

The Association between Leisure Time Physical Activity and Smoking in Adolescence: An Examination of Potential Mediating and Moderating Factors

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Background: Although physical activity has been associated negatively with smoking in adolescence, the association is not well understood. **Purpose:** This study examines the relationship between adolescents' leisure time physical activity and smoking behavior, while considering BMI, weight concern, sense of coherence, and physically active self-concept as potential mediating and moderating variables. **Method:** Data were obtained through a postal survey among 3,940 Danes aged 16 to 20. Bivariate and multivariate logistic regressions were performed to identify significant associations as well as mediating and moderating effects. **Results:** In the bivariate model, leisure time physical activity was negatively associated with smoking; adolescents who were active at least one hour per week were up to half as likely to smoke as inactive adolescents. In the adjusted model, however, the association disappeared. Further analyses revealed that physically active self-concept acted both as a mediator and as a moderator of the studied relationship. **Conclusion:** The data suggest that participation in leisure time physical activity is indeed inversely associated with adolescent smoking, but only when physical activity is perceived as an important part of the self. Hence, interventions designed to promote physical activity among youth may also aim to boost physically active self-concepts.

Key words: adolescence, physical activity, smoking, mediation, moderation, self-concept

Smoking and physical inactivity are behaviors of primary public health concern. The harmful effects of tobacco on people's health are well documented, and it is estimated that worldwide about five million deaths can be attributed to smoking on a yearly basis (Ezzati & Lopez, 2003). Physical activity, on the other hand, has proved to have important beneficial effects on health in terms of aerobic fitness, blood pressure, body composition, and mental health (Amisola & Jacobson, 2003; Boreham, Twisk, Savage, Cran, & Strain, 1997).

It has been suggested that engagement in physical activity may serve as a protective factor for smoking in adolescence (Aaron et al., 1995; Audrain-McGovern,

Rodriguez, & Moss, 2003). Hence, physical activity may improve health not only directly but also through its protecting effect on smoking. However, research investigating the association between physical activity and adolescent smoking has yielded contradictory findings (Sallis, Prochaska, & Taylor, 2000; Wankel & Sefton, 1994). Furthermore, a sound explanation of the potential mechanism through which participation in physical activity may affect smoking behavior is lacking (Audrain-McGovern et al., 2003).

Although several cross-sectional studies have demonstrated a negative correlation between physical activity and the use of tobacco in adolescents (e.g., Melnick, Miller, Sabo, Farrell, & Barnes, 2001; Pate, Heath, Dowda, & Trost, 1996; Wilson et al., 2005), a couple of review studies show that not all evidence points in this direction (Sallis et al., 2000; Wankel & Sefton, 1994). For instance, Sallis et al. (2000) found that out of 15 studies that examined smoking as a correlate of physical activity, six studies showed a negative correlation while nine studies found no significant association. As Bauman, Sallis, Dzewaltowski, and Owen (2002) and Sallis et al. (2000) argue, the inconsistency in findings might be due to methodological differences between studies. In particular, the decision

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This research was conducted with financial support from the Danish National Board of Health and the Danish Cancer Society.

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whether or not to adjust for “third variables” may affect results.

The relationship between adolescent physical activity and smoking has been shown to be rather complex, with many potential mediating and moderating factors involved. While moderating factors may obscure an association because they change the effect of a predictor on the outcome variable, mediating variables may explain the association by accounting for the influence of the predictor on the outcome variable (Baron & Kenny, 1986). Examination of data for potential mediating factors may thus be necessary to obtain an accurate understanding of the relationship between physical activity and smoking (Bauman et al., 2002). In addition, research on moderating effects is needed to pinpoint the conditions under which physical activity exerts its effect on smoking. However, many studies have reported merely bivariate correlations, thereby ignoring the role of mediators and moderators (e.g., Melnick et al., 2001; Pate et al., 1996; see also Kremers, De Bruijn, Doormers, Van Lenthe, & Brug, 2007).

