Effects of In-school Health Information on Adolescents' Health Outcomes and Behaviors

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Abstract

Objective: This project evaluated the long-term impact of an in-school health advocacy program on adolescents' health outcomes and behaviors. Study 1 assessed the average treatment effect of health information about the importance of exercise on adolescents' Body Mass Index (BMI). Study 2 evaluated the impact of health information regarding smoking, parental modeling, depressive moods, and environmental cues on individuals' smoking intensities as they transitioned from adolescence into early adulthood. **Methods:** Data were used from the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative study of American youth. In-school health information and measures of health were based on participant self-report. The correlated random effects estimator (Study 1) and the random effects estimator (Study 2) were used to evaluate the effects of the two distinct pieces of information within the in-school health program. **Results:** Study 1 revealed that in-school health information about the importance of exercise significantly reduced adolescents' BMI. On average, the BMI of adolescents who received information on exercise was reduced by 0.633. Study 2 found that information about smoking, compared to no health information, did not significantly reduce individuals' smoking frequencies. Nevertheless, additional findings from Study 2 underscored the pivotal roles played by mental well-being, parental behaviors, and environmental cues in shaping individuals' smoking habits during the transition from adolescence to early adulthood. **Discussion:** Findings from Study 1 indicate that exposure to in-school health information about the importance of exercise led to a significant reduction in adolescents' BMI. Findings from Study 2 highlight the potential efficacy of extending health information delivery to parents, addressing adolescents' mental health needs, and providing appropriate environmental cues in promoting healthy behaviors and discouraging negative ones.

These implications could inform policy considerations for comprehensive health interventions targeting this demographic.

Keywords: Adolescents' health outcomes and behaviors; BMI; Smoking; Health interventions

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I. Introduction

Healthy lifestyles and behaviors, such as sufficient exercise and sleep, maintaining a healthy weight, and refraining from smoking and binge drinking, have both short-term and long-term benefits. These behaviors promote health and well-being during adolescence and are associated with higher levels of healthy behaviors during adulthood Frech (2012). In contrast, the lack of these behaviors can contribute to the development of chronic diseases, thereby impacting people's overall well-being and their ability to recover from illness Strine et al. (2008).

It is crucial that adolescents learn about health information, as adolescence is an optimal time to adopt appropriate attitudes, beliefs, and behaviors related to health. When learned early in life, behaviors that promote good health are more likely to be sustained throughout adulthood Lau et al. (1990). Additionally, it is preferable to prevent health-damaging behaviors at an early age than to modify an already-established habit later Alexander (1994). Adolescents are in a critical life transition phase and often initiate decision-making for risky health behaviors, as identified by the Centers for Disease Control and Prevention CDC (2022b), which include sexual behaviors, tobacco use, unintentional injuries, dietary behaviors, physical activity, and substance use. Trends among high school students have shown an increase in the prevalence of high-intensity drinking, electronic cigarette use, and sexually transmitted diseases Kratzke et al. (2018). Thus, introducing proper interventions to adolescents that may help develop healthy behaviors and prevent risky behaviors is crucial to both physical and mental health.

Schools serve as optimal platforms to provide health education to adolescents. While community programs aim to address individual and community health, their reach to adolescents is limited Kratzke et al. (2018). Schools, on the other hand, possess the potential to reach to this

demographic on a large scale Rudd and Walsh (1993). Moreover, health education and academic learning complement each other. Educators and health professionals have long recognized the positive relationship between health and education Kolbe (2019). Research shows that health issues can limit students' motivation and abilities to learn, hence hindering academic performance Basch (2011). Therefore, fostering comprehensive school environments that prioritize health, well-being, and academic success among adolescents is crucial Langford et al. (2014). Delivering health information in schools emerges as a cost-effective and far-reaching strategy to promote the health and well-being of adolescents.

1.1 Literature Gaps

Research focusing on programs dedicated to promoting health and well-being in schools remains limited Curran et al. (2014). Despite the importance of promoting adolescent health in schools, there is still a disconnect between the health advocacy programs and education systems in the United States that has not been fully addressed Birch and Auld (2019). Although the CDC (2019) has outlined the desired characteristics of effective health education programs, many schools in the United States fail to offer adequate health education programs in terms of both quality and quantity Videto and Dake (2019). Thus, it is crucial to conduct more studies to evaluate current health curricula in schools and explore ways to better integrate health and education. Additionally, integrating social psychology theories into the evaluation of in-school health advocacy programs could provide fresh perspectives for designing more effective health interventions tailored for adolescents.

