that are the topic of research throughout this thesis are alcohol use, smoking, cannabis use, physical exercise, healthy nutrition, bullying/being bullied, sexual behavior and screen time behaviors (playing videogames, watching television and using the Internet/computer). In addition, Part 1 focusses on the associations of health-related behaviors with health outcomes (**chapter 3**), with special attention given to screen time (**chapter 4**) and bullying (**chapter 5**). In Part II (**chapters 6 and 7**), the associations are studied of health-related behaviors with educational outcomes. In Part 3, a systematic review is first presented on the international literature on the effects of multibehavioral whole school approach interventions (**chapter 8**). Thereafter, the effects and lessons learned from a whole school Health Promoting School pilot in The Netherlands are discussed (resp. **chapter 9** and **chapter 10**). After that, the study protocol (**chapter 11**) and the results are presented from the controlled experiment follow-up study that followed from that pilot (**chapter 12**). Finally, a synthesis and discussion of the main findings is presented in the General Discussion (**chapter 13**).

Part 1

When investigating the effects of health-related behaviors on health or educational outcomes, most studies thus far only integrated one, or a small subset of, health-related behaviors. Not sufficiently taking into account behavioral clustering and associations makes research prone to methodological error. It introduces a higher chance of reporting overestimations of true effects. Therefore, in the first part of this thesis the topic of research is to study how different health-related behaviors cluster in adolescents, and how such patterns of health-related behaviors are related to their

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psychosocial and physical health. Behaviors that are classically perceived as being related to health (e.g. smoking) as well as others that are only relatively recently started to be seen as such (e.g. compulsive internet use), are all included.

In **chapter 2** it is discussed how different health-related behaviors cluster within adolescents. Information on such clustering has important implications for research and the effectiveness of interventions due to the possible synergistic effects that result from it. This means that certain behaviors increase the likelihood of being involved in other risk behaviors. Interventions that target clustered behaviors simultaneously have been shown to be more effective and cost-effective than those that tackle the same behaviors via separate interventions. However, in order to design such interventions more knowledge on behavioral clustering is needed. In this chapter the clustering patterns of a range of health behaviors were studied via factor analysis. This deduced four overarching behavioral patterns from the individual behaviors, i.e.: 1) risk-prone behavior: alcohol use, drug use, being sexually active and smoking, 2) bully behavior: bullying, being bullied and compulsive internet use, 3) problematic screen time use: compulsive and excessive screen time use and 4) sedentary behavior: low physical exercise, unhealthy nutrition habits and excessive screen time use. In a subsequent cluster analysis it was shown that, in general, certain clusters of health-related behaviors were associated with being overweight, students' self-efficacy and psychosocial problems. These associations were relatively independent of demographics such as ethnicity, gender and socio-economic status. Such knowledge can be used to design more effective and feasible school based interventions, for example by use of Transfer-oriented Learning. This is said to take place when students apply what they have learned in a context different from that in which they learned it. This means for example that, if resisting peer pressure would be an important tool to prevent youth from starting smoking, such a skill can also be taught to be applied e.g. when teaching students to resist drug use or to partake in unprotected sex. This has been hypothesized to lead to more effective interventions with a lighter load on the curriculum than implementing separate lifestyle-improving interventions.

In **chapter 3** it is shown how health-related behaviors are related to adolescents' psychosocial health, and to what extent behavioral correlations are responsible for the confounding of these associations. This means that the associations of health-related behaviors with psychosocial problems can be confounded when assessed via analyses that only take that behavior into account (*single-behavioral analyses*) versus analyses that also take correlated health-related behaviors into account (*multi-behavioral analyses*). In this chapter it is demonstrated that when only adjusting for the effects of standard demographics (gender, socioeconomic status, ethnicity, age) nearly all health-related behaviors were significantly associated with psychosocial problems in such single-behavior analyses. However, multi-behavioral analyses showed that these psychosocial problems were only associated with compulsive internet use and

videogame playing, smoking, cannabis use, and being bullied. Thus, it was shown that not correcting for correlated behaviors may introduce confounding of the studied associations. These associations were studied separately for boys and girls, since several large meta-analyses showed that they are likely to differ. Health-related behaviors were more often, and stronger, associated with psychosocial problems in girls than in boys. This difference might be explained by the differences in how boys and girls perceive risky behaviors. Such risky and unhealthy behavior is more prevalent in boys, which might indicate that it is perceived more as being normal. Thus, such behaviors seem to be a stronger indicator for psychosocial problems for girls than for boys.

In **chapter 4** the relatively new “screen time behaviors” were highlighted. These screen time behaviors regard, i.e. using the Internet, watching television and playing videogames. These screen time behaviors are increasingly shown to be related to other behaviors that are also perceived as being related to health and to health outcomes such as being overweight and having psychosocial problems. These associations with other health-related behaviors and with psychosocial and physical health were assessed in this chapter. This was done via cross-sectional multivariate regression models for two different screen time-aspects. The first screen time aspect regarded excessive screen time use (>2 hours/day) and the second is compulsive screen time use, in which case other activities such as school work, contact with friends are neglected so that one can play videogames or spend time on the Internet. Especially compulsive Internet use and videogame playing were associated with other health-related behaviors, namely bullying, being bullied, skipping school, alcohol use and unhealthy eating habits. Compulsive and excessive screen time use were respectively associated with different health outcomes, namely with several psychosocial problems and being overweight. Although these two screen time aspects showed to be differently related to health outcomes and known health-related behaviors, behavioral interrelatedness caused significant inter-behavioral confounding, which speaks for more multi-behavioral analyses in future studies. Overall, it is demonstrated in this chapter that screen time behaviors should be included more in future health behavior studies and Health Promoting School interventions.

Chapter 5 was dedicated to studying the effects of peer bullying on adolescents' health. Bullying is a behavior that has been relatively underexposed in research and interventions in comparison to “classic” health-related behaviors such as alcohol use, nutrition or smoking. Nowadays, bullying is more and more perceived as a serious threat to adolescents' psychosocial wellbeing. Few studies to date have distinguished between the possible directional paths of bullying and psychosocial problems. This is needed in order to know whether bullying leads to psychosocial problems and/or vice versa. Therefore, in this chapter the bidirectional effects of bullying and bully victimization on adolescents' psychosocial problems were studied. The applied longitudinal cross-lagged panel study is a design that allows for making such inferences.