The purpose of the present study was to take a closer look at the association between leisure time physical activity and cigarette smoking in adolescence by taking into account various individual variables that possibly mediate and/or moderate the association. These variables, i.e., body mass index (BMI), weight concern, sense of coherence, and physically active self-concept, were included since they could be expected to play a role in the relationship between physical activity and smoking.

Greater participation in physical activity has been associated with lower BMI and less weight concern among youth (Gillison, Standage, & Skevington, 2006; Janssen et al., 2005; Levin, Lowry, Brown, & Dietz, 2003; Neumark-Sztainer, Paxton, Hannan, Haines, & Story, 2006). In turn, weight concern and, to a lesser degree, a higher BMI have been linked with increased smoking, especially among girls (Boles & Johnson, 2001; Camp, Klesges, & Relyea, 1993; French, Perry, Leon, & Fulkerson, 1994; Potter, Pedersen, Chan, Aubut, & Koval, 2004). Hence, participation in physical activity might prevent smoking due to its favorable effect on body weight. A moderating role for BMI and weight concern could also be proposed. Physically active adolescents with weight problems might be more likely to smoke than their active peers without weight concerns since they may use smoking as an additional mean to control weight.

Sense of coherence is another personal variable that has been linked to both physical activity and smoking. Like other indicators of poor psychological well-being, such as depressive mood and low-self-esteem, a low sense of coherence has been associated with higher levels of smoking (e.g., Glanz, Maskarinec, & Carlin, 2005) and lower levels of physical activity (Brown & Blanton, 2002; Hassmen, Koivula, &

Uutela, 2000). Hence, a mediating role of sense of coherence could be expected in the way that participation in physical activity will increase adolescents' sense of coherence, which in turn may reduce smoking behavior.

Finally, adolescents' self-concept regarding physical activity has been put forward as a variable that may link physical activity and smoking. Research has demonstrated that adolescents who identify themselves as a “jock” or “sporty” are less likely to engage in smoking (LaGreca, Prinstein, & Fetter, 2001; Verkooijen, de Vries, & Nielsen, 2007). Moreover, Rodriguez and Audrain-McGovern (2005) found that adolescents' global physical self-concept (i.e., an overall estimation of the physical self, including physical appearance and competence) served as a mediator in the physical activity and smoking relationship. Thus, leisure time physical activity may contribute to a physically active self-concept, which then keeps adolescents from smoking.

The present study employs cross-sectional survey data from a large sample of Danish adolescents to examine the association between leisure time physical activity and cigarette smoking, while exploring the above-mentioned potential mediating and moderating variables.

Methods

Sample and Procedures

In autumn 2002, self-administered data were collected as part of Monitoring of Unges Livsstil og Dagligdag [MULD: Monitoring of Young People's Lifestyle and Daily Life], a national cross-sectional survey that targets Danish adolescents aged 16 to 20. The protocol for this survey was approved by the Danish Data Protection Agency. Participants for the survey were randomly selected from the Danish Population Register using date of birth as the selection criterion. Questionnaires, along with a letter of information and a pre-stamped return envelope, were sent to the home addresses of 6,000 adolescents. In order to enhance the response rate, a lottery was linked to participation. In addition, reminders were sent to non-responders; a first reminder was sent out after two weeks and a second reminder, accompanied with a new questionnaire, after four weeks. Eventually, 3,956 completed questionnaires were received (response rate = 67%). Data of 16 people were excluded because of missing data on gender or age, leaving a sample of 2,211 females (56%) and 1,729 males (44%). The mean age was 18.0 (SD = 1.42). The majority of the respondents were Protestants (70%), 20% reported to be not religious, and 3.4% were Muslim. About three out of four respondents (77%) were attending school.

Measures

The questionnaire comprised 16 pages, with 80 questions in all, and covered a broad spectrum of health- and lifestyle-related topics. Key variables are described here.

