

The Effects of Adolescent Health-Related Behavior on Academic Performance: A Systematic Review of the Longitudinal Evidence

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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.

KEYWORDS: health behavior, academic performance, adolescents

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 (Clift & Bruun Jensen, 2005; Lee, 2009; Mukoma & Flisher, 2004). Since the late 1980s, the World Health Organization (WHO) has fostered the links between health and education by means of Health Promoting Schools, starting with the 1986 Ottawa Charter (WHO, 1986, 1997; WHO, UNESCO, & UNICEF, 1992). This initiative has developed into comprehensive

theoretical frameworks of good practices, and there is empirical evidence that these initiatives improve students' health and health behaviors (Barnekow-Rasmussen & Rivett, 2000; Clift & Bruun Jensen, 2005).

Less is known about the effects of health-related behaviors, which are often assumed to be unhealthy in nature, on the academic performance of students (Murray, Low, Hollis, Cross, & Davis, 2007; Symons, Cinelli, James, & Groff, 1997). As Flay (2002) stated 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. (p. 407)

The October 2011 issue of *The Journal of School Health*, titled "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 (Basch, 2011; Taras, 2005a, 2005b). 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 pathways (Balsa, Giuliano, & French, 2011), and only a 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.

Method

This systematic literature review was designed according to the Cochrane Collaboration's definition, as elaborated further in the PRISMA and MOOSE statements (Higgins & Green, 2008; Liberati et al., 2009; Stroup et al., 2000).

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 they are 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, sexual activity, nutrition, bullying/being bullied, watching television, Internet use, and video game playing. Four components (the target population was 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 U.K. and U.S. 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 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 (WHO, UNESCO, & UNICEF, 1992). 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 researchers independently decided if the retrieved articles were original research papers that studied school grades as the outcome variable of interest, health-related behaviors were the predicting variables 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 researcher, although this was rarely necessary. Of the remaining articles, full-text copies were retrieved. If full-text articles could not be found, the authors were contacted by email. Those articles were similarly assessed for inclusion as described above. References for all the articles were then scanned (citation tracking) for further relevant source papers, and similar procedures were used to include or exclude them. Reviews that did not contain original empirical research were used for citation tracking only.

Data Extraction Process

Two authors independently extracted the following data from the included studies: (a) study design, (b) type of data collected, (c) number of participants, (d) health-related behaviors studied, (e) operationalization of health-related behaviors and educational performance, (f) duration of the study and follow-up, and (g) main study findings. Disagreements were again resolved by discussion between the two review authors, and if necessary by a third 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 eight previously unidentified studies, resulting in 30 articles that met inclusion criteria and were included in the review (Table 1).

Study Characteristics

Some studies investigated more than one “unhealthy” behavior. Out of the total of 30 included studies, six investigated the effect of substance abuse on students’ academic performance (three investigated smoking and four alcohol use); six the effects of being bullied or bullying; four the effects of sexual intercourse, including early sexual intercourse; nine the effects of physical activity; one the effects of nutrition; and six the effects of screen time use (one on Internet use, four on playing video games, and four on watching television; Table 1). Although it may appear as

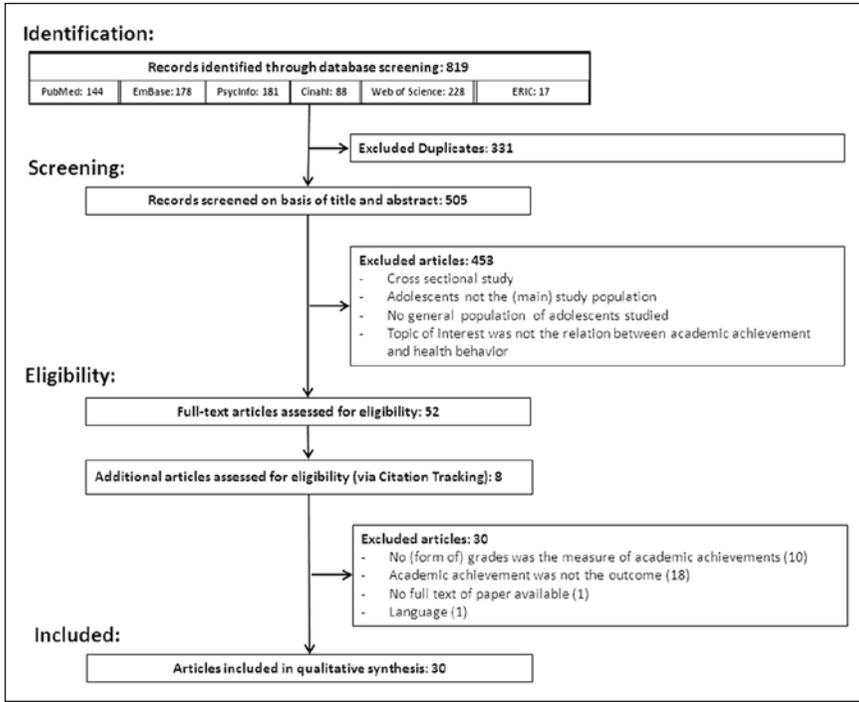


FIGURE 1. Flow diagram of the review inclusion process according to the QUORUM Statement (Liberati et al., 2009).

if the total number of studies exceeds 30 in some tables, this is because some studies included more than one type of health-related behavior. The study designs were fairly uniform (24 prospective cohort studies, 3 retrospective cohort studies, 2 randomized controlled trials, and 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 one academic year to more than 10 years; only three of the 30 studies lasted more than five years. The quality of the included studies was assessed based on the STROBE statement (Vandenbroucke et al., 2007; Table 2). The main study findings are summarized in Table 3.

