



Longitudinal patterns and predictors of multiple health risk behaviors among adolescents: The TRAILS study



Andrea F. de Winter^{a,*}, Leenke Visser^{a,b}, Frank C. Verhulst^c, Wilma A.M. Vollebergh^d, Sijmen A. Reijneveld^a

^a Department of Health Sciences, University Medical Center Groningen, University of Groningen, the Netherlands

^b School for Marketing Management, Hanze University of Applied Sciences, Groningen, the Netherlands

^c Department of Child and Adolescent Psychiatry, Erasmus Medical Center, Rotterdam, the Netherlands

^d Department of Social Sciences, Utrecht University, Utrecht, the Netherlands

ARTICLE INFO

Available online 4 December 2015

Keywords:

Adolescence
Multiple health risk behaviors
Longitudinal study
Social factors
Self-control
Parental health behaviors

ABSTRACT

Background. Most studies on multiple health risk behaviors among adolescents have cross-sectionally studied a limited number of health behaviors or determinants.

Purpose. To examine the prevalence, longitudinal patterns and predictors of individual and multiple health risk behaviors among adolescents.

Methods. Eight health risk behaviors (no regular consumption of fruit, vegetables or breakfast, overweight or obesity, physical inactivity, smoking, alcohol use and cannabis use) were assessed in a prospective population study (second and third wave). Participants were assessed in three waves between ages 10 and 17 (2001–2008; $n = 2230$). Multiple linear regression was used to assess the influence of gender, self-control, parental health risk behaviors, parental monitoring and socioeconomic factors on the number of health risk behaviors adjusted for preceding multiple health risk behaviors (analysis: 2013–2014).

Results. Rates of >5 health risk behaviors were high: 3.6% at age 13.5 and 10.2% at age 16. Smoking at age 13.5 was frequently associated with health risk behaviors at age 16. No regular consumption of fruit, vegetables and breakfast, overweight or obesity, physical inactivity and smoking predicted the co-occurrence of health risk behaviors at follow-up. Significant predictors of the development of multiple health risk behaviors were adolescents' levels of self-control, socioeconomic status and maternal smoking.

Conclusions. Multiple health risk behaviors are common among adolescents. Individual and social factors predict changes in multiple health risk behaviors, showing that prevention targeting multiple risk behaviors is needed. Special attention should be paid to adolescents with low self-control and families with low socioeconomic status or a mother who smokes.

© 2015 Elsevier Inc. All rights reserved.

Introduction

Many health risk behaviors, such as poor dietary habits, physical inactivity or substance use, develop or increase during adolescence (Alamian and Paradis, 2009b; Monshouwer et al., 2012; Nader et al., 2008; Trang et al., 2012; Mitchell et al., 2012; Ortega et al., 2013). This can have enduring effects on health behaviors during adulthood (Ortega et al., 2013; Trudeau et al., 2004; Post et al., 2001) and may increase the occurrence of disease and mortality in older age (Djoussé et al., 2009). Unfortunately, many adolescents do not meet the guidelines for specific health behaviors; prevalence rates for unhealthy behaviors among adolescents vary from 5.0% to 88.5% (Pearson et al., 2009; Pronk et al., 2004; Plotnikoff et al., 2009; Sanchez et al., 2007).

Especially, fruit and vegetable guidelines are less frequently met in adolescents (Sanchez et al., 2007). Furthermore, health risk behaviors often occur simultaneously (Pronk, 2012; Plotnikoff et al., 2009; Alamian and Paradis, 2009a; Lawlor et al., 2005; Mistry et al., 2009; Trang et al., 2012; Sanchez et al., 2007; Van Nieuwenhuijzen et al., 2009). Studies on multiple health risk behavior in the US (Pronk, 2012; Sanchez et al., 2007; Mistry et al., 2009), Canada (Plotnikoff et al., 2009; Alamian and Paradis, 2009a; Li et al., 2009), Australia (Lawlor et al., 2005) and Europe (Pearson et al., 2009; Van Nieuwenhuijzen et al., 2009) frequently studied a combination of smoking, alcohol use, diet and physical activity. Epidemiological studies in adults show that multiple health risk behaviors may substantially increase health risks (Åkesson et al., 2007; Myint et al., 2009; Chiuvé et al., 2006; Martin-Diener et al., 2014; Khaw et al., 2008). Insight into the patterns and predictors of multiple health risk behaviors in adolescents may contribute to more successful and targeted prevention.

Multiple theories have been used to explain the behavior of individuals by addressing both individual and environmental factors (Jessor,

* Corresponding author at: University Medical Center Groningen, Department of Health Sciences, Community and Occupational Medicine, Antonius Deusinglaan 1, FA10, 9713 AV Groningen, the Netherlands. Fax: +31 50363 6251.

E-mail address: a.f.de.winter@umcg.nl (A.F. de Winter).

1984). Theories suggest that individual factors such as gender, (Plotnikoff et al., 2009; Ottevaere et al., 2011; Mistry et al., 2009; Mahalik et al., 2013) previous health behavior (Paavola et al., 2004; Gillander Gådin and Hammarström, 2002) and self-control (Moffitt et al., 2011; Griffin et al., 2012; Williams and Ricciardelli, 2003; Pokhrel et al., 2014; Wills et al., 2007, 2008) may affect health risk behaviors. In addition, the social environment may also play an important role in the development of health risk behaviors (Bandura, 2004; Pampel et al., 2010). Previous studies have found associations between individual or multiple health risk behaviors among adolescents and parental health behaviors, (Frech, 2012; Feunekes et al., 1998; Cameron et al., 2011; Sanchez et al., 2007) parental monitoring, (Mistry et al., 2009; Frech, 2012) and low socioeconomic status (SES) (Alamian and Paradis, 2009a,b; Lawlor et al., 2005; Mistry et al., 2009). Trajectories of health risk behaviors in youth have been linked to health risk behaviors and health in adulthood (Hamil-Luker and Angela, 2007; Mahalik et al., 2013; Frech, 2012; Angela and Hamil-Luker, 2005).

Although current knowledge of multiple health risk behaviors among adolescents is mostly based on cross-sectional studies, longitudinal studies can provide valuable insights into the development of health risk behaviors and, furthermore, give stronger evidence for the impact of individual and social factors. More insight into the role that potentially modifiable factors such as self-control or parental behaviors play on changes in multiple health risk behaviors will aid prevention programs that target multiple health risk behaviors. Therefore, this prospective study aimed to: 1) assess the prevalence and longitudinal patterns of individual or multiple health risk behaviors during adolescence and 2) identify predictors of changes in adolescents' multiple health risk behaviors.