Almost all hypothesized bidirectional effects were significant: bullying and bullying victimization at baseline lead to more future psychosocial problems and the prevalence of certain psychosocial problems vice versa lead to more bullying and/or being bullied more. Hereby it was demonstrated that one should not be viewed simply as a consequence of the other, but rather that a more complex interpretation is appropriate. These findings also emphasize the importance to view bullying as a health compromising behavior that should be tackled via preventive intervention among adolescents. Current studies state that especially a Whole School Approach seems appropriate way to intervene, since bullying is considered a social group phenomenon that develops and takes place both at school and in the social outside-of-school context.

Part 2

To date, most HPS interventions have been designed by health scientists and professionals from medicine and public health. This has resulted in interventions with a strong focus on health promotion that virtually hold no regard for the main incentive that drives education professionals: improving students' school performances. Health Promoting Schools should aim to create a better school that simultaneously improves youngsters' health. To get education professionals more enthusiastic about the Health Promoting School, research should be more actively involved with the question whether healthier students also perform better in school. If schools are to be motivated to invest in Health Promoting Schools, the relationships between health behaviors and school performances need to be clarified. Therefore, the second part of this thesis is dedicated to studying the relationships between health behaviors and school performances in adolescents.

In **chapter 6** a systematic literature review is presented of the longitudinal research on the effects of different health-related behaviors on the school performances of adolescents. This review included studies from the medical, psychological and educational literature, dating back to 1992. Positive effects on school performances were found for healthy nutrition and team sports. The effects of all other behaviors (i.e. alcohol use, smoking, early sexual intercourse, bullying, physical activity and screen time use) were dependent on contextual factors and often mediated by psychosocial problems, social structures and/or socio-demographics. This means that such associations between health behaviors and academic achievement might be straightforward, "direct" effects, in which a change in behavior creates a change in school performance. A second option is that health-related behaviors and school performances are "indirectly associated", which means that certain behaviors affect the prevalence of psychosocial problems; these problems are subsequently the "indirect" cause of the change in school performances. In the latter situation psychosocial problems are referred to as a mediator. With such indirect effects only the

school performances of those students are affected that develop psychosocial problems as a result of certain health-related behaviors. To better understand such complex effects, future research should entail study populations with sufficient diversity with regard to the mentioned social and psychosocial factors. Overall, significant effects were identified between most health-related behaviors and school performances. Social Capital Theory, Social Exchange Theory and Social Bonds theory were used to interpret and explain the findings.

In **chapter 7** the associations of a range of health-related behaviors with school grades were studied in a sample of Dutch high school adolescents. Via structural equation modeling (SEM), these associations were estimated with use of mixed-effects regression models. In addition, the mediating role of psychosocial problems was studied. The goal of these additional analyses was to better understand underlying mechanisms. Similarly as in chapter 6, the “direct” associations of health-related behaviors and school performances were studies as well as the “indirect” associations via mediation of psychosocial problems. Smoking, bullying, being bullied, compulsive and excessive internet use and low physical activity were all associated directly with lower school grades. Indirect associations were found between being bullied, smoking, excessive and compulsive internet use and students’ grades via mediation of psychosocial problems. More longitudinal studies on the topic are needed to increase our understanding of these associations and the possible causal mechanisms at work.

Part 3

The third part of this thesis is dedicated to evaluating the Utrecht Healthy School intervention. In **chapter 8** a literature review is presented that describes the effective elements and implementation lessons learned from studies that evaluated interventions with similar characteristics as the Utrecht Healthy School intervention. After that, the effects and lessons learned from the Utrecht Healthy School Pilot are presented in respectively **chapters 9 and 10**. Subsequently, the effects of the Utrecht Healthy School intervention were studied in a controlled follow-up study, (**chapter 12**). The study protocol for this controlled follow-up study is presented in **chapter 11**. The thesis will be finalized in the General Discussion (**chapter 13**).

In **chapter 8** a literature review is presented on the effectiveness of multi-behavioral, school-based interventions aimed to stimulate healthy behavior in adolescents. It also explored the lessons learned on such interventions’ design and implementation. Studies were included that evaluated Health Promoting School interventions that simultaneously targeted multiple health-related behaviors in adolescents and included at least one of the Whole School Approach principles. The involvement of parents and community surroundings were positively related to achieving behavioral change, whereas the evidence that creating a healthy school environment and/or policies made for a more effective intervention was less prominent. The most important lessons

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learned that were encountered entailed that for adequate implementation an intervention: 1- operates from the pre-existent school settings, 2- is fine-tuned to its target population, 3- is also embedded within family and community settings and, 4- is independently led by the school itself with special attention for a 'healthy school coordinator' for program coordination. Due to the small number of empirical studies it was not possible to determine synergistic effects of tackling certain behaviors in clustered fashion compared to an individual-behavior tailoring approach. The same goes conclusions about the effects of interscholastic characteristics such as including parents or school policies. Therefore, more research is needed that evaluates Health Promoting School interventions.

In **chapter 9** a qualitative study is presented in which semi-structured interviews were performed with representatives of the involved parties in the design and implementation of the Utrecht Healthy School Pilot to identify learned lessons. An important lesson learned was that becoming a HPS should be considered a comprehensive curriculum change that requires significant organizational investments. This means that that a certain level (or standard) of infrastructure is required to become a Health Promoting School. It was stated not to be feasible for just any school at any point in time to undertake such efforts successfully. It has to be considered a well-planned comprehensive investment. Schools with more pressing problems like mergers, financial stress or management changes should not (yet) aim to become a Health Promoting School. Also, integrating an intervention into a school's existing infrastructure instead of implementing it "*one size fits all*" minimizes the additional burden to the curriculum, which creates a more relevant intervention and strengthens feelings of intervention ownership and motivation among teachers. Furthermore, implementation should be led by a steering group of professionals from health sciences and education as well as "*local stakeholders*" (i.e. parents, students and teachers from the school) to combine knowledge on practical feasibility and evidence based practices. Involving the outside-of-school environment was also said to lead to a better embedding, as was having a central Health Promoting School coordinator. Such a coordinator should have the appropriate personal competencies and be facilitated with the sufficient executive power to get things done effectively. These aspects should be taken into account when evaluating a Health Promoting School initiative's design and implementation.