Drinking Alcohol, Smoking, and Marijuana Use

An overview of the effect sizes of drinking and smoking on adolescents' grades is provided 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 (Balsa et al., 2011; Crosnoe, 2002; Peleg-Oren, Saint-Jean, Cardenas, Tammara, & Pierre, 2009; Sabia, 2009). These studies were all large cohort studies including students of different ethnic and socioeconomic backgrounds, and they used complex multilevel, multibehavioral

TABLE 1*Main Characteristics of All Retrieved Studies*

Behavior(s) studied	Main author	Year	Duration	Sample <i>N</i>	Location	Study design
Sexual behavior	Resnick	1994	5 years	1,806	USA	Retrospective cohort study
Sexual behavior	Schvaneveldt	2001	10 years	1,145	USA	Prospective cohort study
Sexual behavior	Sabia	2007	5 years	27,000	USA	Prospective cohort study
Sexual behavior	Tubman	1996	2 years	1,167	USA	Prospective cohort study
Smoking	Tucker	2008	10 years	6,527	USA	Prospective cohort study
Smoking	Pennanen	2011	2 years	2,188	Finland	Randomized controlled trial
Smoking	Ellickson	2001	5 years	4,327	USA	Prospective cohort study
Alcohol use	Balsa	2011	1 year	4,292	USA	Prospective cohort study
Alcohol use	Peleg-Oren	2009	1 year	12,352	USA	Retrospective cohort study
Alcohol use	Sabia	2009	1 year	16,721	USA	Prospective cohort study
Alcohol use and physical activity	Crosnoe	2002	3 years	2,651	USA	Prospective cohort study
Physical activity	Broh	2002	2 years	12,578	USA	Prospective cohort study
Physical activity	Coe	2006	1 year	214	USA	Randomized controlled trial
Physical activity	McNulty Eitle	2002	2 years	10,087	USA	Prospective cohort study
Physical activity	McNulty Eitle	2005	2 years	5,081	USA	Prospective cohort study
Physical activity	Hanson	1998	2 years	11,683	USA	Prospective cohort study
Physical activity	Miller	2005	2 years	586	USA	Prospective cohort study
Physical activity	Nelson	2006	1 year	11,957	USA	Prospective cohort study
Physical activity and screen time	Dumais	2008	2 years	15,362	USA	Prospective cohort study
Screen time	Gentile	2011	2 years	3,034	Singapore	Longitudinal panel study
Screen time	Johnson	2007	8 years	678	USA	Prospective cohort study
Screen time	Sharif	2010	2 years	6,468	USA	Prospective cohort study
Screen time	Smith	1992	2 years	1,208	USA	Prospective cohort study
Bullying and screen time	Norris	2010	2 years	Not known	USA	Prospective cohort study
Bullying	Beran	2009	1 year	4,111	Canada	Retrospective cohort study
Bullying	Forrest	2012	2 years	1,457	USA	Prospective cohort study
Bullying	Juvonen	2011	3 years	2,300	USA	Prospective cohort study
Bullying	Rothon	2011	2 years	2,093	UK	Prospective cohort study
Bullying	Stavriniades	2011	2 years	238	Cyprus	Prospective cohort study
Nutrition	Chen	2002	1 year	690	Taiwan	Prospective cohort study

models to account for the nested data structure and potential interbehavioral confounding. Three studies specifically investigated potential gender- and race-specific effects to unravel causal pathways (Balsa et al., 2011; Crosnoe, 2002; Sabia, 2009).

Two of those studies indicated that extreme alcohol use by adolescents had a much smaller effect on academic performance than is often assumed (Balsa et al., 2011; Sabia, 2009). The researchers stated that poorer school performance was related to significant interactions with socioeconomic status (SES), gender, or preexisting psychosocial problems. It was found, for example, that increased alcohol consumption

TABLE 2
Overview of the Quality of the Included Studies

Main author	Sample characteristics					Statistical analyses					
	Nat. repres.	SES	Ethnicity	Age range in years	Loss to follow-up	Address missing data	Clear in/exclusion criteria	Demogr. corrections ^a	Inter-behav. corrections ^b	Additional statistical analyses	ML ^c analyses
Resnick	Yes	Diverse	Diverse	12–18	Unclear	No	Yes	Yes	No	Stratified by gender	No
Schvaneveldt	Yes	Diverse	Diverse	7–22	50%	Yes	Yes	Yes	No	Stratified by gender and ethnicity	No
Sabia (2007)	Yes	Diverse	Diverse	12–18	29%	Yes	Yes	Yes	No	Stratified by gender and age	Yes
Tubman	No	Restricted	Restricted	15–17	<10%	Yes	Yes	Yes	No	Stratified by gender	No
Tucker	No	Diverse	Diverse	13–23	34%	Yes	Yes	Yes	No	Stratified by gender and age	Yes
Pennanen	No	Diverse	Diverse	13–16	20%	Yes	Yes	Yes	No	Interactions with gender and intervention	Yes
Ellieckson	No	Diverse	Diverse	12–18	33%	Yes	Yes	Yes	No	No	Yes
Balsa	Yes	Diverse	Diverse	12–18	54%	Yes	Yes	Yes	Yes	Stratified by gender and interactions with age and baseline GPA	Yes
Peleg-Oren	Yes	Diverse	Diverse	13–18	N/A	No	Yes	Yes	No	Stratified by gender and race	Yes
Sabia (2009)	Yes	Diverse	Diverse	12–18	29%	Yes	Yes	Yes	Yes	Stratified by gender	Yes
Crosnoe	No	Diverse	Diverse	14–17	36%	Yes	Yes	Yes	Not clear	Interactions by gender and athletic status	Yes
Broh	Yes	Diverse	Diverse	13–18	49%	Yes	Yes	Yes	No	Mediations by general self-esteem	No
Coe	No	Restricted	Unknown	11–13	7%	No	Yes	No	No	Stratified by gender and ethnicity	No
McNulty Eitle (2002)	Yes	Diverse	Diverse	13–16	21%	Yes	Yes	Yes	No	Stratified by gender with race interactions	No
McNulty Eitle (2005)	Yes	Diverse	Diverse	13–16	21%	Yes	Yes	Yes	No	Stratified by gender with race interactions	Yes
Hanson	Yes	Diverse	Diverse	15–18	61%	No	Not clear	Yes	No	Stratified by gender	No
Miller	No	Diverse	Diverse	13–18	<20%	No	Yes	Yes	No	Stratified by gender and race	No