Methods

Sample and procedures

This study used data from the first, second and third waves of the Tracking Adolescents' Individual Lives Survey (TRAILS), a prospective cohort study of Dutch adolescents. Sample selection involved five municipalities in the north of the Netherlands and started in 2001. During the first measurement wave (T1), 2230 children (mean age = 11.09 years, SD = 0.56; response rate 76%) were enrolled in the study (for more details about the sample selection, see De Winter et al., 2005), of whom 2149 (96.4%; mean age = 13.56 years, SD = 0.53) and 1816 (81.4%; mean age = 16.26 years, SD = 0.73) participated in the second (T2) and third (T3) measurement waves, respectively. The first assessment wave of TRAILS ran from March 2001 to July 2002. The first follow-up assessment (T2) was held two to three years after T1 (mean number of months 29.47, SD = 5.43; range 16.69–48.06). The second follow up was held 0.9 to 4 years after T2 (mean number of months 32; SD = 7.07; range 11–53).

During T1, parents or guardians (preferably the mother, 95.6%) were interviewed in their homes. They were also asked to fill out questionnaires during the three measurement waves. The adolescents filled out questionnaires at school or other testing locations, under the supervision of one or more TRAILS assistants. The design of each wave of the TRAILS study was approved by the Dutch National Medical Ethics Committee.

Measures

Health risk behavior among adolescents at T2 and T3

Adolescents documented their health behaviors at T2 and T3 by completing a self-report questionnaire using questions of which the validity was confirmed in previous studies (Van Nieuwenhuijzen et al., 2009). The weight and height of the adolescents were also measured at T2 and T3. All health behaviors were classified as in agreement with (national) guidelines at the moment of measurement (yes/no), using the same criteria for T2 and T3. Each health risk factor is described in more detail below.

No regular fruit consumption: fruit was consumed on fewer than five days a week. No regular vegetable consumption: vegetables were consumed on fewer than five days a week. No regular breakfast: breakfast was consumed on fewer than five days a week.

Overweight or obesity: body mass index (BMI; in kg/m²) was calculated by measuring weight and height using regularly calibrated equipment (models 770 and 214, respectively; Seca, Hamburg, Germany). The definition of overweight or obesity was in accordance with international age- and gender-adjusted BMI criteria (Cole et al., 2000).

Physical inactivity: the Short Questionnaire to ASsess Health-enhancing physical activity (SQUASH) (Wendel-Vos et al., 2003) was used; it included questions about activities such as walking or sport. Since physical activity varies participants were instructed to think about a regular week in the past months. The amount of physical activity was quantified in the Metabolic Equivalent of the Tasks (METs). Moderate and vigorous physical activity (METs ≥ 3) was defined as meeting the recommended level of physical activity (7 days a week, 60 min a day); physical inactivity was defined as METs < 3 using a subdivision of light physical activity versus moderate and vigorous physical activity (Pate et al., 1995; Haskell et al., 2007).

Alcohol use: at T2 and T3, this was defined as alcohol use during the past 12 months. Alcohol use was assessed by asking how often participants drank alcoholic beverages in the last 12 months with fourteen categories ranging from 0 to more than 40 times. At the time of the study, adolescents aged 16 and older could legally drink alcohol in the Netherlands. An additional variable for alcohol use at T3 was constructed based on the guidelines for adults. The guideline for adults was as follows: not more than one drink per day for women and two drinks per day for men (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010).

Smoking: at T2 and at T3 smoking was defined as smoking one or more cigarettes. Smoking was measured by asking participants whether they have ever smoked, even though it was only one cigarette or a few puffs with five categories ranging from I never smoked to I smoke each day. The categories "I smoked never" and "I have smoked in the past but I stopped completely" were classified as non-smoking.

Cannabis use: any use during the past 12 months. Cannabis use was assessed by asking how often participants used cannabis in the last 12 months ranging from 0 to more than 40 times.

Individual characteristics

Self-control (T1) was assessed by the Dutch parent version of the Early Adolescent Temperament Questionnaire-Revised (EATQ-R) using the Effortful control scale (11 items, $\alpha = 0.86$), which denotes the capacity to voluntarily regulate behavior and attention (Putnam et al., 2001; Rothbart et al., 2000). Examples of items are: "Has a difficult time tuning out background noise and concentrating when trying to study" (Reversed) or "Is usually able to stick with his/her plans and goals." Items were rated on a five-point scale; higher scores reflect greater self-control.

The adolescents' levels of education were measured at T2 and consisted of eight categories (ranging from primary school to pre-university education).

Social environment characteristics

Socioeconomic status at T1 was measured with a parental questionnaire by assessing family income, highest maternal and paternal educational level attained, and the occupational levels of both parents (using the International Standard Classification for Occupations) (Ganzeboom and Treiman, 1996). An index of socioeconomic status was created by averaging the standardized scores of the five indicators giving all factors equal weights. Because of the interrelationships between different SES indicators, composite SES measures fully account for the effects that can be attributed to socioeconomic conditions, such as resources available to families, the ability to build up networks or influence of parental education on raising a child (Galobardes et al., 2007; Lahelma et al., 2004). The scale captured 61.2% of the variance in the five items and had an internal consistency of 0.84. Missing values (e.g., only one parent in the family) did not affect the association of this scale with other variables (Veenstra et al., 2005). Three SES groups were created, in which the lowest 25% of the scores were categorized as "low SES," the highest 25% as "high SES" and the remaining groups as "intermediate SES."

The following parental behaviors were measured; responses could be given separately for the father and mother. If the mother was the person completing the survey she also provided information on the health behaviors of the father and vice versa.

Physical activity (PA): how many days in an average week the parent engaged in PA for at least 30 min during the summer (question 1) and winter (question 2). Responses ranged from 0 (never) to 7 (seven days per week). Responses to the two questions were averaged.

Parental smoking (T2): tobacco smoking during the last four weeks. Responses ranged from 1 (never smoked) to 7 (more than 20 cigarettes a day).

Parental alcohol use (T2): number of glasses alcohol per week was assessed by asking about alcohol use during the week and weekend (number of days) and the number of glasses ranging from 1 (none/a few times) to 6 (more than 20 glasses a week).

Parental monitoring (T2): adolescents reported how much their mother and/or father knew about aspects of their lives, leading to separate mean scores for each parent. The questions involved knowledge about friends, spending money, time spending or activities after school and in the evening and substance use (Patterson and Stouthamer-Loeber, 1984).