1.2 Theoretical Background

The study relied on relevant health behavior and social psychology theories to help understand the factors that lead to certain health outcome and behaviors. By utilizing a social psychology framework, an economic health model was constructed to statistically analyze pertinent variables.

1.2.1 Theory of Planned Behavior

The Theory of Planned Behavior Ajzen (1985) posits that behaviors are determined by intentions, which are shaped by three factors: attitudes, subjective norms, and perceived behavioral control. This theory suggests the importance for in-school health advocacy program to deliver effective messages that foster positive beliefs toward healthy behaviors such as physical activities. The importance of subjective norms suggests the need to extend health-attitude interventions to individuals closely connected to adolescents, such as parents, peers, or mentors, as they can significantly impact adolescents' perceptions of norms regarding health behaviors and beliefs. In addition, it

is important to assist adolescents in developing perceived behavioral control to engage in healthy behaviors. Within the school context, for instance, physical environments can be redesigned to facilitate health behaviors. Health professionals can provide a diverse range of physical education programs aimed at boosting students' confidence and enhancing their behavioral control in participating in physical activities.

1.2.2 Health Belief Model

The Health Belief Model Rosenstock (1974) proposes that individual's motivation to undertake health behaviors is influenced by individual perceptions, modifying factors, and the likelihood of action. Individual perceptions include individual's awareness of health consequences, perception of one's susceptibility to illness, and the importance of health behaviors. Modifying factors include environmental cues that affect individuals' intentions to perform health behaviors. Likelihood of action refers to the extent that individuals are willing to actually perform the behaviors, which is determined by perceived benefits and costs. The Health Belief Model suggests potential guidelines for effective in-school health advocacy programs, such as emphasizing the positive consequences of healthy behaviors and the negative consequences of unhealthy ones. Programs that influence individual perceptions, create modifying cues, and remove barriers for individuals to engage in health behaviors may yield long-term benefits in shaping adolescents' health beliefs and behaviors.

1.2.3 Social Cognitive Theory

According to the Social Cognitive Theory Bandura (2002), cultural and social context play crucial roles in shaping individuals' beliefs and intentions. SCT suggests that social interactions and environmental factors may impact the acquisition and maintenance of behavioral patterns. When applying SCT to the development of health behaviors, interventions should consider cultivating social environments that foster collective self-efficacy, thereby enhancing individual self-efficacy in adopting and maintaining health-related behaviors. Consequently, in-school health programs incorporating social interactions and support, such as collective physical education classes, may prove effective in initiating and sustaining health behaviors.

In conclusion, the theories outlined above offer a structured framework for understanding the determinants of health behaviors, offering valuable guidance in designing effective in-school health advocacy programs. These theories underscore the significance of factors such as attitudes, perceived behavioral control, social influence, and environmental cues in shaping health behaviors. By integrating these elements, in-school health programs have the potential to cultivate positive health beliefs and behaviors in adolescents. Evaluating existing programs within the broader context of social psychology is essential to identify areas for improvement

1.3 Study Objective

The primary aim of this project was to systematically analyze the impact of in-school health information on adolescents' health outcomes and behaviors, drawing upon a combined framework of social psychology and economic health theories. Study 1 specifically investigated the impact of health information regarding exercise on adolescents' Body Mass Index (BMI). Meanwhile, Study 2 delved into the effects of health information about smoking, parental behaviors, depressive moods, and environmental cues on individuals' smoking frequencies throughout the transition from adolescence into early adulthood.

II. Study 1: Information About Exercise and BMI

While prior research has examined the influence of in-school health information on specific health concerns like eating disorders Kremer et al. (2020), relatively less attention has been dedicated to its impact on broader health indicators, such as Body Mass Index (BMI). BMI serves as a measurable gauge of adolescents' underweight or overweight status, offering an objective and consistent measure for large-scale analysis. Unlike variables like exercise amounts, BMI provides a standardized metric. Given the increasing prevalence of childhood obesity Li et al. (2020) and the lasting health consequences of excessive weight during adolescence Guo and Chumlea (1999), monitoring adolescents' BMI becomes crucial for assessing their health status. Study 1 specifically assessed the average treatment effect of health information about exercise on adolescents' BMI across a one-year period.