In **chapter 10** the effects of the Utrecht Healthy School Pilot were described. This pilot aimed to stimulate healthy behavior on a range of different behaviors as well as having a healthy weight and reducing psychosocial problems. These outcomes were compared in the group of fourth grade high school students of 2007 versus those of 2010 (all about 16 years old). These students were chosen because they were the first cohort that received their first three years of high school education via the Utrecht Healthy School method at the pilot school (2007-2010) versus those that received their education there prior to the intervention's introduction (2004-2007). Significant

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improvements were reported for extreme alcohol use, smoking, sedentary time, and bullying behaviors. In addition, the post-intervention group showed significantly fewer psychosocial problems. However, the pilot's limited design impairs drawing solid conclusions about the intervention's effectiveness. Therefore its effects were studied further in the controlled follow-up study of chapter 11.

In **chapter 11** the study protocol is described of the Utrecht Healthy School, the controlled experimental follow-up study that followed the Utrecht Healthy School Pilot. In this follow up study the intervention was implemented on two high schools in the Netherlands with two control schools to match. The schools in this study were relatively standard Dutch high schools that tailored, designed and integrated their own Health Promoting School via Whole School Approach without external financing or organizational aid. This double case study provides insights into the feasibility and effectiveness of such an approach for future schools. The goal of this study was therefore twofold, namely to study whether it is feasible to implement the comprehensive Utrecht Healthy School intervention on relatively representative Dutch high schools, and what the effects are in terms of changing students' health-related behaviors and outcomes.

In **chapter 12** the effects are presented of the UHS intervention after one and two years of intervention are presented. These results are twofold: the effectiveness to stimulate healthy behavior and health as well as the implementation success were evaluated. The aspects that were used to assess the success of implementation were aspects that were identified in chapters 8 and 9. On one of the two intervention school (Intervention School A) efforts were structurally embedded in the school curriculum, tailored to the specific needs of Intervention School A, and coordinated by a central, empowered health promoting school coordinator to steer efforts, both at school and by fine tuning them with external public health professionals. Overall, Intervention School B had motivated teachers and implemented some specific innovations, such as a healthy canteen, but still their policy was hardly different from many standards schools in the Netherlands. The process evaluations showed that Intervention School B struggled with more competing problems, which led to them not perceiving the UHS as a priority.

At Intervention School B, as expected from the process evaluation of the implementation process, no priority targets were significantly improved. Conversely, at Intervention School A two priority targets (reducing BMI and excessive Internet use) were successfully improved after 1 year of intervention and these improvements were strengthened after the second year. Other priority targets (i.e. stimulating physical activity, a reduction of smoking and healthier nutrition habits) did not change significantly compared to the controls. The process evaluation gave important clues to why those might not have been successfully improved. For example, to improve healthy nutrition an intervention was implemented that focused on eating less junk food, while

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the annual survey only measured consumption of healthy nutrition habits (regular breakfast, fruits and vegetables). Another example regarded physical activity. The annual survey questioned behavior in relation to sports activities outside of school, while the intervention that was implemented regarded additional sports lessons at school.

In this chapter it was demonstrated that merely looking at quantitative effects in evaluating complex interventions such as Health Promoting Schools is inadequate and that complementing this with a proper evaluation of implementation processes is valuable. The information yielded allowed to interpret the quantitative findings in context. Overall, despite the study's relative small size, the findings of the Utrecht Healthy School study should lead to careful optimism.

In **chapter 13** the General Discussion of this thesis is presented. In this chapter several important aspects were discussed of the associations of health-related behaviors of adolescents with their academic achievements and psychosocial problems, as well as the implications of their clustering patterns for future health promoting school interventions. Finally, the effects and lessons learned from the Utrecht Healthy School Pilot and experimental follow-up study are discussed from a practical and methodological perspective.

As stated, the clustering of health-related behaviors has important consequences for the design of future health promoting school interventions through e.g. the described Transfer-oriented Learning. Given the findings in the first part of this thesis, it is a positive development to see school based interventions move towards a comprehensive, whole school approach that would facilitate a clustered approach to improving a broader range of different health behaviors among adolescents. To improve upon current practices in this area, research on the clustering of health behaviors is vital, since it is necessary to identify common determinants across different types of health behaviors.

This study also showed the close associations that exist between health behaviors and academic achievement. These effects should be made clearer to both the health promotion field as well as in the education sector. Health promoters need to better understand that health promoting schools are not meant to be health centers, but primarily schools where health is promoted. Conversely, the education sector needs to be better informed on the close crosslinks between health and education so that better informed decisions can be made when evaluating whether or not to be engaged in certain Health Promoting School endeavors.

Lastly, generalizations about the effectiveness of the Utrecht Healthy School should not to be made based on the studies in this thesis, given their modest sizes. However, both at the pilot school as well as in the controlled experimental study results were promising. Some of the priority targets that were set in the tailoring process were significantly

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improved. Also, several valuable learned lessons were presented about the intervention's feasibility. These can help schools with future Health Promoting School plans.