Smoking. Smoking status was assessed with the question: “Do you smoke?” The answer options were yes—daily, yes—at least once a week, yes—less than once a week, and no—I don’t smoke. Respondents were considered to smoke if they indicated to smoke at least weekly (Flay, Hu, & Richardson, 1998; Kremers, Mudde, & De Vries, 2001). Thus, a dichotomous variable for smoking was created by giving a score “1” to the answers yes/daily and yes/at least once a week, and a score “0” to the other answers.

Body Mass Index (BMI). Self-reported height (in cm) and weight (in kg) were used to calculate respondents’ BMI. Respondents were subsequently classified as underweight, normal weight, or overweight using Cole’s international age and gender adjusted BMI cut-off points (Cole, Bellizzi, Flegal, & Dietz, 2000).

Weight concern. Respondents were considered to have weight concerns (i.e., score “1” vs. score “0”) when they answered *no* to the question, “Are you satisfied with your body weight?” and, in addition, indicated an amount as an answer to the next question, “How many kilograms would you like to weigh less?”

Sense of coherence (SOC). A shortened 9-item version of the original 29-item sense of coherence measure (Antonovsky, 1993) was used. Respondents were asked to indicate their agreement (1—totally disagree to 5—totally agree) with statements like: “I feel that what I do in my daily life is meaningful,” and “I believe that I am able to manage most situations that one will experience in life.” Where necessary, scores were recoded such that a higher score always indicated a higher sense of coherence. Because an item analysis revealed that one item lowered the inter-item correlation substantially, a sum-score was calculated, leaving this particular item out (Cronbach’s $\alpha = .77$).

Physically active self-concept (PA self-concept). The extent to which physical activity was perceived as a part of one’s self-concept was assessed by an item that was taken from a study by Sparks & Shepherd (1992) and adapted to the topic of physical activity. Respondents were asked to indicate their agreement (1—totally disagree to 5—totally agree) with the statement “physical activity and sports are an important part of who I am.”

Leisure time physical activity (LTPA). LTPA was assessed with a self-developed question that asked respondents to state how many hours in a typical week they spent on physical activity in their leisure time. It was stressed that this could be any kind of activity—from dance, skateboarding, to organized sports—but should not include physical activity at work, in school, or for transportation. The answers were grouped into four categories: less than 1 hr per week (1), at least 1 but less than 3-1/2 hr per week (2), 3-1/2 to 6 hr per week (3), and more than 7 hr per week (4). The minimum amount of physical activity recommended by the Danish National Board of Health is 30 min a day, which corresponds to 3-1/2 hr per week.

Data Analysis

The data were analyzed with SPSS statistical software. After a descriptive analysis of the key variables, the data were tested for mediation. According to Baron & Kenny (1986), a mediation model is supported when four criteria are met: (1) the predictor variable is significantly associated with the outcome variable, (2) the predictor variable is significantly associated with the mediator, (3) the mediator is significantly associated with the outcome variable while controlling for the predictor, and (4) the significant association between the predictor and the outcome variable is significantly reduced when for the effect of the mediator is controlled. In order to test the first condition, a series of bivariate logistic regressions was conducted with the potential mediators (i.e., BMI, weight concern, sense of coherence, and PA self-concept) as the independent variable and smoking as the dependent variable. In order to test criteria (2), we examined whether variables that were significantly associated with smoking also showed a significant association with leisure time physical activity using bivariate correlations. Finally, to test criteria (3) and (4), a multiple logistic regression model was used, with smoking as the dependent variable and leisure time physical activity, age, and the four potential mediators as the independent variables. In addition, a Sobel test (1982) was conducted to test the significance of the indirect effect in case a potential mediator met all four criteria. This test provides an estimate of the magnitude of the indirect effect and the corresponding *z*-value.

Unlike mediation, there is no need for a moderator to be correlated with either the predictor or the outcome variable. Instead, moderation should show by significant interactions of the predictor and the moderator on the outcome variable (Baron & Kenny, 1986). Thus, in order to establish effect moderation, interaction terms between leisure time physical activity and each of the four studied variables were calculated and tested on their significance in explaining smoking, while controlling for the main effects of these variables.