Statistical analyses

First, the prevalence rates of individual and multiple health risk behaviors at T2 and T3 were computed for boys and girls. The number of an individual's health risk behaviors was seen as a risk score ranging from 0 to 8.

Second, the association between the health risk behaviors at T2 and each separate health risk behavior at T3 were examined to describe longitudinal patterns of health risk behavior. Eight multivariable logistic regression analyses were performed, with and without adjustment for gender, leading to odds ratios and 95% confidence intervals. These analyses were then repeated using the dichotomized multiple health risk score (i.e., a score more than 5 versus less). A score of more than 5 was used because this leads to a prevalence of about 10% at T3, which is comparable to similar cut-off points used for classifying psychosocial problems (Achenbach and Rescorla, 2010; <http://www.sdqinfo.org/>). Twenty imputed datasets were analyzed since missing data may affect the validity of the results and reduce the statistical power. To achieve good efficiency of estimation and sufficient statistical power, missing data were imputed 20 times (Graham, 2009). The imputed datasets were then pooled to obtain estimates of parameters and standard errors.

In addition, a Latent Transition Analysis (LTA) was performed to identify patterns of health risk behaviors and to examine whether and how individuals changed their patterns over time. LTA is a longitudinal extension of Latent Class Analysis (LCA) (Collins and Wugalter, 1992). The LTA did not provide new insights into the patterns of health risk behaviors (longitudinal or otherwise; results not shown). Therefore, the multiple health risk score was used for further analyses.

Third, the effects of individual and social factors on bivariate and multivariate (mutually adjusted) changes in multiple health risk behaviors were examined using linear regression analyses (based on imputed datasets). Adolescents' gender, self-control risk, SES (T1), parental health behaviors (smoking, alcohol use, physical activity) and parental monitoring (T2) were included as independent variables, correcting for the multiple health risk score at T2. Furthermore, possible changes to the multivariate model were examined: what would happen if the adolescents' school level at T2 was included instead of parental socioeconomic status at T1? Differences in peer setting at the school level might affect the results.

As a final step, the multivariate logistic and linear regression analyses were repeated using the T3 variable for adolescent alcohol use that is based on adult guidelines. This data was used to examine whether results regarding the longitudinal patterns and change of multiple health risk behaviors were similar.

All statistical analyses were performed in 2013–2014 using SPSS Windows, version 20, except for the LTA (which were done in Mplus 7.11) (Muthén and Muthén, 1998).

Results

Descriptive statistics of predictor variables are presented in Table 1.

The prevalence of separate and multiple health risk behaviors by adolescents at T2 and T3 are presented in Table 2. The most common health risk behaviors at T2 and T3 were no regular fruit consumption, physical inactivity and alcohol use. Results were rather similar for girls and boys except for physical inactivity: girls were more frequently physical inactive.

Prevalence rates for overweight or obesity, smoking, alcohol use and cannabis use increased during adolescence. Few adolescents met all the guidelines: 4.2% did at T2 and 1.4% did at T3. Many of them had more than five health risk behaviors: 3.6% at T2 and 10.2% at T3 with no regular fruit consumption, physical inactivity and alcohol use being the most frequent constituent factors.

Table 3 shows that all health risk behaviors at T2 were associated with many individual health risk behaviors at T3 and multiple health

risk behaviors at T3 as well, although not all the relationships reached statistical significance.

Three patterns deserve special attention. First, individual health risk behaviors at T2 were most strongly related to the same health risk behaviors at T3, with odds ratios (OR) varying from 1.95 (cannabis T2/T3) to 22.2 (overweight/obesity T2/T3). Behaviors with the strongest relationships (OR of 5 or more) e.g. fruit and vegetables consumption, breakfast, overweight or obesity, physical inactivity and smoking, significantly predicted multiple health risk behaviors at T3. Second, smoking at T2 increased the likelihood of most other health risk behaviors at T3. Significant associations were found for no regular fruit and vegetable consumption, overweight or obesity and cannabis use. Furthermore, smoking was most strongly associated with having multiple health risk behaviors at T3. Third, regarding separate health risk behaviors at T3, physical inactivity at T2 only significantly increased the risk of future physical inactivity; however it was a predictor for having multiple health risk behaviors. Adjustment for gender revealed similar results. Repeating the analyses using alcohol use at T3 according to the guidelines for adults yielded similar results for having individual and multiple health risk behaviors with two exceptions: not having breakfast regularly was not significantly related to alcohol use at T3, whereas smoking was significantly related to alcohol use at T3 (results not shown).

Table 4 shows that adolescents' levels of self-control, family SES and mothers' smoking behavior predicted multiple health risk behaviors at T3 in the multivariate regression analyses. Fathers smoking, mothers who were physically inactive and parental monitoring were separately related to multiple health risk behaviors but not mutually adjusted. Including school level instead of SES in the multivariate regression model did not affect the results appreciably, although self-control was no longer significant ($\beta = 0.10$, $p = 0.084$). A lower school level was a significant predictor of multiple health risk behaviors.

Repeating the analyses with the T3 alcohol use variable based on the guidelines for adults yielded similar results. The only exception was that maternal monitoring became a significant predictor of multiple health risk behaviors (results not shown).

Discussion

This study is the first to examine the prevalence, longitudinal patterns and a combination of individual and social predictors of a large range of health risk behaviors. Most of the surveyed adolescents did not meet the guidelines for individual healthy behaviors. Furthermore, individual health risk behaviors most strongly predicted the same health risk behaviors. No regular use of fruit, of vegetables, and of breakfast, overweight or obesity, physical inactivity and smoking predicted the future co-occurrence of health risk behaviors. Self-control, socioeconomic status of the family (or adolescent) and smoking of the mother predicted changes in multiple health risk behaviors. This study contributes to the existing knowledge base demonstrating tracking of cardiovascular risk factors (e.g. diet and physical activity) and risk behaviors such as smoking, alcohol and drugs during adolescence.

Few adolescents (4.2% at T2, 1.4% at T3) met all the guidelines for a healthy lifestyle. Other studies have found similar or higher prevalence rates for unhealthy behaviors among adolescents, varying from 5.0% to 88.5% (Pearson et al., 2009; Pronk et al., 2004; Plotnikoff et al., 2009). We found rather similar patterns for girls and boys except for physical inactivity. Other studies report no gender differences (Van Nieuwenhuijzen et al., 2009; Pronk, 2012) or showed that boys (Bachmann et al., 2012; Mahalik et al., 2013) or girls (Frech, 2012; Mahalik et al., 2013; Mistry et al., 2009) have higher prevalence rates of health risk behaviors although patterns may vary depending on age or outcomes (Mahalik et al., 2013). Rates of multiple health risk behaviors increased during adolescence, from 3.6% to 10.2% for more than 5 health risk behaviors. This age effect confirms the findings of other studies among adolescents (Plotnikoff et al., 2009; Alamian and

Table 1

Demographic characteristics of adolescents and the health behaviors of parents and parental monitoring by gender.