NEDERLANDSE SAMENVATTING

Nederlandse samenvatting

Gezondheidsgerelateerde gedragingen zoals roken, pesten, alcoholgebruik en ongezonde eetgewoonten dragen significant bij aan de last op de volksgezondheid door hun relatie met belangrijke aandoeningen zoals diabetes, cardiovasculaire ziekten en psychiatrische en psychosociale aandoeningen. Veel van dit gedrag ontstaat in de adolescentie en leidt vaak tot een slechtere gezondheid op volwassen leeftijd. Omdat kinderen een groot deel van hun tijd op school besteden, stelt de Wereldgezondheidsorganisatie (WHO) dat dit de ideale plek is om aan gezondheidsbevordering te doen. Dit heeft geleid tot de ontwikkeling van de *Totale School Aanpak (Whole School Approach)* van de Gezonde School (*Health Promoting School*). In het kort focust deze methode op het combineren van bewezen effectieve lesmethoden voor gezondheidsonderwijs (gefocust op persoonlijke vaardigheden), een geïntegreerd gezondheidsbeleid, een gezonde schoolomgeving en intensieve samenwerking met de sociale omgeving zoals de familie en wijk.

In de introductie (**hoofdstuk 1**) wordt uiteengezet hoe in dit proefschrift drie samenhangende onderwerpen worden besproken die allen te maken hebben met gezondheidsgerelateerd gedrag in adolescenten en recente Gezonde School ontwikkelingen. In het daarop volgende Deel 1 van het proefschrift wordt onderzocht hoe verschillende gezondheidsgerelateerde gedragingen clusteren in adolescenten en wat de implicaties daarvan kunnen zijn voor gezondheidsbevordering op school (**hoofdstuk 2**). Wanneer er over gezondheidsgerelateerd gedrag wordt gesproken, gaat het in het gehele proefschrift om de gedragingen alcoholgebruik, roken, gebruik van cannabis, bewegen, gezonde voedingsgewoonten, pesten/gepest worden, seksueel gedrag en screen time gedrag (televisie kijken, internet- en computergebruik en gaming). Vervolgens wordt in Deel 1 ook bestudeerd wat de verbanden zijn tussen dit gezondheidsgedrag en de gezondheid van adolescenten (**hoofdstuk 3**) met speciale aandacht voor screen time (**hoofdstuk 4**) en pesten (**hoofdstuk 5**). In Deel 2 (**hoofdstuk 6 en 7**) wordt er gekeken naar de relatie tussen gezondheidsgedrag en schoolprestaties. In Deel 3 wordt eerst een systematische literatuurstudie gepresenteerd over de effecten van Gezonde School-interventies die de Totale School Aanpak volgen (**hoofdstuk 8**). Daarna worden de effecten en geleerde lessen van een Gezonde School pilot uit Nederland gepresenteerd (resp. **hoofdstuk 9 en 10**). Dit wordt opgevolgd door de resultaten van een gecontroleerde vervolgstudie naar de effecten van dezelfde Gezonde School interventie (**hoofdstuk 12**). Ter afsluiting wordt er in de Algemene Discussie (**hoofdstuk 13**) een synthese en een discussie van de belangrijkste uitkomsten gepresenteerd.

Deel 1

De meeste studies naar de effecten van gezondheidsgedrag op gezondheidsuitkomsten en schoolprestaties hebben tot nu toe vooral één soort

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gedrag, of een kleine subgroep, geïncludeerd. Onvoldoende rekening houden met de clustering van zulk gedrag en hun onderlinge verbanden maakt onderzoek gevoelig voor methodologische fouten. Dit maakt het waarschijnlijker dat gevonden effecten en verbanden overschattingen van de werkelijke verbanden zijn. Daarom wordt er in Deel 1 van dit proefschrift gekeken naar hoe een breed scala aan gezondheidsgereelde gedrag clustert met elkaar, en hoe deze patronen van gedrag gerelateerd zijn aan de psychosociale en fysieke gezondheid van adolescenten. Dit wordt bestudeerd voor gedrag dat klassiek gezien wordt als gezondheidsgereelde (bijv. roken), maar ook voor gedrag dat pas meer recent als zodanig wordt beschouwd (bijv. compulsief internetgebruik).

In **hoofdstuk 2** wordt besproken hoe verschillende gezondheidsgereelde gedragingen clusteren in adolescenten. Informatie over dergelijke clusterpatronen van gedrag kan belangrijke implicaties hebben voor onderzoek en de effectiviteit van interventies door de (mogelijk) resulterende synergistische effecten. Synergistische effecten houden hier in dat het vertonen van bepaald gedrag de kans vergroten dat iemand ook een ander specifiek gedrag vertoont. Recente literatuur laat zien dat interventies die zich richten op het simultaan aanpakken van samenhangend gedrag effectiever en kosteneffectiever zijn dan aparte interventies per individueel gedrag. Dergelijke interventies ontwerpen vraagt echter meer kennis over de clustering van gezondheidsgereelde gedrag. In dit hoofdstuk worden deze gedragsclusters bestudeerd door gebruik van factor analyse. Dit resulteerde in een reductie van een breed scala aan gedragingen tot vier overkoepelende patronen, namelijk: 1) *risicogedrag* (alcoholgebruik, drugsgebruik, seksueel actief zijn en roken), 2) *pestgedrag* (pesten, gepest worden en compulsief internet- en computergebruik), 3) *problematisch screen time gedrag* (compulsief en excessief screen time gedrag), en 4) *sedentair gedrag* (weinig beweging, ongezonde voedingsgewoonten en excessief screen time gedrag). Een hierop volgende clusteranalyse liet zien dat bepaalde gedragsclusters waren geassocieerd met overgewicht, zelfredzaamheid en psychosociale problemen. Deze verbanden waren relatief onafhankelijk van demografische karakteristieken, zoals etniciteit, geslacht en sociaaleconomische status (SES). Dergelijke kennis kan bijvoorbeeld worden gebruikt bij het ontwerpen van effectiever en meer haalbare Gezonde School interventies door gebruik van Transfer-oriented Learning. Dit houdt in dat leerlingen dat wat zij in een bepaalde context hebben geleerd in een andere context kunnen toepassen. Dit betekent bijvoorbeeld dat wanneer het weerstaan van groepsdruk van belang zou zijn om te zorgen dat jongeren niet gaan roken, dergelijke vaardigheden ook kunnen worden toegepast wanneer het bijvoorbeeld gaat om het leren weerstaan van drugsgebruik of deelnemen in onveilige seks. Verschillende studies stellen dat een dergelijke aanpak leidt tot effectievere interventies die relatief minder extra druk op het curriculum geven dan het implementeren van aparte-leefstijl interventies.