(continued)

TABLE 2 (continued)

Main author	Sample characteristics					Statistical analyses					
	Nat. repres.	SES	Ethnicity	Age range in years	Loss to follow-up	Address missing data	Clear in/exclusion criteria	Demogr. corrections ^a	Inter-behav. corrections ^b	Additional statistical analyses	ML ^c analyses
Nelson	Yes	Diverse	Diverse	12–18	19%	Yes	Yes	Yes	Yes	Behavioral cluster analyses	Yes
Dumais	Yes	Diverse	Diverse	15–18	24%	Yes	Yes	Yes	Yes	Stratified by SES-quartiles	No
Gentile	Yes	Diverse	Diverse	7–15	12%	Yes	Yes	Yes	Yes	No	Yes
Johnson	No	Diverse	Diverse	14–22	13%	No	Yes	Yes	No	No	No
Sharif	Yes	Diverse	Diverse	10–14	30%	No	Yes	Yes	Yes	Mediation by substance use, problem behavior, and sensation seeking	No
Smith	No	Diverse	Diverse	12–15	24%	Yes	Yes	Yes	No	Interaction by SES	No
Norris	Yes	Diverse	Diverse	14–22	Not clear	Yes	Yes	Yes	No	Mediated by excessive Internet use, gender and race	Yes
Beran	Yes	Diverse	Diverse	12–15	N/A	Yes	Yes	Yes	No	Mediated by psychosocial problems	Yes
Forrest	No	Diverse	Diverse	9–13	16%	Yes	Yes	Yes	No	Stratified by gender, SES, and ethnicity	Yes
Juvonen	No	Diverse	Diverse	11–15	25%	Yes	Yes	Yes	No	Interactions with gender and ethnicity	Yes
Rothon	No	Unknown	Diverse	11–14	25%	Yes	Yes	Yes	Yes	Stratified by gender	Yes
Stavrimides	No	Unknown	Unknown	10–12	0%	No	Yes	Yes	No	Exploratory factor analysis	No
Chen	No	Unknown	Unknown	15–17	0%	Yes	Yes	No	No	No	No

Note: Nat. repres. = nationally representative; Demogr. = demographic; Inter-behav. = inter-behavioral.

a. Minimum controlling for demographic confounders, defined as controlling for gender, age, socioeconomic status (SES).

b. Corrections for confounding applied for correlated/clustering HBSC-behaviors.

c. ML = Multilevel analyses; to account for a hierarchical data structure (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.

TABLE 3
Retrieved Studies: Predictor Measures, Outcome Measures, and Main Finding(s)

Author	Predictor measure(s)	Outcome measure(s)	Main study finding(s)
Tucker	Substance use (smoking, alcohol and marijuana use) 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	Nonsmokers, experimenters, smokers	Grades \geq C	Compared with nonsmokers, early smokers in Grade 7 were more likely to have academic problems (. . .) By Grade 12 experimenters had academic difficulties.
Balsa	Alcohol use	GPA ^a	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.
Bullying/being bullied 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.

(continued)

TABLE 3 (continued)

Author	Predictor measure(s)	Outcome measure(s)	Main study finding(s)
Juvonen	Modified Peer Victimization Scale	GPA	Being bullied affected students' poor grades negatively.
Norris	Christie-Metzel BULLY BEHAVIOR SCALE	PIAT score ^b	Only in combination with excessive Internet use did bullying/being bullied affect students' grades.
Rothon	Olweus Bully-Victim Score	GLES Score > 5 ^c	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 onset sexual intercourse (<10 years)	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 score ^d ; GPA	Negative association with non-school-related activities such as sports participation.
Coe	Self-reported physical activity	GPA construct; Terra Nova Scores ^e	Vigorous physical activity patterns led to improved grades.

(continued)

TABLE 3 (continued)

Author	Predictor measure(s)	Outcome measure(s)	Main study finding(s)
Crosnoe	Self-reported extracurricular activities	Self-reported GPA	Positive relation of sports participation and academic performance.
McNulty Eitle (2005)	Self-reported sports participation	Standardized test scores	Positive effects of sports participation on grades.
McNulty Eitle (2002)	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.
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 Gentile	(video game playing, Internet use, and watching television) 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; GPA	Study shows a negative relationship between video game playing and watching TV and academic performance.