		T1	T2	T3
Mean age in years (SD)	Girls	11.09 (0.55)	13.56 (0.54)	16.28 (0.71)
	Boys	11.13 (0.56)	13.57 (0.52)	16.28 (0.71)
Mean self-control (SD)	Girls	3.35 (0.65)		
	Boys	3.10 (0.69)		
Mean school-level (SD)	Girls		4.86 (2.06)	
	Boys		4.61 (2.11)	
Low SES (%)	Girls	23.2		
	Boys	27.4		
Parental physical activity ^a	Mother		4.55 (1.97)	
	Father		4.43 (2.03)	
Parental alcohol consumption ^b	Mother		5.73 (7.69)	
	Father		10.50 (11.47)	
Parental smoking ^c	Mother		2.01 (2.41)	
	Father		2.00 (2.41)	
Parental monitoring ^d	Mother		1.55 (0.54)	
	Father		1.79 (0.38)	

^a Number of days in an average week the parent engaged in physical activity for at least 30 min during summer and winter.^b Number of glasses of alcohol consumed per week.^c Tobacco smoking during the last four weeks from 1 (never smoked) to 7 (more than 20 cigarettes a day).^d Adolescents reported (on a 3-point scale ranging from 0 = nothing to 2 = much) how much their mother and how much their father knew about three aspects of their lives, e.g. friends, leisure time, leading to mean scores for each parent separately.

Paradis, 2009a; Mistry et al., 2009; Ottevaere et al., 2011; Sanchez et al., 2007; Frech, 2012; levers-Landis et al., 2015) for a wider range of behaviors. These results demonstrate that many adolescents are at risk for poor health outcomes.

Individual health risk behaviors at T2 were most strongly related to the same health risk behaviors at T3. Associations were especially strong for physical inactivity and for overweight or obesity, indicating considerable stability for these behaviors. A previous study examining the longitudinal associations between health risk behaviors concluded that smoking was the most stable behavior, which might be explained by the addictive effect of nicotine (Paavola et al., 2004). However, that study was conducted among 15-, 21- and 28-year-olds, whereas rates

of tobacco, alcohol and cannabis use were still increasing strongly in this study's sample consistent with other studies (Bachmann et al., 2012; Mahalik et al., 2013; levers-Landis et al., 2015). These studies have shown that these health risk behaviors increase during adolescence whereas in adulthood more stability was found (Mahalik et al., 2013; Bachmann et al., 2012). Differences in study characteristics may explain this variation in results.

The co-occurrence of health risk behaviors was most strongly predicted by no regular consumption of vegetables, overweight or obesity, and smoking. The finding that regular consumption of vegetables was a predictor for the level of future multiple health risk behaviors supports the idea that family factors are important. Consumption of

Table 2Prevalence rates of individual and multiple health risk behaviors among adolescents at T2 and T3.¹

Health risk behaviors	2nd measurement (T2)			3rd measurement (T3)		
	Girls	Boys	Total	Girls	Boys	Total
	%	%	%	%	%	%
No regular fruit ^a	52.3	58.9	55.4	53.1	62.1	57.3
No regular vegetables ^a	18.0	25.5	21.5	20.1	26.5	23.1
No regular breakfast ^a	25.2	21.3	23.3	25.5	22.6	24.1
Overweight or obesity	9.6	8.1	8.9	16.3	13.6	15.0
Physical inactivity ^b	71.2	56.0	64.0	70.9	50.5	61.4
Smoking ^c	33.8	29.2	31.6	52.7	49.0	51.0
Alcohol use ^d	63.3	62.0	62.7	89.6	86.7	88.3
Cannabis use ^e	5.2	5.1	5.1	22.1	27.2	24.4
Number (min–max)	854–885	781–799	1640–1684	834–882	759–775	1593–1657
Multiple health risk score	%	%	%	%	%	%
0	3.8	4.6	4.2	1.0	1.9	1.4
1	15.8	18.3	17.0	7.2	10.7	8.8
2	24.1	27.0	25.5	19.8	19.9	19.8
3	27.4	24.6	26.1	25.5	23.1	24.3
4	17.9	15.5	16.8	21.6	21.3	21.5
5	7.2	6.9	7.0	14.5	13.3	13.9
6	2.9	2.6	2.8	7.8	7.7	7.8
7	0.8	0.5	0.7	2.6	1.9	2.3
8	0.1	–	0.1	0.1	0.1	0.1
Number	825	737	1562	774	684	1458

¹ These analyses were restricted to the adolescents who had complete data on the health risk factors at T2 and T3. The prevalence of health risk behavior at T2 for adolescents with and without data at T3 was comparable.^a Fruit, vegetables or breakfast consumed fewer than five days a week.^b Physical inactivity in the past months.^c Smoking one or more cigarettes.^d Drinking alcohol during the past 12 months.^e Cannabis use during the past 12 months.

Table 3
Results of repeated multivariate logistic regression analyses relating T2 (predictors) to T3 (outcomes); column numbers 1 to 8 relate to the row numbers with the eight health risk behaviors at T2.