In **hoofdstuk 3** wordt belicht hoe verschillende gezondheidsgerelateerde gedragingen van adolescenten samenhangen met hun psychosociale gezondheid, en in hoeverre gedragsclustering verantwoordelijk is voor het vertekenen ("confounding") van deze verbanden. Dit houdt in dat schattingen vertekend kunnen raken wanneer de relatie tussen een enkel gedrag en psychosociale problemen in kaart wordt gebracht zonder correctie voor gecorreleerd gedrag. In dit hoofdstuk wordt belicht dat dat wanneer er alleen wordt gecorrigeerd voor de effecten van standaard demografische eigenschappen (zoals geslacht, SES, etniciteit, leeftijd) dat bijna al het gezondheidsgerelateerde gedrag significant gerelateerd is aan psychosociale gezondheid. Dit veranderde in analyses waarin de verbanden tussen psychosociale gezondheid en de gemeten soorten gedrag gezamenlijk werden meegenomen (multi-gedragsanalyses). Uit die analyses werd duidelijk dat die verbanden alleen significant zijn voor compulsief internet- en computergebruik en gaming, roken, gebruik van cannabis, en gepest worden. Het niet corrigeren voor gecorreleerd gezondheidsgerelateerd gedrag kan dus leiden tot een vertekening van onderzochte relaties. Deze relaties tussen gezondheidsgedragingen en psychosociale gezondheid werden apart onderzocht voor jongens en meisjes, omdat grote meta-analyses hebben aangetoond dat er waarschijnlijk verschillen bestaan tussen de relaties in deze groepen. Gezondheidsgerelateerd gedrag was in dit hoofdstuk vaker en sterker geassocieerd met psychosociale problemen in meisjes dan in jongens. Dit verschil kan mogelijk worden verklaard door het verschil in hoe meisjes en jongens risicogedrag beleven. Dergelijk gedrag komt bij jongens vaker voor, wat er op kan duiden dat het door jongens dus als normaler wordt ervaren. Daarmee lijkt dit gedrag dus bij meisjes meer indicatief te zijn voor psychosociale problemen dan bij jongens.

In **hoofdstuk 4** wordt het relatief nieuwe "screen time gedrag" speciaal belicht. Onder screen time gedrag wordt internet- en computergebruik, televisie kijken en gamen verstaan. Van dit screen time gedrag wordt in toenemende mate aangetoond dat het gerelateerd is aan fysieke en psychosociale gezondheid, en aan gedragingen die klassiek als gezondheidsgerelateerd worden gezien (bijv. alcoholgebruik en roken). Deze verbanden met "klassieke" gezondheidsgerelateerde gedragingen en met psychosociale en fysieke gezondheid werden in dit hoofdstuk onderzocht. Dit werd gedaan via cross-sectionele multivariate regressiemodellen voor twee verschillende aspecten van screen time. Het eerste aspect betrof excessief gebruik (>2 uur/dag) en het tweede betrof compulsief gedrag, waarmee gedrag bedoeld wordt zoals het afraffen van schoolwerk en verwaarlossen van relaties met vrienden om te kunnen gamen en internetten. Vooral het compulstieve gedrag hield verband met ander ongezond gedrag zoals pesten, gepest worden, spijbelen, alcoholgebruik en ongezonde voedingsgewoonten. Compulsief en excessief screen time gedragingen waren geassocieerd met verschillende gezondheidsuitkomsten, namelijk respectievelijk met psychosociale problemen en overgewicht. Hoewel deze twee aspecten van

screen time andere verbanden lieten zien met gezondheidsuitkomsten en -gedrag, zorgde hun onderlinge clustering toch voor significante vertekening (confounding) van de verbanden in de één-gedrags-analyses. Dit spreekt voor meer multi-gedragsanalyses in toekomstig onderzoek. Concluderend wordt in dit hoofdstuk aangetoond dat *screen time* gedrag meer moet worden geïntegreerd in toekomstige studies en Gezonde School interventies.

Hoofdstuk 5 is gewijd aan het bestuderen van de effecten van pesten op de gezondheid van adolescenten. Pesten is een gedrag dat relatief onderbelicht is in onderzoek en interventies in vergelijking met "klassiek" gezondheidsgerelateerd gedrag zoals alcoholgebruik, voedingsgewoonten of roken. Tegenwoordig wordt pesten meer en meer gezien als schadelijk voor het psychosociale welbevinden van adolescenten. Relatief weinig studies hebben de mogelijke richting(en) van effecten tussen pesten en psychosociale problemen onderzocht. Deze kennis is noodzakelijk wanneer men wil weten of pesten leidt tot psychosociale problemen en/of vice versa. Daarom werden in dit hoofdstuk de bi-directionele relaties onderzocht van pesten en gepest worden met de psychosociale problemen van adolescenten. Het gebruikte longitudinale cross-lagged panel design is een geschikte methodiek om dergelijke conclusies te kunnen trekken. Bijna alle veronderstelde bi-directionele effecten waren significant: pesten en gepest worden op baseline leidden beide tot meer toekomstige psychosociale problemen, en vice versa leidde het vóórkomen van psychosociale problemen op baseline ook tot meer pestgedrag en gepest worden op een later tijdstip. Dit laat zien dat het één niet simpel gezien zou moeten worden als een gevolg van het ander, maar dat een complexere interpretatie op zijn plaats is. Deze bevindingen benadrukken ook het belang om pesten te zien als een gezondheidsgerelateerd gedrag dat via preventieve interventie bij adolescenten aangepakt dient te worden. Recente studies stellen dat vooral de Totale School Aanpak hiervoor geschikt lijkt, omdat pesten wordt gezien als een sociaal groepsfenomeen dat zich zowel ontwikkelt en plaatsvindt op school als in de buitenschoolse sociale context.