(continued)

TABLE 3 (continued)

Author	Predictor measure(s)	Outcome measure(s)	Main study finding(s)
Norris	Hours/week gaming and Internet use	PIAT score	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	Self- and parental grade reporting	Adverse effects for both behaviors on school performance, mostly due to increased sensation seeking behavior.
Smith	Hours/week watching TV	Several standardized test scores	Effects depended on (parental) SES: students with higher SES are negatively affected on their academic performance by excessive television watching, whereas the associations are significant for better grades in low SES students.

a. GPA stands for Grade Point Average.

b. Peabody Individual Achievement Test.

c. General Certificate of Secondary Education Examinations.

d. National Center for Education Statistics Item Response Theory Score.

e. National Standardized Test Score for Educational Performance.

TABLE 4
Health Behavior and School Grades: Specific Main Study Effects

Study	Follow-up ^a	Predictor measure(s)	Outcome measure(s) and range	Main study effect(s) ^b
Substance use (smoking, alcohol and marijuana use)				
Tucker	10 years	Smoking vs. not smoking	GPA ^c	$\beta = -.12^*$
Penner	2 years	Never smoked (1), <1/month (2), >1/month (3), >1/week (4)	GPA on 6-point scale	Standardized correlation coefficient: .24**
Ellickson	5 years	Nonsmokers (1), experimenters (2), regular smokers (3)	Grades \geq C	OR 2.00–3.00*
Balsa	1 year	Alcohol use: (1) >100 drinks/month, (2) monthly binge drinking	GPA	>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] Very early vs. early users: OR 2.29 [1.64, 3.19]*
Peleg-Oren	1 year	Alcohol use: Nonusers (1), early users, <age 13 (2), very early users \geq age 13 (3)	GPA, <C	Very early users vs. nondrinkers: OR 3.22 [2.02, 5.10]* Binge drinking: Girls: $B = -.08$ [SE .06] Boys: $B = -.12$ [SE .05]*
Sabia (2009)	1 year	Alcohol use: Binge drinking >2/month (not = 0, yes = 1)	Overall GPA construct; 4-point range	Boys: Nonathletes: $\beta = -.01$ [SE .05] Athletes: $\beta = .07$ [SE .03]* Girls: Nonathletes: $\beta = .01$ [SE .02] Athletes: $\beta = .07$ [SE .03]*
Crosnoe	3 years	By athletic status and gender	GPA, 4-point range	

(continued)

TABLE 4 (continued)

Study	Follow-up ^a	Predictor measure(s)	Outcome measure(s) and range	Main study effect(s) ^b
Bullying/being bullied				
Beran	1 year	Being bullied	GPA	Unable to retrieve direct effect
Forrest	2 years	Being bullied: low bully victim score	State Achievement Test	Not being bullied: $\beta = 1.70^{***}$
Juvonen	6 months	Being bullied	Overall GPA construct	Being bullied: $\beta = -.03$ [SE .01]*
Norris	2 years	Bullying: Bullying score	PIAT Math Test Score ^d	Being bullied: $B: .00$ [SE .00]
Rothon	2 years	Being bullied	PIAT Vocabulary Score	Being bullied: $B: .00$ [SE .00]
Stavrinides	6 months	(1) Being bullied, (2) Bullying	Grades \geq D	Being bullied: OR 46 [.28-.76]**
			Overall achievement score	Being bullied: $\beta = -.23^*$
				Bullying: $\beta = -.55^{**}$
Sexual behavior				
Resnick	5 years	Early onset sexual intercourse (<10 years)	Below average GPA	Boys: OR 1.47*, Girls: not sign/reported
Schvaneveldt	6 years	Sexually active yes/no	GPA	$\beta = -.35^*$
Sabia (2007)	5 years	Sexually active yes/no	GPA	Boys: $\beta = -.20^*$, Girls: $\beta = -.17$
Tubman	2 years	Age of first sexual intercourse	GPA, 7-point range	Significant correlation***
Physical activity				
Broh	2 years	Sports participation: (1) interscholastic, (2) intramural	Standardized Math Test Scores	Interscholastic: $B = .06$ [SE .01]***
			Standardized Reading Test Scores	Intramural: $B = -.067$ [SE .02]***
			Math grades	Interscholastic: $B = -.096$ [SE .03]***
			English grades	Interscholastic: $B = .111$ [SE .02]***
				Intramural: $B = -.194$ [SE .04]***
				Interscholastic: $B: .141$ [SE .02]***
				Intramural: $B = -.193$ [SE .03]***
Dumais	2 years	Hours of sports/week	GPA	Hours sports/week: $B = -.02$ [SE .00]***
			NCES IRT score, 9-point range ^e	Hours sports/week: $B = -.30$ [SE .030]***

(continued)

TABLE 4 (continued)