T2	Individual health risk behaviors at T3								Multiple health risk behaviors at T3
	1	2	3	4	5	6	7	8	
	OR	OR	OR	OR	OR	OR	OR	OR	OR
	CI	CI	CI	CI	CI	CI	CI	CI	CI
1. No regular fruit	5.68*	1.52*	1.31*	1.04	1.05	1.04	1.00	0.86	1.72*
	4.56–7.08	1.15–2.01	1.01–1.71	0.74–1.46	0.81–1.36	0.84–1.30	0.73–1.36	0.68–1.10	1.20–2.48
2. No regular vegetables	1.65*	5.83*	1.32	1.31	1.12	1.10	0.76	1.37*	2.43*
	1.23–2.21	4.48–7.58	0.96–1.80	0.92–1.86	0.82–1.55	0.83–1.45	0.54–1.08	1.03–1.83	1.70–3.48
3. No regular breakfast	1.22	1.17	5.14*	1.41	1.01	1.30	0.67*	0.83	1.68*
	0.94–1.60	0.87–1.56	3.92–6.73	0.97–2.06	0.72–1.42	0.98–1.71	0.48–0.95	0.62–1.11	1.17–2.43
4. Overweight or obesity	0.93	1.08	2.15*	22.2*	1.03	0.75	0.83	0.73	2.49*
	0.62–1.40	0.66–1.76	1.52–3.04	14.5–33.9	0.66–1.62	0.52–1.08	0.46–1.51	0.47–1.14	1.56–3.97
5. Physical inactivity	1.10	0.98	0.87	0.75	16.6*	0.97	0.83	0.90	1.65*
	0.89–1.37	0.75–1.26	0.67–1.12	0.54–1.06	12.4–22.1	0.77–1.22	0.59–1.17	0.71–1.15	1.16–2.36
6. Smoking	1.52*	1.37*	1.26	1.96*	1.06	5.00*	1.23	2.47*	2.94*
	1.16–1.99	1.03–1.83	0.94–1.69	1.39–2.77	0.78–1.45	3.73–6.72	0.76–1.99	1.89–3.23	1.95–4.44
7. Alcohol use	1.15	0.89	1.23	0.91	0.93	2.02*	2.25*	2.04*	1.37
	0.90–1.46	0.65–1.23	0.93–1.62	0.59–1.41	0.66–1.30	1.61–2.53	1.59–3.19	1.54–2.69	0.91–2.07
8. Cannabis use	0.85	1.11	1.27	1.27	0.97	1.00	0.68	1.95*	1.26
	0.52–1.40	0.59–2.09	0.70–2.29	0.67–2.42	0.55–1.72	0.59–1.69	0.22–2.09	1.13–3.39	0.73–2.17

Odds ratios (OR) with 95% confidence intervals (CI); Multiple: 0–5 = 0; 6–8 = 1.

* $p < .05$.

vegetables by adolescents is strongly influenced by their parents' attitudes towards a healthy diet, their support, rules and monitoring and, furthermore, the availability of vegetables (Feunekes et al., 1998; St. George and Wilson, 2012; Videon and Manning, 2003). Moreover, limited health literacy on the part of parents has recently been shown to influence children's nutritional behavior (Sealy et al., 2012).

Both individual and social factors were predictors of changes in multiple health risk behaviors. First, lower levels of self-control increased the risk of multiple health risk behaviors consistent with other studies (Griffin et al., 2012; Williams and Ricciardelli, 2003; Fergusson et al., 2013; Wills et al., 2008). It should be noted that the effect of self-control decreased when controlling for school level. Previous research found that self-control correlates with cognitive abilities, gender, conduct problems and SES, (Fergusson et al., 2013) which may be captured by school level. Different types of self-control have been related to health risk behavior. Adolescents with high levels of impulsiveness have been shown to be less able to resist temptations such as substance use (Wills et al., 2006). Capacities for planning, problem solving and goal setting have been shown to be related to more fruit and vegetable intake, more participation in sports and less sedentary behavior (Wills et al., 2007).

Second, of the measured parental factors, only maternal smoking predicted changes in multiple health risk behaviors in the multivariate analyses. Parental factors such as parental support, parenting style, monitoring and parental health behaviors are believed to play an important role in influencing the health behaviors of their children. Evidence for the relationship between parental and youth health behavior is inconsistent or weak (Anderssen et al., 2006; Edwardson and Gorely, 2010; Rossow and Rise, 1994). The findings of this study suggest that modeling the mother's behavior and receiving emotional support from her may be more important than similar factors related to the father. However, we cannot fully explain the underlying family dynamics with our data. Parental concordance on a range of home environmental factors (e.g., importance of family meals, parent feeding practices, encouraging child physical activity) was associated with healthy diet and physical activity (Berge et al., 2015). We did not find significant effect of parental monitoring whereas in a review evidence was found that parental support, parenting style and parental monitoring were important to prevent health risk behaviors in youth at risk for metabolic syndrome and type 2 diabetes (Lawman and Wilson, 2012). Unfortunately, in contrast to our study, a limited number of parental factors or few health risk behaviors of adolescents have been

Table 4
Univariate and multivariate linear regression analyses to predict multiple health risk behaviors at T3.

	Univariate		Multivariate	
	B (SE)	Beta	B (SE)	Beta
Gender	−0.07 (0.08)	−0.02	−0.11 (0.07)	−0.04
Self-control	−0.38 (0.06)***	−0.17	−0.16 (0.06)**	−0.07
Multiple health risk behavior T2	0.58 (0.03)***	0.50	0.45 (0.03)***	0.43
SES ^a	−0.39 (0.05)***	−0.20	−0.11 (0.05)*	−0.05
Physical activity – mother	−0.06 (0.02)**	−0.07	−0.01 (0.02)	−0.01
Physical activity – father	−0.05 (0.02)*	−0.07	−0.02 (0.02)	−0.02
Alcohol consumption – mother	0.000 (0.006)	0.003	0.001 (0.01)	0.01
Alcohol consumption – father	0.003 (0.003)	0.02	−0.003 (0.003)	−0.02
Smoking – mother	0.13 (0.02)***	0.21	0.02 (0.02)**	0.07
Smoking – father	0.10 (0.02)***	0.15	0.05 (0.02)	0.04
Parental monitoring – mother	−0.62 (0.11)***	−0.19	−0.05 (0.12)	−0.02
Parental monitoring – father	−0.56 (0.07)***	−0.21	−0.11 (0.08)	−0.04

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

^a SES was treated as a continuous variable.

investigated (Lawman and Wilson, 2012). The influence of parental factors on multiple health risk behaviors deserves more research.

Third, the family's or adolescent's SES were significant predictors of multiple health risk behaviors, which is in line with other research about adolescents (Schrijvers and Schuit, 2010). Among adolescents with a lower SES, multiple factors such as low health literacy, less positive attitudes towards healthy behaviors and higher levels of peer pressure might increase the risk of unhealthy behaviors. Furthermore, families with a low SES face more financial constraints in buying fruit or participating in sports, and may experience more stressful life events. However, there is a lack of clear support for various explanations for the relationship between SES and health risk behaviors (Pampel et al., 2010).

Strengths and limitations

This study has several strengths. It described the patterns and predictors of a large range of multiple health risk behaviors among adolescents belonging to a representative population-based cohort in the Netherlands with high response rates and limited attrition during follow-up. Imputation was performed to prevent the exclusion of respondents with one or more missing values regarding behaviors or predictors.