Deel 2

Tot nu toe zijn de meeste Gezonde School interventies ontwikkeld door gezondheidswetenschappers en -professionals uit de medische en public health wereld. Dit heeft er toe geleid dat deze interventies klassiek een sterke focus hebben op gezondheidspromotie en praktisch geen rekening houden met de voornaamste drijfveer van professionals in de educatiesector: het bevorderen van de leerprestaties van leerlingen. Gezonde School interventies zouden als doel moeten hebben om een betere school te creëren die leerprestaties bevordert en tegelijkertijd de gezondheid van jongeren bevordert. Om professionals uit de educatiesector te enthousiasmeren voor de Gezonde School moet onderzoek zich actiever richten op de vraag of

gezondere leerlingen ook beter presterende leerlingen zijn. Om betrokkenen op scholen te motiveren om te investeren in de Gezonde School moet het duidelijker worden hoe gezondheidsgedrag en schoolprestaties gerelateerd zijn. Daarom wordt in Deel 2 van dit proefschrift onderzocht hoe gezondheidsgerelateerd gedrag samenhangt met de schoolprestaties van adolescenten.

In **hoofdstuk 6** wordt een systematische review van de literatuur gepresenteerd over de effecten van verschillende gezondheidsgedragingen op de schoolprestaties van adolescenten. Studies uit de medische, psychologische en educatieliteratuur van 1992 tot en met 2013 zijn bestudeerd. Positieve effecten werden gevonden voor gezonde voeding op schoolprestaties. De effecten van alle andere gedragingen (alcoholgebruik, roken, vroeg seksueel actief zijn, pesten, sporten en screen time gedrag) waren afhankelijk van contextuele factoren. In de meeste gevallen werden zij gemedieerd door psychosociale problemen, sociale structuren en/of sociaal-demografische factoren. Dit houdt in dat de verbanden tussen gezondheidsgedrag en schoolprestaties ten eerste rechtlijnige, "directe" verbanden kunnen zijn, waarbij een verandering in gedrag zorgt voor de verandering in schoolprestaties. Een tweede optie is dat gezondheidsgedrag en schoolprestaties "indirect geassocieerd" kunnen zijn, waarbij bepaald gezondheidsgerelateerd gedrag zorgt voor een verandering in het voorkomen van psychosociale problemen. Psychosociale problemen zijn daar de indirecte oorzaak voor de (extra) verandering in schoolprestaties, waardoor ze een mediator worden genoemd. Met zulke indirecte effecten is het mogelijk dat leerlingen die geen psychosociale problemen ontwikkelen ten gevolge van bepaald gezondheidsgerelateerd gedrag ook geen verminderde schoolprestaties ervaren, terwijl zij bij wie het gedrag wel tot psychosociale problemen leidt ook gevolgen op hun schoolprestaties ervaren. Om deze complexe effecten beter te begrijpen, is het van belang dat toekomstige studies onderzoekspopulaties bevatten met voldoende diversiteit met betrekking tot genoemde sociale en psychosociale factoren. Algemeen gesproken werden significante effecten gevonden tussen het meeste gezondheidsgerelateerde gedrag en schoolprestaties. Social Capital Theory, Social Exchange Theory en Social Bonds Theory werden door de geïncludeerde studies gebruikt om deze bevindingen te interpreteren en verklaren.

In **hoofdstuk 7** werden de verbanden onderzocht tussen verschillende gezondheidsgerelateerde gedragingen en de schoolprestaties van Nederlandse middelbare scholieren. Via *structural equation modeling* (SEM), werden deze verbanden in kaart gebracht met *mixed-effects regressiemodellen*. Ook werd de mediërende rol van psychosociale problemen in de onderzochte verbanden bestudeerd. Het doel van deze mediationanalyses was om de mechanismen tussen gezondheidsgerelateerd gedrag en schoolprestaties beter te begrijpen. Evenals in hoofdstuk 6 werden zo de "directe" associaties tussen gezondheidsgedrag en schoolprestaties onderzocht alsmede de "indirecte" associaties via de mediatie door

psychosociale problemen. Roken, pesten, gepest worden, compulsief en excessief internet- en computergebruik, en onvoldoende lichamelijke beweging waren allen verbonden met lagere schoolcijfers via een direct verband. Er bestond een "indirect verband" tussen gepest worden, roken, compulsief en excessief internet- en computergebruik en lagere schoolcijfers via de mediërende effecten van psychosociale problemen. Meer longitudinale studies rondom dit onderwerp zijn nodig om deze verbanden en de mogelijke achterliggende causale mechanismen beter te begrijpen.

Deel 3

Deel 3 is toegewijd aan het evalueren van de Utrecht Gezonde School interventie. Allereest wordt een literatuurreview gepresenteerd waarin effectieve elementen en geleerde lessen uit gelijksoortige interventies werden geïdentificeerd (**hoofdstuk 8**). Daarna worden de effecten en de geleerde lessen uit de Utrecht Gezonde School Pilot beschreven (**hoofdstuk 9 en 10**). Vervolgens wordt in **hoofdstuk 11** het studieprotocol beschreven van de studie uit **hoofdstuk 12**, waarin de effecten van de gecontroleerde follow-up studie de *Utrecht Gezonde School* studie worden gepresenteerd. De thesis wordt afgesloten in de Algemene Discussie (**hoofdstuk 13**).

In **hoofdstuk 8** wordt een literatuurreview gepresenteerd naar de effectiviteit van multi-gedragsinterventies op scholen, die gericht zijn op het stimuleren van gezond gedrag onder adolescenten. In de review worden de geleerde lessen beschouwd met betrekking tot het ontwerpen en implementeren van dergelijke interventies. De studies die werden opgenomen, waren zij die een Gezonde School interventie evaluateerden, waarbij meerdere gezondheidsgedragingen tegelijkertijd werden gestimuleerd in adolescenten. Daarbij moest in een geëvalueerde interventie minimaal één van de pijlers van de *Totale School Aanpak* worden gehanteerd. Het betrekken van ouders en de wijk had een positieve invloed op het bereiken van gedragsverandering, terwijl er minder sterk bewijs was dat het creëren van een gezonde schoolomgeving en/of een gezond schoolbeleid dit ook had. De belangrijkste lessen uit deze studies met het oog op een goede implementatie waren dat een interventie: 1) opereert vanuit de bestaande infrastructuur van een school, 2) qua vorm en inhoud afgestemd is op de doelpopulatie, 3) ook is ingebeteld in de buitenschoolse omgeving (wijk, familie), en 4) onafhankelijk door de school zelf wordt geleid met een speciale "gezonde school coördinator" present. Door het kleine aantal empirische studies dat voldeed aan de inclusiecriteria was het niet mogelijk om eventuele synergistische effecten te analyseren met betrekking tot een geclusterde aanpak versus een aanpak die focust op individueel gedrag. Hetzelfde geldt voor de effecten van school-niveau kenmerken, zoals het betrekken van ouders of het belang van een geïntegreerd Gezonde School beleid. Ondanks veelbelovende stappen voorwaarts is er daarom nog steeds meer