Study	Follow-up ^a	Predictor measure(s)	Outcome measure(s) and range	Main study effect(s) ^b
Coe	1 year	Sports participation: low (1), medium (2), vigorous (3)	(1) Overall GPA construct (2) Terra Novae scores GPA, 4-point range	Low to vigorous activity: +10% in test scores (1) and grades (2); not significant
Crosnoe	3 years	Sports participation by gender: male nonathletes are the reference category		Boys athletes: $\beta = .09$ [SE .04]* Girls: Nonathletes: $\beta = .10$ [SE .04]** Girls: Athletes: $\beta = .18$ [SE .04]*** GPA: Football OR 1.03
McNulty Eitle (2002)	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 points [M 50.25 points, SE 0.25]	Basketball OR 1.71*** Other OR 1.51*** Test score: Football: OR .99 Basketball OR .98*** Other: OR: 1.00
McNulty Eitle (2005)	2 years	Team and individual sports participation	Standardized test scores in Math Standardized test scores in science Standardized test scores in reading	Team sports: boys: $B = 1.21$ [SE .57]** Team sports: girls: $B = 1.49$ [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 0.51] Team sports: girls: $B = .68$ [SE 0.43] Indiv. sports boys: $B = .08$ [SE .57] Indiv. sports girls: $B = .55$ [SE .41]

(continued)

TABLE 4 (continued)

Study	Follow-up ^a	Predictor measure(s)	Outcome measure(s) and range	Main study effect(s) ^b
Hanson	2 years	Sports participation	GPA	Sports participation: Boys: $\beta = .06^{**}$ Sports participation: Girls: $\beta = -.06^{*}$
Miller	2 years	Sports participation	GPA, 7-point range	Sports participation: Boys: $\beta = -.09$ Sports participation: Girls: $\beta = .12^{**}$
Nelson	1 year	Physical activity, >5 times/week	Last grade in math: an A Last grade in English: an A	RR 1.08 [1.01, 1.15]* RR 1.06 [.99, 1.13]
Nutrition Chen	1 year	Breakfast attendance	GPA ranking on Math GPA ranking on Chemistry	Correlation coefficient: .48** Correlation coefficient: .49**
			GPA ranking on Chinese GPA ranking on Chem-lab	Correlation coefficient: .47** Correlation coefficient: .44
			GPA ranking on Anatomy	Correlation coefficient: .42**
			GPA ranking on English	Correlation coefficient: .48**
Screen time (video game playing, Internet use, and watching television) Gentile	2 year	Compulsive gaming: GPA difference compulsive gamers and other students	GPA: (1) 1 year follow-up (2) 2 year follow-up Grades \geq D	(1) GPA difference: $B = -0.48^{*}$ (2) GPA difference: $B = -0.41^{*}$ OR 1.64 [1.08–2.46]*
Johnson	8 years	Watching TV: <1 hr/day versus >3 hr/day		
Dumais	2 years	Hours/week: (1) (online) gaming, (2) watching TV	NCES IRT-score, 9-point range GPA	Gaming: $B = -.42$ [SE .10]*** TV: $B = -.71$ [SE .08]*** Gaming: $B = -.04$ [SE .01]*** TV: $B = -.02$ [SE .01]***

(continued)

TABLE 4 (continued)

Study	Follow-up ^a	Predictor measure(s)	Outcome measure(s) and range	Main study effect(s) ^b
Norris	2 years	Internet use: (1) E-mail, (2) chatting, (3) games, (4) surfing	Standardized PIAT Math score	E-mail: $\beta = .00$ [<i>SE</i> .00] Chatting: $\beta = -.01$ [<i>SE</i> .00]* Surfing: $\beta = .00$ [<i>SE</i> .00] Games: $\beta = .00$ [<i>SE</i> .00]
			Standardized PIAT Vocabulary score	E-mail: $\beta = .01$ [<i>SE</i> .00] Chatting: $\beta = -.01$ [<i>SE</i> .00]* Surfing: $\beta = .00$ [<i>SE</i> .00] Games: $\beta = .00$ [<i>SE</i> .00]
Sharif	2 years	Hours/week: (1) (online) gaming, (2) watching TV	School performance: (1) excellent, (2) good, (3) low	Gaming: $\beta = .10$ *** Watching TV $\beta = .13$ ***
Smith	2 years	Hours/week watching TV	GPA Overall GPA Reading GPA Math GPA Language	<i>B</i> $-.03$ [<i>SE</i> 0.05] <i>B</i> $-.11$ [<i>SE</i> 0.07] <i>B</i> $.17$ [<i>SE</i> 0.09] <i>B</i> $.07$ [<i>SE</i> 0.09]

Note: All effects were presented with their 95% confidence intervals (in case of odds ratios [ORs]) or with their respective *p* value (in case of *B*s or Betas) where possible. Effects that lack these specifications were presented as such due to lacking information in the original papers.

a. 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.

b. *B* =standardized effect measure; β = unstandardized effect measure.

c. Grade Point Average; by default this measure is indicated by a 5-point range, since most studies used this measure.

d. Peabody Individual Achievement Test.

e. General Certificate of Secondary Education Examinations.

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

significantly lowered the grade point average (GPA; a commonly used metric for school achievement in North America) for boys, although with relatively small effect sizes, whereas no such associations were found for girls (Balsa et al., 2011). In addition, findings revealed that interbehavioral confounding often arises when clustered behaviors (e.g., smoking, alcohol use, and drug use) are analyzed without using multibehavioral analyses; then, effects are likely to be overestimations of true effects (Sabia, 2009).