Some limitations should also be considered. First, the analyses were based on self-reported data, which might introduce bias. However, anonymity was assured and self-reported measures of substance use have acceptable validity and reliability (Del Boca and Darkes, 2003). Second, the multiple risk score involved the dichotomization of individual behaviors. Recently, the limitations of this analysis have been described (McAloney et al., 2013). Individuals may have the same risk score with different health risk behaviors or with different severity, though our analyses show that three behaviors are major constituents i.e. no regular fruit consumption, physical inactivity and alcohol use. Moreover, this approach is relevant from a health promotion perspective targeting an accumulation of risks. Third, it was not possible to conduct the data collection in the same months for all participants during the measurement waves introducing potentially variation in the data on fruit, vegetables or physical activity. Fourth, we used self-report measures regarding various health behaviors which may have added some measurement error. If so, this may lead to underestimation of the contribution of certain factors. Smoking of the adolescents was not measured for a specific time frame. Furthermore, one of the parents provided information on the health behaviors of both parents, this could have led to an under- or overestimation of diet, alcohol use, and physical activity. Fifth, overweight and obesity are not actually behaviors but outcomes of health behaviors. However, as such, they strongly represent behaviors leading to energy intake and output, and are included in many public health guidelines.

Implications

Adolescents with low levels of self-control who come from families with a low SES and have mothers who smoke are vulnerable to developing multiple health risk behaviors, making them an important target group for prevention. Enhancing self-control may be a fruitful strategy for preventing multiple health risk behaviors. Socioeconomic status cannot be changed easily; further research is needed to improve understanding of the pathways explaining the relationship between SES or school level and multiple health behaviors. Furthermore, the impact of other relevant individual and social predictors on multiple health behaviors (such as cognitive abilities, life events, mental health and peer influences) needs to be explored.

Conflict of interest

None declared.

Financial disclosure

TRAILS has been financially supported by various grants from the Netherlands Organization for Scientific Research NWO (Medical Research Council program grant GB-MW 940-38-011; ZonMW Brainpower grant 100-001-004; ZonMw Risk Behavior and Dependence grants 60-60600-97-118; ZonMw Culture and Health grant 261-98-710; Social Sciences Council medium-sized investment grants GB-MaGW 480-01-006 and GB-MaGW 480-07-001; Social Sciences Council project grants GB-MaGW 452-04-314 and GB-MaGW 452-06-004; NWO large-sized investment grant 175.010.2003.005; NWO Longitudinal Survey and Panel Funding 481-08-013), the Dutch Ministry of Justice (WODC), the European Science Foundation (EuroSTRESS project FP-006), Biobanking and Biomolecular Resources Research Infrastructure BBMRI-NL (CP 32), and the participating universities.

Transparency document

The [Transparency document](#) associated with this article can be found, in online version.

Acknowledgments

The authors thank all the adolescents, their parents and teachers who participated in this research and to everyone who worked on this project and made it possible. This research is part of the Tracking Adolescents' Individual Lives Survey (TRAILS). Participating centers of TRAILS include various departments of the University Medical Center and University of Groningen, the Erasmus University Medical Center, Rotterdam, the University of Utrecht, the Radboud Medical Center Nijmegen and the Parnassia Bavo group, all in The Netherlands.

References

- Achenbach, T.M., Rescorla, L.A., 2010. Multicultural supplement to the manual for the ASEBA preschool forms & profiles: child behavior checklist for ages 1 1/2–5, language development survey, caregiver-teacher report form; an integrated system of multi-informant assessment. University of Vermont, research center for children youth & families.
- Åkesson, A., Weismayer, C., Newby, P., Wolk, A., 2007. Combined effect of low-risk dietary and lifestyle behaviors in primary prevention of myocardial infarction in women. *Arch. Intern. Med.* 167, 2122–2127.
- Alamian, A., Paradis, G., 2009a. Clustering of chronic disease behavioral risk factors in Canadian children and adolescents. *Prev. Med.* 48, 493–499.
- Alamian, A., Paradis, G., 2009b. Correlates of multiple chronic disease behavioral risk factors in Canadian children and adolescents. *Am. J. Epidemiol.* 170, 1279–1289.
- Anderssen, N., Wold, B., Torsheim, T., 2006. Are parental health habits transmitted to their children? An eight year longitudinal study of physical activity in adolescents and their parents. *J. Adolesc.* 29, 513–524.
- Angela, M., Hamil-Luker, J., 2005. Processes of cumulative adversity: childhood disadvantage and increased risk of heart attack across the life course. *J. Gerontol. Ser. B Psychol. Sci. Soc. Sci.* 60, S117–S124.
- Bachmann, M., Znoj, H., Brodbeck, J., 2012. Smoking behaviour, former quit attempts and intention to quit in urban adolescents and young adults: a five-year longitudinal study. *Public Health* 126, 1044–1050.
- Bandura, A., 2004. Health promotion by social cognitive means. *Health Educ. Behav.* 31, 143–164.
- Berge, J.M., MacLehose, R.F., Meyer, C., Didericksen, K., Loth, K.A., Neumark-Sztainer, D., 2015. He said, she said: examining parental concordance on home environment factors and adolescent health behaviors and weight status. *J. Acad. Nutr. Diet.* <http://dx.doi.org/10.1016/j.jand.2015.05.020> (in press).
- Cameron, A.J., Crawford, D.A., Salmon, J., et al., 2011. Clustering of obesity-related risk behaviors in children and their mothers. *Ann. Epidemiol.* 21, 95–102.
- Chiuve, S.E., McCullough, M.L., Sacks, F.M., Rimm, E.B., 2006. Healthy lifestyle factors in the primary prevention of coronary heart disease among men: benefits among users and nonusers of lipid-lowering and antihypertensive medications. *Circulation* 114, 160–167.
- Cole, T.J., Bellizzi, M.C., Flegal, K.M., Dietz, W.H., 2000. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 320, 1240–1243.
- Collins, L.M., Wugalter, S.E., 1992. Latent class models for stage-sequential dynamic latent variables. *Multivar. Behav. Res.* 27, 131–157.
- De Winter, A.F., Oldehinkel, A.J., Veenstra, R., Brunnekreef, J.A., Verhulst, F.C., Ormel, J., 2005. Evaluation of non-response bias in mental health determinants and outcomes in a large sample of pre-adolescents. *Eur. J. Epidemiol.* 20, 173–181.