toekomstig onderzoek nodig waarin de effecten van Gezonde School interventies worden geëvalueerd.

Hoofdstuk 9 betreft een kwalitatief onderzoek naar de lessen over de implementatie van de Utrecht Gezonde School Pilot. Deze werden gedestilleerd door middel van semi-gestructureerde interviews bij vertegenwoordigers van alle partijen die betrokken waren bij het ontwerpen en implementeren van de interventie. Een belangrijke les betrof dat het worden van een Gezonde School gezien dient te worden als een ingrijpende curriculumverandering met flinke organisatorische vereisten. Dit is niet haalbaar voor iedere school op ieder moment, want het betreft structurele veranderingen die dienen te worden ingebed in het curriculum. Het moet geen tijdelijk "project" zijn. Ook belemmeren problemen zoals organisatorische hervormingen of fusies de kans op een succesvolle implementatie. Een ander aspect dat een succesvolle implementatie stimuleert was dat een interventie in de bestaande infrastructuur van school dient te worden geïntegreerd. Het kiezen van een dergelijke, op maat gemaakte Gezonde School aanpak boven het implementeren als een vooraf gestandaardiseerde interventie verlicht de belasting op het curriculum. Ook bleek het op maat maken van zowel het format als de inhoud van een interventie stimulerend en zorgend voor meer psychologisch eigenaarschap onder de staf en docenten. Het betrekken van de buitenschoolse partijen zoals de familie en de wijk zou het inbedden van de interventie ten goede zou komen, net als de aanwezigheid van een centrale Gezonde School-coördinator om een soepele implementatie te verzorgen en begeleiden. Verder bleek het belangrijk dat tijdens de ontwerp fase de kennis en inzichten van professionals uit het gezondheidsveld, ouders, leerlingen en docenten via actieve participatie werden gecombineerd om zo tot een praktisch haalbare interventie te komen met gebruik van bewezen effectieve lesmethoden en interventies. Deze aspecten moeten in ogenschouw worden genomen wanneer men de ontwikkeling en implementatie van een Gezonde School interventie evalueert.

In **hoofdstuk 10** worden de effecten gepresenteerd van de Utrecht Gezonde School Pilot. Deze richtte zich op het stimuleren van een breed scala aan gezondheidsgerelateerd gedrag, een gezond gewicht en een vermindering van psychosociale problemen. Deze uitkomsten werden vergeleken tussen de vierdeklassers uit 2007 versus die uit 2010 (allen ongeveer 16 jaar oud). Deze leerlingen werden gekozen, omdat zij het eerste cohort betroffen die hun eerste drie jaar middelbare school via de Utrecht Gezonde School werden onderwezen op de pilot school (2007-2010) versus de groep die hun totale eerste drie jaar kregen zonder de interventie (2004-2007). Significante verbeteringen werden gerapporteerd met betrekking tot bingedrinken, roken, sedentair gedrag, en pestgedrag. Ook rapporteerde de post-interventiegroep minder psychosociale problemen. Echter, gezien de beperkte bewijskracht die inherent is aan de studieopzet, zijn slechts

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beperkte conclusies te trekken over de effectiviteit van de Utrecht Gezonde School interventie op basis van deze pilot.

Naar aanleiding van deze pilot studie werd de experimentele, gecontroleerde vervolgstudie *de Utrecht Gezonde School (UGS) studie* opgezet. **hoofdstuk 11** bestaat uit het studieprotocol waarin deze vervolgstudie wordt uiteenzet. In deze vervolgstudie werd de Utrecht Gezonde School interventie geïmplementeerd op twee middelbare scholen in Nederland met twee scholen als controlegroep. De scholen in deze studie ontwierpen en implementeerden zonder externe financiële of organisatorische hulp zelf hun Gezonde School via de Totale School Aanpak. Deze dubbele case studie biedt inzichten in de haalbaarheid en effectiviteit van een dergelijke aanpak voor scholen met gelijke ambities in de toekomst. Het doel van deze vervolgstudie was daarmee tweeledig, namelijk om te bestuderen of het haalbaar zou zijn voor deze relatieve standaard Nederlandse middelbare scholen om een veelomvattende interventie als de Utrecht Gezonde School op maat te maken en te implementeren. Het andere doel was om te onderzoeken wat de effecten van de interventie zouden zijn met betrekking tot het positief stimuleren van gezondheidsgerelateerde gedragingen en de fysieke en psychosociale gezondheid.

In **hoofdstuk 12** worden de effecten van de Utrecht Gezonde School na 1 en 2 jaar interventie gepresenteerd. Deze resultaten zijn tweeledig: de effectiviteit werd onderzocht om gedragsveranderingen en gezondheid te stimuleren alsmede het succes waarmee de scholen de interventie op maat hebben gemaakt en geïntegreerd in hun curriculum. De aspecten waarmee de implementatie werd beoordeeld, waren de aspecten die in Hoofdstuk 8 en 9 het meest van belang bleken voor optimale implementatie van dergelijke interventies. Op Interventieschool A waren de ondernomen acties en innovaties 1) structureel geborgd in het curriculum, 2) op maat gemaakt om bij de school te passen, en 3) georganiseerd door een centrale Gezonde School-coördinator met zeggenschap om het geheel professioneel aan te sturen, zowel binnen school als door de afstemming met externe zorg- en preventieprofessionals. Op Interventieschool B was er, ondanks de gemotiveerde docenten, nauwelijks een afwijkende situatie ten opzichte van standaardscholen in Nederland. De procesevaluatie leerde dat Interventieschool B meer te maken had met bijkomende problemen, zoals reorganisaties, waardoor zij de Gezonde School niet als prioriteit zagen.