Table 1. *Statistics by Gender*

	Males			Females			Difference
	M	SD	%	M	SD	%	p-value ^a
Smoking			26.5			25.7	.606
Age	18.02	1.42		18.05	1.41		.351
BMI							<.001
Underweight			1.4			2.4	
Normal weight			81.6			84.8	
Overweight			17.0			12.8	
Weight concern			19.7			53.3	<.001
Sense of coherence	3.47	0.42		3.52	0.42		<.001
PA self-concept	3.52	1.38		3.39	1.35		<.001
LTPA							<.001
< 1 hr/wk			23.1			27.0	
1–3.5 hr/wk			19.3			30.0	
3.5–7 hr/wk			29.9			28.8	
> 7 hr/wk			27.7			14.2	

^aPearson χ^2 test or Fisher’s exact test for comparison of percentages and independent samples *t*-test for comparing continuous variables.

Results

Descriptive Analysis of the Data

Means and standard deviations of the studied variables are presented in Table 1. Smoking was about equally prevalent among males and females (26.5% and 25.7%). With age, the proportion of smokers increased from 18.3% among 16-year-olds to 31.5% among 20-year-olds (data not shown). Even though more males than females were overweight (17% vs. 13%), far more females showed concern about their weight; 53% of the girls and about 20% of the boys indicated that they would like to weigh less. Female respondents scored slightly higher on the sense of coherence scale than males. In contrast, males scored higher on physically active self-concept. Furthermore, self-reported leisure time physical activity was higher among males than females. Twenty-eight percent of the males spent more than 7 hr per week on leisure time physical activity compared to only 14% of the females. Further, 42% of the males did not meet the recommended amount of 3-1/2 hr of physical activity per week compared to 57% of the females.

Logistic Regression Analysis of Smoking

Table 2 presents the outcomes of the logistic regression analyses of smoking. While there was no association with gender, age was positively associated with smoking. The crude, but not the adjusted, odds ratios regarding BMI indicated a significant lower chance of smoking for normal weight adolescents compared to overweight adolescents (crude odds ratio [COR] = 0.78, 95% CI: 0.64, 0.96). Being concerned about

Table 2. *Crude and Adjusted Odds Ratios for Smoking*

Variables	Crude		Adjusted	
	OR	95% CI	OR	95% CI
Gender (female vs. male)	0.96	0.83–1.11	0.96	0.80–1.14
Age	1.19**	1.13–1.25	1.18**	1.12–1.25
BMI				
Overweight	1	–	1	–
Normal weight	0.78*	0.64–0.96	0.88	0.70–1.12
Underweight	0.74	0.42–1.29	0.73	0.39–1.37
Weight concern (yes vs. no)	1.08	0.93–1.25	0.98	0.81–1.19
Sense of coherence	0.59**	0.49–0.69	0.56**	0.47–0.68
PA self-concept	0.68**	0.65–0.72	0.68**	0.63–0.73
LTPA				
< 1 hr/wk	1	–	1	–
1–3.5 hr/wk	0.61**	0.50–0.74	0.94	0.75–1.18
3.5–7 hr/wk	0.62**	0.52–0.76	1.15	0.90–1.45
> 7 hr/wk	0.50**	0.40–0.62	1.11	0.84–1.47

* *p* < .05, ** *p* < .001.

one’s weight, on the other hand, was not associated with smoking status. Sense of coherence showed a strong negative association with smoking (COR = 0.59, 95% CI: 0.49, 0.69), indicating that adolescents with a higher sense of coherence were less likely to smoke. Controlling for the covariables did not affect the association (adjusted odds ratio [AOR] = 0.56, 95% CI: 0.47, 0.68). Also physically active self-concept was inversely related to smoking (AOR = 0.68, 95% CI: 0.65, 0.72). Finally, in the bivariate model, self-reported leisure time physical activity was negatively associated with smoking. Adolescents who were active at least 1 hr per week were almost half as likely to smoke as inactive adolescents (COR = 0.58, 95% CI: 0.50, 0.68). Interestingly, the odds ratios for smoking did not differ substantially among the (higher) activity levels. In the model that controlled for the covariates, however, physical activity no longer showed a significant association with smoking (i.e., AORs approached 1 and were insignificant).