Most investigators explained the relationship between alcohol use and academic performance in terms of social exchange theory (SET; Emerson, 1976). Simplified, this theory states that certain behaviors or actions are driven by the reciprocal benefit that one gains from them. 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, whereas other effects of alcohol use impaired their school performance; the net outcome was a negative effect on alcohol users' grades. Other investigators explained their findings using another theory, social capital theory (SCT; Coleman, 1988). 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 (1988) put it, "Just as physical and human capital facilitate productive activity, social capital does as well" (p. S101). In the study by Crosnoe (2002), this theory was used to illustrate that alcohol use results in a trade-off balancing a student's relatedness to school with popularity and stronger relationships with peers (Crosnoe, 2002). Overall, all four studies reported alcohol use adversely affects the academic performance of adolescents.

Three studies investigated the effects of smoking on school grades (Ellickson et al., 2001; Pennanen, Haukkala, de Vries, & Vartiainen, 2011; Tucker, Martinez, Ellickson, & Edelen, 2008). Although the study's samples were ethnically and socio-economically diverse, they were not representative. Attrition at follow-up was in the average range (20% to 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 affect students' grades adversely, 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 combined substance use alongside smoking and alcohol (Crosnoe, 2002).

Sports and Physical Activity

Nine studies investigated the effects of physical activity on students' grades (Broh, 2002; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Crosnoe, 2002; Dumais, 2008; McNulty Eitle, 2005; McNulty Eitle, 2002; Hanson & Kraus, 1998; Miller, Mellnick, Barnes, Farrell, & Sabo, 2005; Nelson & Gordon-Larsen, 2006). These were all relatively large studies that involved nationally representative samples of adolescents, with the exception of two (Coe et al., 2006; Miller et al., 2005). These latter two were much smaller studies and not nationally representative. All studies investigated the effects of potential modifiers such as SES, gender, race, and self-esteem measures. Only one study used multibehavioral analyses to account for possible confounding of interbehavioral correlations with several unhealthy behaviors (Dumais, 2008), and only one used a multilevel structure to account for the nested data structure (McNulty

Eitle, 2005). Loss to follow-up varied substantially across studies, from 7% (Coe et al., 2006) to 61% (Hanson & Kraus, 1998; 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 that sports participation had a positive impact on students' school grades (Coe et al., 2006; Dumais, 2008; Hanson & Kraus, 1998; Miller et al., 2005). However, with the exception of Coe et al. (2006), none found a simple, straightforward association between greater participation in sports and better grades. For example, Broh (2002) found interscholastic sports to have a more pronounced effect on school grades than intramural sports or cheerleading, whereas McNulty Eitle and Eitle (2002) and Hanson and Kraus (1998) found significant interaction effects between grades and gender, ethnicity, and especially SES, interactions that modified the association between sports participation and academic performance. These investigators found White, upper-class female athletes' grades benefitted the most from sports participation. In a follow-up study, similar interactions were demonstrated, but these were less consistent than in the original study (McNulty Eitle, 2005).

Thus, most researchers 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 (Broh, 2002). Such networks may create beneficial social capital through the acquisition of new information, resources, opportunities, and networks, which in turn may improve students' academic performance (Broh, 2002; Dumais, 2008). "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" (Dumais, 2008, p. 884). Researchers concluded that the social network was 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 (Broh, 2002; Dumais, 2008; McNulty Eitle, 2005; McNulty Eitle & Eitle, 2002).

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 did (Broh, 2002), strengthening confidence in an SCT-based explanation of effects. Additionally, the physiological explanation—that students who exercise during the school day are more aroused, and thus concentrate more and have an increased attention span to benefit performance—was not supported by the studies that differentiated among types of sports, because similar activity levels resulted in different effects on academic performance, although one would expect *all athletic students* to show similar improvements (Broh, 2002; Dumais, 2008; Hanson & Kraus, 1998). Finally, the differing effects seen in different SES groups (Hanson & Kraus, 1998) or in males and females (McNulty Eitle & Eitle, 2002) made for an even stronger case for the socialization explanation.

Nutrition

Only one study investigated the effects of healthy nutrition on school grades (Chen & Liao, 2002). 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 bullying behaviors (i.e., bullying or being bullied) on school grades (Beran & Lupart, 2009; Forrest, Bevans, Riley, Crespo, & Louis, 2012; Juvonen, Yueyan, & Espinoza, 2011; Norris, 2010; Rotheron, Head, Klineberg, & Stansfeld, 2011; Stavrinides, Georgiou, Nikiforou, & Kiteri, 2011). These studies all had small to modest sized samples, although all but one (i.e., Beran & Lupart, 2009) had a diverse, but not nationally representative, population of teenagers regarding SES and ethnicity. One study did not include a description of the participants' demographic characteristics (Stavrinides et al., 2011). All six studies had relatively low attrition at follow-up (0% to 25%), and all emphasized studying causal pathways by studying interactions with gender (Forrest et al., 2012; Juvonen et al., 2011; Rotheron et al., 2011), SES (Forrest et al., 2012), and psychosocial problems (Beran & Lupart, 2009; Stavrinides et al., 2011).

The authors of all six studies concluded that bullying behaviors affected school grades. Most analyzed direct effects of this relationship and indirect effects via mediation by psychosocial problems. Although revealing, these characteristics make it difficult to compare the effects of bullying to the effects of other behaviors. Two studies indicated that bullying behaviors did not *directly* influence academic performance (Beran & Lupart, 2009; Forrest et al., 2012). Instead, the adverse effects of bullying on academic achievement resulted from mediation by psychosocial problems. In these studies, bullied adolescents obtained lower grades than their nonbullied peers, because they exhibited more emotional problems, conduct problems, and hyperactivity, and had fewer prosocial 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 poorly academically when being bullied (Beran & Lupart, 2009; Forrest et al., 2012; Stavrinides et al., 2011). Social stressors and depressive symptoms were also found to be mediators of this association (Juvonen et al., 2011; Rotheron et al., 2011).