- Del Boca, F.K., Darkes, J., 2003. The validity of self-reports of alcohol consumption: state of the science and challenges for research. *Addiction* 98, 1–12.
- Djoussé, L., Driver, J.A., Gaziano, J.M., 2009. Relation between modifiable lifestyle factors and lifetime risk of heart failure. *JAMA* 302, 394–400.
- Edwardson, C.L., Gorely, T., 2010. Parental influences on different types and intensities of physical activity in youth: a systematic review. *Psychol. Sport Exerc.* 11, 522–535.
- Fergusson, D.M., Boden, J.M., Horwood, L.J., 2013. Childhood self-control and adult outcomes: results from a 30-year longitudinal study. *J. Am. Acad. Child Adolesc. Psychiatry* 52 (7), 709–717 (e1).
- Feunekes, G., de Graaf, C., Meyboom, S., van Staveren, W., 1998. Food choice and fat intake of adolescents and adults: associations of intakes within social networks. *Prev. Med.* 27, 645–656.
- Frech, A., 2012. Healthy behavior trajectories between adolescence and young adulthood. *Adv. Life Course Res.* 17, 59–68.
- Galobardes, B., Lynch, J., Smith, G.D., 2007. Measuring socioeconomic position in health research. *Br. Med. Bull.* 81–82, 21–37.
- Ganzeboom, H.B.G., Treiman, D.J., 1996. Internationally comparable measures of occupational status for the 1988 international standard classification of occupations. *Soc. Sci. Res.* 25, 201–239.
- Gillander Gådin, K., Hammarström, A., 2002. Can school-related factors predict future health behaviour among young adolescents? *Public Health (Nat.)* 116, 22–29.
- Graham, J.W., 2009. Missing data analysis: making it work in the real world. *Annu. Rev. Psychol.* 60, 549–576.
- Griffin, K.W., Scheier, L.M., Acevedo, B., Grenard, J.L., Botvin, G.J., 2012. Long-term effects of self-control on alcohol use and sexual behavior among urban minority young women. *Int. J. Environ. Res. Public Health* 9, 1–23.
- Hair, E.C., Park, M.J., Ling, T.J., Moore, K.A., 2009. Risky behaviors in late adolescence: co-occurrence, predictors, and consequences. *J. Adolesc. Health* 45, 253–261.
- Hamil-Luker, J., Angela, M., 2007. Gender differences in the link between childhood socioeconomic conditions and heart attack risk in adulthood. *Demography* 44, 137–158.
- Haskell, W.L., Lee, I., Pate, R.R., et al., 2007. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 116, 1081.
- <http://www.sdqinfo.org/>.
- Ievers-Landis, C.E., Walders-Abramson, N., Amodei, N., et al., 2015. Longitudinal correlates of health risk behaviors in children and adolescents with type 2 diabetes. *J. Pediatr.* 166, 1258–1264 (e3).
- Jessor, R., 1984. Adolescent development and behavioral health. In: Matarazzo, J.D., Weiss, S.M., Herd, J.A., et al. (Eds.), *Behavioral Health: A Handbook of Health Enhancement and Disease Prevention*. John Wiley & Sons, New York, NY, pp. 69–90.
- Khaw, K.T., Wareham, N., Bingham, S., Welch, A., Luben, R., Day, N., 2008. Combined impact of health behaviours and mortality in men and women: the EPIC-Norfolk prospective population study. *PLoS Med.* 5, e12.
- Lahelma, E., Martikainen, P., Laaksonen, M., Aittomäki, A., 2004. Pathways between socioeconomic determinants of health. *J. Epidemiol. Community Health* 58, 327–332.
- Lawlor, D.A., O'Callaghan, M.J., Mamun, A.A., Williams, G.M., Bor, W., Najman, J.M., 2005. Socioeconomic position, cognitive function, and clustering of cardiovascular risk factors in adolescence: findings from the Mater University Study of Pregnancy and its outcomes. *Psychosom. Med.* 67, 862–868.
- Lawman, H.G., Wilson, D.K., 2012. A review of family and environmental correlates of health behaviors in high-risk youth. *Obesity* 20, 1142–1157.
- Li, F.X., Robson, P.J., Chen, Y., Qiu, Z., Lo Siou, G., Bryant, H.E., 2009. Prevalence, trend, and sociodemographic association of five modifiable lifestyle risk factors for cancer in Alberta and Canada. *Cancer Causes Control* 20, 395–407.
- Mahalik, J.R., Levine Coley, R., McPherran Lombardi, C., Doyle Lynch, A., Markowitz, A.J., Jaffee, S.R., 2013. Changes in health risk behaviors for males and females from early adolescence through early adulthood. *Health Psychol.* 32, 685.
- Martin-Diener, E., Meyer, J., Braun, J., et al., 2014. The combined effect on survival of four main behavioural risk factors for non-communicable diseases. *Prev. Med.* 65, 148–152.
- McAloney, K., Graham, H., Law, C., Platt, L., 2013. A scoping review of statistical approaches to the analysis of multiple health-related behaviours. *Prev. Med.* 56 (6), 365–371.
- Mistry, R., McCarthy, W.J., Yancey, A.K., Lu, Y., Patel, M., 2009. Resilience and patterns of health risk behaviors in California adolescents. *Prev. Med.* 48, 291–297.
- Mitchell, J., Pate, R., Beets, M., Nader, P., 2012. Time spent in sedentary behavior and changes in childhood BMI: a longitudinal study from ages 9 to 15 years. *Int. J. Obes.* 37, 54–60.
- Moffitt, T.E., Arseneault, L., Belsky, D., et al., 2011. A gradient of childhood self-control predicts health, wealth, and public safety. *Proc. Natl. Acad. Sci. U. S. A.* 108, 2693–2698.
- Monshouwer, K., Harakeh, Z., Lugtig, P., et al., 2012. Predicting transitions in low and high levels of risk behavior from early to middle adolescence: the TRAILS study. *J. Abnorm. Child Psychol.* 40, 923–931.
- Muthén, L.K., Muthén, B.O., 1998. Statistical analysis with latent variables. *Mplus User's guide*, 1998–2012.
- Myint, P.K., Luben, R.N., Wareham, N.J., Bingham, S.A., Khaw, K.T., 2009. Combined effect of health behaviours and risk of first ever stroke in 20,040 men and women over 11 years' follow-up in Norfolk cohort of European Prospective Investigation of Cancer (EPIC Norfolk): prospective population study. *BMJ* 338, b349.
- Nader, P.R., Bradley, R.H., Houts, R.M., McRitchie, S.L., O'Brien, M., 2008. Moderate-to-vigorous physical activity from ages 9 to 15 years. *JAMA* 300, 295–305.