Testing for Mediators of the LTPA-Smoking Association

The disappearance of the association between leisure time physical activity and smoking after controlling for the covariates suggests that one or more of these variables mediated the association. Physically active self-concept was the only variable significantly associated with both leisure time physical activity (Pearson correlation coefficients ranged from 0.50 for females to 0.55 for males, *p*’s < .001) and smoking, and hence was the only variable that qualified as potential mediator. Further analyses revealed that inclusion of physically active self-concept in the regression model indeed caused the reduction of the effect of leisure time physical activity on smoking. Furthermore, the Sobel test (1982) showed a significant mediating effect

of physically active self-concept on the leisure time physical activity and smoking relationship (z value = -11.34 , $p < .001$).

Testing for Moderators of the LTPA-Smoking Association

To test for moderator effects, all possible two-way interactions between leisure time physical activity and the covariables were tested on their significance in explaining smoking. One interaction turned out to be significant, namely between physically active self-concept and leisure time physical activity. A closer examination of the interaction revealed that adolescents who were very active (LTPA = 4) and reported a strong physically active self-concept (PA self-concept > 3) were significantly less likely to smoke (OR = 0.67, 95% CI: 0.45, 0.99) than inactive adolescents (LTPA = 1) with a strong physically active self-concept. However, adolescents who were very active but showed a weak physically active self-concept (PA self-concept < 3) were not less likely to smoke (OR = 1.29, 95% CI: 0.63, 2.62) than inactive adolescents with a weak physically active self-concept.

Discussion

Previous research has provided mixed evidence for a negative association between physical activity and smoking in adolescence (Sallis et al., 2000; Wankel & Sefton, 1994). The current study examined how physical activity relates to current smoking among a sample of 16- to 20-year-old Danes. Moreover, an effort was made to gain a better understanding of the mechanism through which physical activity may affect smoking behavior by considering the potential mediating and moderating roles of BMI, weight concern, sense of coherence, and physically active self-concept.

Consistent with previous studies (e.g., Melnick et al., 2001; Pate et al., 1996; Wilson et al., 2005), the unadjusted data showed an inverse association between leisure time physical activity and smoking. Adolescents who reported to spend at least 1 hr of their leisure time on physical activity per week were about half as likely to smoke compared to adolescents who reported to be less physically active. Interesting to note is that being active more hours a week did not reduce the odds of smoking much further. Thus, it was the sedentary adolescents who stood out from the rest.

The association between leisure time physical activity and smoking disappeared when the covariables were taken into account, which is a sign of mediation effects. Further examination of the data revealed that physically active self-concept operated as the effect mediator. Hence, in line with the findings by Rodriguez and Audrain-McGovern (2005), our data suggest that participation in leisure time physical activity

may have an indirect protective effect on smoking behavior through its effect on adolescents' self-concept. In addition, physically active self-concept appeared to be an effect moderator. When physical activity was not perceived as an important part of the self, higher participation in physical activity was not associated with a lower likelihood of smoking. Hence, a strong physically active self-concept seems to be a precondition for physical activity to be protective of smoking. It should be stressed, however, that the exact causal mechanisms among physical activity, self-concept, and smoking need further support from longitudinal data.