Two studies even showed that just the fear of being bullied adversely affected the relationship with teachers and peers (Beran & Lupart, 2009; Forrest et al., 2012). This avoidance and mistrust have 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 these studies suggested that bullying 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 (Juvonen et al., 2011; Rotheron et al., 2011).

In summary, evidence showed that being bullied can 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 articles studied the effect of early sexual activity on school grades and all reported negative effects (Resnick & Blum, 1994; Sabia, 2007; Schvaneveldt, Miller, Berry, & Lee, 2001; Tubman, Windle, & Windle, 1996; see Table 4). All

studied representative populations except one, which used a restricted population regarding SES and ethnicity (Tubman et al., 1996). All four sets of authors performed gender-specific analyses, with one also using age-specific stratified analyses and multilevel models (Sabia, 2007); this last study was also the largest study ($N > 27,000$ vs. 1,145–1,806 participants in other studies; see 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 is more complex than a straightforward, negative causal effect; they studied explanations by third factors, such as other health-related behaviors, SES, race, and family conditions. One of the studies reported possible confounding by other, related psychosocial and behavioral problems, such as alcohol use and delinquency. Tubman et al. (1996) opined,

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. (p. 341)

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 environments, these behaviors were less related to a decrease in school grades, because interest in academic performance was already lower in these groups. Tubman et al. (1996) concluded that SES and social environment (e.g., peer groups and family support) explained most of the observed associations between early sexual activity and school grades.

Consistent findings were reported by two other studies that also concluded these social factors confound the relationship between early sexual intercourse and school grades (Resnick & Blum, 1994; Schvaneveldt et al., 2001). 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 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. (1996). 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. For these students, sexual intercourse initiation hardly changed their perception of the *value* of good school grades, and thus, sexual activity had the smallest effect on school grades. This outcome was most evident among Black, low-SES males, who had the most negative view about the educational and occupational opportunities open to them in the United States; White, high-SES females were on the other end of this spectrum (Schvaneveldt et al., 2001).

The findings of the three smaller studies were generally confirmed in the one study (Sabia, 2007) that was much larger than the others on the topic. Sabia found

that the effect of sexual initiation was substantially reduced in terms of effect size and statistical significance when a multibehavioral approach was applied with correction for social factors. The gender differences identified in the other studies could also be explained in part by underlying socioeconomic constructs and the perceived benefits that intercourse initiation offers in contrast to higher school performance (Sabia, 2007).

Watching Television, Playing Video Games, and Internet Use: Screen Time Behaviors

Screen time behaviors were also shown to have complex effects on school grades (Dumais, 2008; Gentile et al., 2011; Johnson, Cohen, Kasen, & Brook, 2007; Norris, 2010; Sharif, Wills, & Sargent, 2010; Smith, 1992; see Table 4). The six studies on this topic all had socioeconomically and ethnically diverse study populations with average losses at follow-up of 12% to 30%, although one study did not provide these data (i.e., Norris, 2010). All studies included corrections for confounding by age, SES, and gender, and statistical analyses included application of multilevel models (Gentile et al., 2011; Norris, 2010) and corrections for possible interbehavioral confounding (Gentile et al., 2011; Sharif et al., 2010). In addition, three also looked at possible interaction effects with other health behaviors, SES, and psychosocial problems (Norris, 2010; Sharif et al., 2010; Smith, 1992).

First, excessive television watching was associated with developing attention problems, learning difficulties, and adverse long-term educational outcomes (Johnson et al., 2007). Adolescents that watched one 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 three 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 (Johnson et al., 2007; Smith, 1992). Both studies showed similar mediating effects of the screen content; entertainment content affected grades negatively whereas educational content improved them. Eventually, though, watching television had a net negative overall effect due to the more frequent watching of entertainment (Johnson et al., 2007; Smith, 1992).

Second, playing video games and Internet use showed similar complex effects. Certain online behaviors (e-mailing) stimulated grades, whereas others (chatting) negatively affected them (Norris, 2010). 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 situation was hypothesized to facilitate the socialization and emotional development of adolescents: "Most games require some level of literacy and critical thinking skills to successfully navigate fields within the game, and master progressive levels" (Norris, 2010, p. 78). Similar effects were reported for Internet use. Particularly, 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” (Norris, 2010, p. 77).

Thus, the effects of screen time should be interpreted in light of media content and activity (Gentile et al., 2011; Sharif et al., 2010). 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 (Gentile et al., 2011; Sharif et al., 2010). Effect sizes were comparable with those of factors such as SES and parenting style, which have previously been found to strongly influence school performance (Sharif et al., 2010).

Multibehavioral 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 nonathlete 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—that is, it protected against substance use (Crosnoe, 2002). Another example concerned the combined effects of bullying, Internet use, and playing video games on academic performance. *Just* being bullied did not have a direct significant effect, but it did when excessive Internet use was included as a mediating variable in the association with school performance (Norris, 2010).

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 early sexual activity, alcohol use, smoking, bullying, and screen time had more complex relationships with academic achievement. Moreover, in general, these effects were not straightforward but interacted with or were mediated by factors such as SES and psychosocial problems.