- Ortega, F.B., Konstabel, K., Pasquali, E., et al., 2013. Objectively measured physical activity and sedentary time during childhood, adolescence and young adulthood: a cohort study. *PLoS One* 8, e60871.
- Ottevaere, C., Huybrechts, I., Benser, J., et al., 2011. Clustering patterns of physical activity, sedentary and dietary behavior among European adolescents: The HELENA study. *BMC Public Health* 11, 328.
- Paavola, M., Vartiainen, E., Haukka, A., 2004. Smoking, alcohol use, and physical activity: a 13-year longitudinal study ranging from adolescence into adulthood. *J. Adolesc. Health* 35, 238–244.
- Pampel, F.C., Krueger, P.M., Denney, J.T., 2010. Socioeconomic disparities in health behaviors. *Annu. Rev. Sociol.* 36, 349.
- Pate, R.R., Pratt, M., Blair, S.N., et al., 1995. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 273, 402–407.
- Patterson, G.R., Stouthamer-Loeber, M., 1984. The correlation of family management practices and delinquency. *Child Dev.* 1299–1307.
- Pearson, N., Atkin, A.J., Biddle, S.J., Gorely, T., Edwardson, C., 2009. Patterns of adolescent physical activity and dietary behaviours. *Int. J. Behav. Nutr. Phys. Act.* 6 (45–5868–6–45).
- Plotnikoff, R.C., Karunamuni, N., Spence, J.C., et al., 2009. Chronic disease-related lifestyle risk factors in a sample of Canadian adolescents. *J. Adolesc. Health* 44, 606–609.
- Pokhrel, P., Sussman, S., Stacy, A., 2014. Relative effects of social self-control, sensation seeking, and impulsivity on future cigarette use in a sample of high-risk adolescents. *Subst. Use Misuse* 49 (4), 343–351.
- Post, G.B., Vente, W.D., Kemper, H.C., Twisk, J.W., 2001. Longitudinal trends in and tracking of energy and nutrient intake over 20 years in a Dutch cohort of men and women between 13 and 33 years of age: the Amsterdam growth and health longitudinal study. *Br. J. Nutr.* 85, 375–385.
- Pronk, N.P., 2012. The power of context: moving from information and knowledge to practical wisdom for improving physical activity and dietary behaviors. *Am. J. Prev. Med.* 42, 103–104.
- Pronk, N.P., Anderson, L.H., Crain, A.L., et al., 2004. Meeting recommendations for multiple healthy lifestyle factors. Prevalence, clustering, and predictors among adolescent, adult, and senior health plan members. *Am. J. Prev. Med.* 27, 25–33.
- Putnam, S.P., Ellis, L.K., Rothbart, M.K., 2001. The structure of temperament from infancy through adolescence. *Advances in research on temperament* pp. 165–182.
- Rosow, I., Rise, J., 1994. Concordance of parental and adolescent health behaviors. *Soc. Sci. Med.* 38, 1299–1305.
- Rothbart, M.K., Ahadi, S.A., Evans, D.E., 2000. Temperament and personality: origins and outcomes. *J. Pers. Soc. Psychol.* 78, 122.
- Sanchez, A., Norman, G.J., Sallis, J.F., Calfas, K.J., Cella, J., Patrick, K., 2007. Patterns and correlates of physical activity and nutrition behaviors in adolescents. *Am. J. Prev. Med.* 32, 124–130.
- Schrijvers, C.T.M., Schuit, A.J., 2010. Middelengebruik en seksueel gedrag van jongeren met een laag opleidingsniveau. Aangrijpingspunten voor preventie. RIVM Rapport 270372001.
- Sealy, Y.M., Zarcadoolas, C., Dresser, M., Wedemeyer, L., Short, L., Silver, L., 2012. Using public health detailing and a family-centered ecological approach to promote patient-provider-parent action for reducing childhood obesity. *Child. Obes.* 8, 132–146.
- St. George, S.M., Wilson, D.K., 2012. A qualitative study for understanding family and peer influences on obesity-related health behaviors in low-income African-American adolescents. *Child. Obes.* 8, 466–476.
- Trang, N.H., Hong, T.K., Van der Ploeg, H.P., et al., 2012. Longitudinal physical activity changes in adolescents: Ho Chi Minh City Youth Cohort. *Med. Sci. Sports Exerc.* 1481–1489.
- Trudeau, F., Laurencelle, L., Shephard, R.J., 2004. Tracking of physical activity from childhood to adulthood. *Med. Sci. Sports Exerc.* 36, 1937–1943.
- U.S. Department of Agriculture, U.S. Department of Health and Human Services, 2010. *Dietary Guidelines for Americans*, 2010. 7th edition. U.S. Government Printing Office, Washington, DC (December).
- Van Nieuwenhuijzen, M., Junger, M., Velderman, M.K., et al., 2009. Clustering of health-compromising behavior and delinquency in adolescents and adults in the Dutch population. *Prev. Med.* 48, 572–578.
- Veenstra, R., Lindenberg, S., Oldehinkel, A.J., De Winter, A.F., Verhulst, F.C., Ormel, J., 2005. Bullying and victimization in elementary schools: a comparison of bullies, victims, bully/victims, and uninvolved preadolescents. *Dev. Psychol.* 41, 672–682.
- Videon, T.M., Manning, C.K., 2003. Influences on adolescent eating patterns: the importance of family meals. *J. Adolesc. Health* 32, 365–373.
- Wendel-Vos, G., Schuit, A.J., Saris, W.H., Kromhout, D., 2003. Reproducibility and relative validity of the short questionnaire to assess health-enhancing physical activity. *J. Clin. Epidemiol.* 56, 1163–1169.
- Williams, R.J., Ricciardelli, L.A., 2003. Negative perceptions about self-control and identification with gender-role stereotypes related to binge eating, problem drinking, and to co-morbidity among adolescents. *J. Adolesc. Health* 32, 66–72.
- Wills, T.A., Walker, C., Mendoza, D., Ainette, M.G., 2006. Behavioral and emotional self-control: relations to substance use in samples of middle and high school students. *Psychol. Addict. Behav.* 20, 265.
- Wills, T.A., Isasi, C.R., Mendoza, D., Ainette, M.G., 2007. Self-control constructs related to measures of dietary intake and physical activity in adolescents. *J. Adolesc. Health* 41, 551–558.
- Wills, T.A., Ainette, M.G., Stoolmiller, M., Gibbons, F.X., Shinar, O., 2008. Good self-control as a buffering agent for adolescent substance use: an investigation in early adolescence with time-varying covariates. *Psychol. Addict. Behav.* 22, 459–471.