Except for physically active self-concept, the other studied covariables did not appear to effect the association between leisure time physical activity and smoking. Yet, most of these variables showed, as expected, main effects on smoking. Consistent with prior research (Glanz et al., 2005), we found that sense of coherence, an indicator of mental well-being, strongly reduced the odds for current smoking. Furthermore, BMI was associated with smoking behavior in that normal weight adolescents were significantly less likely to be a current smoker than overweight adolescents. In contrast to previous findings (Potter et al., 2004), no evidence was found for a significant association between weight concern and smoking status. Although boys and girls differed substantially on some variables, no moderating effect of gender was found. Boys reported greater participation in physical activity and girls showed more weight concern, but the pattern of relationship between leisure time physical activity and smoking appeared to be similar for both genders.

The present study has some limitations that need to be considered. First of all, the study was to some extent data driven, meaning that other personal variables that might also have been of interest were not available from our data set. Further, the data are based on self-reports and thus sensitive to response bias. Whereas self-reports of adolescents' smoking behavior have shown to be fairly reliable compared to objective measures (Patrick et al., 1994), previous research suggests that adolescents tend to overestimate physical activity in self-reports (McMurray et al., 2004). Also self-reported weight and height have shown not always to be accurate and may lead to an underestimation of the number of overweight respondents (Wang, Patterson, & Hills, 2002). Furthermore, except for the measure of sense of coherence, non-standardized and single-item measures were used to assess the variables of interest. Future research may therefore aim to replicate the present findings with more objective and validated measures. Finally, an important limitation of the present study is its cross-sectional nature. Mediation and moderation processes assume causality; that is, the outcome variable is caused by the predictor and/or mediating variable and not the other way around. However, since the analyses involve data from one point in

time only, causality cannot be determined. Evidence for a protective effect of physical activity on adolescent smoking should be obtained from longitudinal studies.

The current study underscores once again the importance of promoting physical activity among youth. Not only do a large proportion of adolescents not reach the recommended amount of physical activity, which in itself provides adequate reason to encourage activity levels, the present findings also suggest that leisure time physical activity might discourage smoking among adolescents. However, adolescents' self-concept seems to play a vital role here. As our data indicate, participation in leisure time physical activity is associated with less smoking, but only if physical activity is perceived as an important part of the self. Seemingly, young people build self-images around their engagement in physical activity, which in turn may prevent them from getting involved in smoking. This finding agrees with the thinking that a self-concept as a physically active person is incompatible with the self-concept of being a smoker (Escobedo, Marcus, Holtzman, & Giovino, 1993; Melnick et al., 2001). Yet, some adolescents who are physically active appear not to perceive this as a part of their self-image. Possibly, leisure time physical activity among this group is driven by incentives from outside, such as school, parents, or friends, rather than by an internal motivation to be active. As a result, these adolescents may stop being active and be more likely to pursue a smoking career when these external cues fall away (Ryan, Frederick, Lipes, Rubio, & Sheldon, 1997; Vlachopoulos, Karageorghis, & Terry, 2000). Hence, teenagers who are active but who lack a physically active self-image should be regarded as a potential risk group in the design and targeting of health promotion interventions. Identity formation is a key developmental task during adolescence, and involvement in sports and physical activity may contribute greatly to adolescents' identity development (Allender, Cowburn, & Foster, 2006; Melnick et al., 2001). Health promotion efforts should not only aspire to increase activity levels but also aim to enhance and reinforce adolescents' self-perception as a physically active person.