Only a healthy nutritional pattern was positively associated with higher grades in a straightforward way (Chen & Liao, 2002). However, Chen and Liao also conducted the least sophisticated statistical analyses. In short, they only used correlations and did not correct for demographic factors or other potential confounders. As other studies showed that SES and psychosocial problems often affect the association between health-related behaviors and academic performance, Chen and Liao’s findings should be interpreted with caution.

The effects of smoking and alcohol use were predominantly studied without much regard to theoretical explanations. However, most authors seem to agree that these behaviors were not direct causes of poorer school grades, but instead were a proxy for an underlying psychosocial context that caused both. Although 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. 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, multibehavioral analyses (Balsa, 2011; Sabia, 2009).

This finding 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 support for this hypothesis (Sabia, 2007; Schvaneveldt et al., 2001). The results of studies on early sexual activity also suggested that SES and social environment caused the effects on school grades rather than being sexually active. The largest study on the topic with the most advanced statistical methods showed the weakest direct effects of early sexual intercourse on school grades, with most of the association being explained by social and socioeconomic factors (Sabia, 2007). Even though marijuana use is widespread among adolescents and is a potential public health problem (Fergusson & Boden, 2008), no studies were identified that primarily investigated the effect of this substance on school performance.

The effects of bullying behaviors, sports participation, and screen time on school performance were also complex and dependent on social context factors. The effects of bullying 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 (Gentile et al., 2011; Norris, 2010). 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.

Sociological Explanations for the Effects of Health-Related Behaviors on School Grades

Most authors interpreted their findings using SCT or 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 relationship by showing that participation in team and school sports strengthened bonds with school personnel, raised social status, provided entry into elite peer groups, and raised aspirations for college attendance, whereas participation in individual sports did not have these effects and was negatively related to school grades (Crosnoe, 2002; McNulty Eitle & Eitle, 2002). Thus, researchers 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 (Crosnoe, Muller, & Frank, 2004). Whether the trade-off is

termed social capital or the process is described as a social exchange, most studies seemed to support the idea of this underlying mechanism.

However, certain behaviors happen to the individual rather than as a result of action by the individual, such as being bullied. In such instances SCT or SET do not seem to explain the relationship with achievement. Social bonds theory (SBT) provides a better explanation 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 that "include attachment to families, commitment to social norms and institutions (school, employment), involvement in activities, and beliefs that these things are important" (Hirschi, 1969, p. 16).

In contrast, *detachment* from societal or group norms is thought to be the case in bullied teens. Hirschi (1969) emphasized that adolescence is a critical period in one's life for forming social bonds, and peer relations in adolescence are among the most vital in determining the outcome of normal socialization and functioning at school. Bullying may damage these processes and can result in a student not considering school as important. Overall, the effects of social interactions and health-related behaviors on academic performance seem strongly connected. However, SBT was not explicitly used to explain these findings in the studies on bullying and academic performance. Therefore, this explanation is only provided here as an illustrative example that 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. These factors also explained most of the interactions with gender and race that were sometimes found. Researchers concluded that what is considered *normal* behavior differs by SES. These differences were especially apparent regarding the effects of early sexual intercourse or substance use on school grades. These studies showed that social factors such as what students expect school to bring them in the future, having a supporting family environment, their acceptance and social status by and within peer groups, and what they consider to be normal were strong mediators of the relationship between health behavior and school grades. Moreover, these factors differed across SES groups (Tubman et al., 1996).

These effects were found both in studies with ethnically and geographically restricted samples and in studies with large, nationally representative study populations. Unhealthy behaviors had smaller effects on school performance on students with a lower SES, because these students "had less to lose," whereas healthy behaviors, such as more team sports participation, had a larger effect in these same teenagers. The generalizability of these findings gives them more weight and also supports the explanations provided by the 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 include the breadth of research fields investigated and the inclusion of only longitudinal studies. Longitudinal studies 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 of school grades as the single measure of adolescents' academic performances is a potentially problematic one, as it narrows the focus of the study to one specific type of educational outcome measure, whereas others (such as truancy or dropout rates) might also be interesting.

In addition, using a single measure such as school grades does not guarantee completely unbiased results, since the association between behaviors and school grades is likely to be affected by different social and school factors (Tobler, Komro, Dabroski, Aveyard, & Markham, 2011). However, the decision to include this single outcome did allow for better cross-study comparisons and increases confidence in the findings. Another weak point is that only marijuana was included as an indicator of substance use. Although marijuana is the most common drug used by adolescents worldwide, other drugs should also be investigated in future studies. Finally, although the behaviors investigated in this study are recognized internationally as important health-related behaviors, other behaviors may be important in certain specific countries and regions.

Directions for Future Research

As only 30 longitudinal studies were found 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. As 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 also include teenagers' psychosocial contexts to properly study possible 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 multibehavioral approach. This review showed that such comprehensive multi-health behavioral studies are valuable, as it is increasingly recognized that many health-related behaviors cluster together. Studies should include multibehavioral models and researchers should use multilevel models to account for the hierarchical data structure that is often present in large studies of this type. The use of these more sophisticated models 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 often results false *significant* results simply because the estimates of standard errors will be too small (Hox, 2010). 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 studies included in this review are examples of good practices in 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 samples that are sufficiently diverse on these factors. Sample diversity should be combined with multibehavioral measurements and multilevel analysis models. Taken together, these would make for promising research studies that may allow researchers to unravel the causal mechanisms between health behavior and academic performance in teenagers.

APPENDIX

Example of a Search String in PubMed^a

	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 behavior,” “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”

a. 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.

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