Op Interventieschool B, zoals verwacht gezien de beperkte implementatie, verbeterde het gezondheidsgedrag niet significant. Op Interventieschool A verbeterden na 1 jaar interventie twee prioriteitsgedragingen (een bescheiden BMI-afname en minder excessief internet- en computergebruik). Deze effecten waren in het tweede jaar iets sterker. Andere prioriteiten (meer bewegen, minder roken, en gezondere eetgewoonten stimuleren) verbeterden niet significant ten opzichte van de

controlescholen. De procesevaluatie van de implementatie gaf belangrijke aanwijzingen om te verklaren waarom deze aspecten mogelijk niet waren verbeterd. Zo werd met betrekking tot gezondere voeding bijvoorbeeld een interventie gestart gericht op minder slechte voeding (chips, snoep, fastfood), terwijl de jaarlijkse vragenlijst bevroeg of er meer fruit, ontbijt en groente werd geconsumeerd. Ook werden leerlingen in de vragenlijst gevraagd sport-gerelateerd gedrag buiten school, terwijl de ingevoerde sport-interventie zich juist richtte op het aanbieden van extra sportlessen *binnen* schooltijd. De gekozen aanpak van kwalitatieve en kwantitatieve dataverzameling maakte het mogelijk om bevindingen beter te interpreteren.

Dit hoofdstuk illustreert dat alleen kijken naar de kwantitatieve effecten op gedrag en gezondheid van een complexe interventie als een "totale school aanpak Gezonde School" onvoldoende is, en waarom de combinatie met een kwalitatieve procesevaluatie van de implementatie waardevol is. De informatie die deze aanpak oplevert, maakte het mogelijk om de waargenomen effecten in de juiste context te interpreteren. Dit alles leidt tot de conclusies dat, ondanks de beperkte studiegrootte, de bevindingen met betrekking tot de effecten van de Utrecht Gezonde School tot voorzichtig optimisme zouden mogen leiden.

In **hoofdstuk 13** wordt de General Discussion gepresenteerd. Hierin worden enkele belangrijke aspecten uiteengezet met betrekking tot de relatie tussen de gezondheidsgerelateerde gedragingen, schoolprestaties en psychosociale gezondheid van adolescenten. Ook worden de implicaties belicht die de clustering van gezondheidsgerelateerd gedrag met zich mee brengt voor de praktijk en onderzoek. Dit hoofdstuk wordt afgesloten met een beschouwing van de effecten op gezondheid en gezondheidsgerelateerd gedrag en geleerde praktische lessen uit de Utrecht Gezonde School Pilot en vervolgstudie.

De clustering van gezondheidsgerelateerd gedrag kan belangrijke consequenties hebben voor het ontwerpen van toekomstige Gezonde School interventies, bijvoorbeeld door Transfer-oriented Learning. Met het oog op de bevindingen uit Deel 1 van dit proefschrift kan het daarom als positief worden bestempeld dat Gezonde School interventies zich steeds meer bewegen naar de Totale School Aanpak, die een dergelijke geclusterde aanpak optimaal faciliteert. Om deze ontwikkelingen verder te stimuleren, is meer onderzoek naar de clustering van gedrag waardevol, om gezamenlijke determinanten te identificeren die invloed uitoefenen op bepaald gedrag (bijv. omgaan met peer pressure).

In dit proefschrift wordt ook de relatie tussen gezondheidsgedrag en schoolprestaties belicht. De beide sectoren van gezondheidspromotie en onderwijs zouden kennis moeten nemen over deze verbanden. Ook zouden gezondheidsbevorderaars die zich er meer bewust van moeten zijn dat een Gezonde School niet bedoeld is om van school een gezondheidscentrum te maken, maar een school waar gezondheid actief

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wordt gestimuleerd. Anderzijds dient de onderwijssector ook kennis te nemen van de dwarsverbanden tussen gezondheid en educatie. Zo kunnen schoolleidingen beter onderbouwde beslissingen kunnen nemen wanneer zij overwegen of zij zich bezig zouden moeten gaan houden met de gezondheidsbevordering van leerlingen.

Afsluitend moet worden geconcludeerd dat er geen sterke generalisaties gemaakt kunnen worden over de werkzaamheid van de Utrecht Gezonde School interventie, gezien de bescheiden omvang van de studies in dit proefschrift. Echter, op zowel de pilot school in de gecontroleerde vervolgstudie waren de resultaten hoopgevend. Ook werden waardevolle lessen geleerd met betrekking tot de haalbaarheid, het ontwerpen en het implementeren van de Gezonde School interventies. Deze lessen bieden schilen met plannen om aan gezondheidsbevordering te doen via de *Totale School Aanpak* een belangrijk houvast en hulp bij de organisatie om een goede implementatie te bewerkstelligen.

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Dankwoord

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CURRICULUM VITAE

Curriculum Vitae

Vincent Busch was born in Naarden, the Netherlands on October 25, 1985. He graduated from high school at Baken Park Lyceum in 2004. In 2007 he completed his Bachelor of Science degree in Biomedical Sciences at the Vrije Universiteit Amsterdam. Thereafter, he started his Master of Science in International Public Health at the Athena Institute at the Vrije Universiteit Amsterdam. He completed this in 2009 with a final internship at the Dalla Lana School of Public Health at the University of Toronto, Canada. From 2010 until 2013 he worked at the Julius Center for Health Sciences and Primary Care as a PhD student. His PhD research was supervised by prof. dr. Guus Schrijvers, dr. Rob de Leeuw and prof. dr. Tom van Yperen. This PhD research resulted in the studies presented in this thesis.

PUBLICATION LIST

Publication List

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Chapter 2

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