References

- Aaron, D. J., Dearwater, S. R., Anderson, R., Olsen, T., Kriska, A. M., & Laporte, R. E. (1995). Physical activity and the initiation of high-risk health behaviors in adolescents. *Medicine & Science in Sports & Exercise*, *27*, 1639–1645.
- Allender, S., Cowburn, & G., Foster, C. (2006). Understanding participation in sports and physical activity among children and adults: A review of qualitative studies. *Health Education Research*, *21*, 826–835.
- Amisola, R. V., & Jacobson, M. S. (2003). Physical activity, exercise, and sedentary activity: Relationship to the causes and treatment of obesity. *Adolescent Medicine*, *14*, 23–35.
- Antonovsky, A. (1993). The structure and properties of the sense of coherence scale. *Social Science & Medicine*, *36*, 725–733.
- Audrain-McGovern, J., Rodriguez, D., & Moss, H. B. (2003). Smoking progression and physical activity. *Cancer Epidemiology, Biomarkers and Prevention*, *12*, 1121–1129.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173–1182.
- Bauman, A. E., Sallis, J. F., Dziewaltowski, D. A., & Owen, N. (2002). Toward a better understanding of the influences on physical activity. The roles of determinants, correlates, causal variables, mediators, moderators, and confounders. *American Journal of Preventive Medicine*, *23*, 5–14.
- Boles, S. M., & Johnson, P. B. (2001). Gender, weight concerns, and adolescent smoking. *Journal of Addictive Diseases*, *20*, 5–14.
- Boreham, C. A., Twisk, J., Savage, M. J., Cran, G. W., & Strain, J. J. (1997). Physical activity, sports participation, and risk factors in adolescents. *Medicine and Science in Sports and Exercise*, *29*, 788–793.
- Brown, D. R., & Blanton, C. J. (2002). Physical activity, sports participation, and suicidal behavior among college students. *Medicine and Science in Sports and Exercise*, *34*, 1087–1096.
- Camp, D. E., Klesges, R. C., & Relyea, G. (1993). The relationship between body weight concerns and adolescent smoking. *Health Psychology*, *12*, 24–32.
- 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. *British Medical Journal*, *320*, 1240–1243.
- Escobedo, L. G., Marcus, S. E., Holtzman, D., & Giovino, G. A. (1993). Sports participation, age at smoking initiation, and the risk of smoking among U.S. high school students. *Journal of the American Medical Association*, *269*, 1391–1395.
- Ezzati, M., & Lopez, A. D. (2003). Estimates of global mortality attributable to smoking in 2000. *Lancet*, *362*, 847–852.
- Flay, B. R., Hu, F. B., & Richardson, J. (1998). Psychosocial predictors of different stages of cigarette smoking among high school students. *Preventive Medicine*, *27*, A9–A18.
- French, S. A., Perry, C. L., Leon, G. R., & Fulkerson, J. A. (1994). Weight concerns, dieting behavior, and smoking initiation among adolescents: A prospective study. *American Journal of Public Health*, *84*, 1818–1820.
- Gillison, F. B., Standage, M., & Skevington, S. M. (2006). Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behavior: A self-determination theory approach. *Health Education Research*, *21*, 836–847.
- Glanz, K., Maskarinec, G., & Carlin, L. (2005). Ethnicity, sense of coherence, and tobacco use among adolescents. *Annals of Behavioral Medicine*, *29*, 192–199.
- Hassmen, P., Koivula, N., & Uutela, A. (2000). Physical exercise and psychological well-being: A population study in Finland. *Preventive Medicine*, *30*, 17–25.
- Janssen, I., Katzmarzyk, P. T., Boyce, W. F., Vereecken, C., Mulvihill, C., Roberts, C., Currie, C., & Pickett, W. (2005). Health Behaviour in School-Aged Children Obesity Working Group. Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. *Obesity Reviews*, *6*, 123–132.
- Kremers, S. P. J., De Bruijn, G. J., Doormans, M., Van Lenthe, F., & Brug, J. (2007). Moderators of environmental intervention effects on diet and activity in youth. *American Journal of Preventive Medicine*, *32*, 163–172.
- Kremers, S. P. J., Mudde, A. N., & De Vries, H. (2001). Kicking the initiation: Do adolescent ex-smokers differ from other groups within the initiation continuum? *Preventive Medicine*, *33*, 392–401.

- La Greca, A. M., Prinstein, M. J., & Fetter, M. D. (2001). Adolescent peer crowd affiliation: Linkages with health-risk behaviors and close friendships. *Journal of Pediatric Psychology, 26*, 131–143.
- Levin, S., Lowry, R., Brown, D. R., & Dietz, W. H. (2003). Physical activity and body mass index among U.S. adolescents: Youth Risk Behavior Survey, 1999. *Archives of Pediatric and Adolescent Medicine, 157*, 816–820.
- McMurray, R. G., Ring, K. B., Treuth, M. S., Welk, G. J., Pate, R. R., Schmitz, K. H., Pickrel, J. L., Gonzalez, V., Almedia, M. J., Young, D. R., & Sallis, J. F. (2004). Comparison of two approaches to structured physical activity surveys for adolescents. *Medicine & Science in Sports & Exercise, 36*, 2135–2143.
- Melnick, M. J., Miller, M. E., Sabo, D. F., Farrell, M. P., & Barnes, G. M. (2001). Tobacco use among high school athletes and non-athletes: Results of the 1997 Youth Risk Behavior Survey. *Adolescence, 36*, 727–747.
- Neumark-Sztainer, D., Paxton, S. J., Hannan, P. J., Haines, J., & Story, M. (2006). Does body satisfaction matter? Five-year longitudinal associations between body satisfaction and health behaviors in adolescent females and males. *Journal of Adolescent Health, 39*, 244–251.
- Pate, R. R., Heath, G. W., Dowda, M., & Trost, S. G. (1996). Associations between physical activity and other health behaviors in a representative sample of U.S. adolescents. *American Journal of Public Health, 86*, 1577–1581.
- Patrick, D. L., Cheadle, A., Thompson, D. C., Diehr, P., Koepsell, T., & Kinne, S. (1994). The validity of self-reported smoking: A review and meta-analysis. *American Journal Public Health, 84*, 1086–1093.
- Potter, B. K., Pederson, L. L., Chan, S. S., Aubut, J. A., & Koval, J. J. (2004). Does a relationship exist between body weight, concerns about body weight, and smoking among adolescents? An integration of the literature with an emphasis on gender. *Nicotine and Tobacco Research, 6*, 397–425.
- Rodriguez, D., & Audrain-McGovern, J. (2005). Physical activity, global self-concept, and adolescent smoking. *Annals of Behavioral Medicine, 30*, 251–259.
- Ryan, R. M., Frederick, C. M., Lepes, D., Rubio, N., & Sheldon, K. M. (1997). Intrinsic motivation and exercise adherence. *International Journal of Sport Psychology, 28*, 335–354.
- Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine & Science in Sports & Exercise, 32*, 693–975.
- Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhardt (Ed.), *Sociological methodology* (pp. 290–312). San Francisco: Jossey-Bass.
- Sparks, P., & Shepherd, R. (1992). Self-identity and the theory of planned behavior: Assessing the role of identification with “green consumerism.” *Social Psychology Quarterly, 55*, 388–399.
- Verkooijen, K. T., de Vries, N. K., & Nielsen, G. A. (2007). Youth crowds and substance use: The impact of perceived group norms and multiple group identification. *Psychology of Addictive Behaviors, 21*, 55–61.
- Vlachopoulos, S. P., Karageorghis, C. I., & Terry, P. C. (2000). Motivation profiles in sport: A self-determination theory perspective. *Research Quarterly for Exercise and Sport, 71*, 387–397.
- Wankel, L. M., & Sefton, J. M. (1994). Physical activity and other lifestyle behaviors. In R. Bouchard, R. J. Shephard, & T. Stephens (Eds.), *Physical activity, fitness and health* (pp. 530–550). Champaign, IL: Human Kinetics.
- Wang, Z., Patterson, C. M., & Hills, A. P. (2002). A comparison of self-reported and measured height, weight and BMI in Australian adolescents. *Australian and New Zealand Journal of Public Health, 26*, 473–478.
- Wilson, D. B., Smith, B. N., Speizer, I. S., Bean, M. K., Mitchell, K. S., Uguay, L. S., & Fries, E. A. (2005). Differences in food intake and exercise by smoking status in adolescents. *Preventive Medicine, 40*, 872–879.