2.1 Data and Model

The project used data from the National Longitudinal Survey of Adolescent Health (Add Health). Add Health is a nationally representative study of the health and well-being of US adolescents in grades 7–12 who were enrolled in school during 1994–1995. Study 1 focused on data from Wave 1 and Wave 2. Wave 1 data were collected through an in-school questionnaire administered to students in grades 7 through 12 during the academic year 1994–95. Wave 2 data were obtained from a follow-up study involving a series of in-home interviews approximately one year later, in 1996. Inclusion in the analytic sample for adolescents required valid information regarding exposure to in-school health information.

2.1.1 Variables

Dependent Variable

BMI. Each participant's Body Mass Index (BMI) was computed using self-reported height and weight. Unlike adults, interpreting BMI for children and teens is more complex due to variables like age, sex, weight, and height influencing its assessment CDC (2022a). For adolescents, a healthy weight status is typically indicated by a BMI falling between the 5th and 85th percentile on the CDC growth charts, rather than specific numerical ranges. It is important to approach BMI as a complementary health measure for adolescents, considering its limitations in isolation. However, leveraging BMI as a standardized scale can still provide valuable insights into the general impacts of health interventions.

Program Variable

Learned Importance of Exercise. Study 1 focused on a specific component of in-school health information: the importance of exercise. This variable was selected due to its potential impact on adolescents' health behavior perceptions and consequent health outcomes. Participants self-reported exposure to this information during Wave 1 interviews through a question addressing their learning experience in school: "Please tell me whether you have learned about the importance of exercise in a class at school."

Control Variables

Demographics. Demographic variables were collected during Wave 1, including adolescents' biological sex, age, race, and school grade level.

Baseline Exercise. To better assess the impact of in-school health information about the importance of exercise on adolescents' weight outcomes, exercise amount was included as an important control variable. In particular, two variables reflecting individual exercise patterns were included as covariates: general exercise times and exercise to lose weight. Regarding general exercise, participants were asked in both waves, "During the past week, how many times did you do exercise, such as jogging, walking, karate, jumping rope, gymnastics or dancing?" Response options include "not at all," "1 or 2 times," "3 or 4 times," and "5 or more times." Participants were also asked about whether they had engaged in exercise with the objective of weight control, "During the past seven days, did you exercise in order to lose weight or to keep from gaining weight?" Response options included "Yes" or "No."

Sleep Hours. Previous research has consistently demonstrated a negative relationship between sleep duration and BMI in both cross-sectional and longitudinal studies, indicating that shorter sleep duration is associated with higher BMI Garfield (2019). Consequently, sleep hours were included as a covariate to control for in the analysis. In both Wave 1 and Wave 2, participants were asked, "How many hours of sleep do you usually get?" Participants' responses ranged from 1 to 20 hours.

Sedentary Behaviors. Research has shown that sedentary behaviors such as watching TV are associated with obesity Crespo et al. (2001). With sedentary alternatives replacing physical

activities as leisure pursuits Boone et al. (2007), it is reasonable to expect an inverse relationship between hours of TV viewing and the amount of exercise. Recognizing the potential influence of sedentary hours on participants' BMI, in addition to in-school health information, sedentary behaviors measured in hours were included in the model as a crucial control variable. In both Wave 1 and Wave 2, participants were asked, "How many hours a week do you watch television?" Participants' responses ranged from 0 ("Doesn't watch TV") to 51 hours.

Physical Education. Given the emphasis of Social Cognitive Theory (SCT) on the role of social influence in shaping health behaviors, particularly how peers' behaviors or attitudes may act as reinforcements or punishments, participation in physical education classes becomes a significant factor influencing individual health behaviors such as exercise and beliefs towards health outcomes like BMI. Therefore, adolescents' participation in physical education classes was included in the model as a crucial control variable. It is important to note that the extent of participation in physical education may be endogenous, impacting both attention to in-school health information and the dependent variable, BMI. Participants were asked in both waves, "In an average week, on how many days do you go to physical education classes at school?" Responses ranged from 0 to 5 days.

Learned Consequences of Obesity. According to the Health Belief Model, factors influencing people's awareness of health consequences play a crucial role in shaping their perception of the importance of health behaviors. In addition to information about the importance of exercise, a second component of the in-school health program related to the consequences of overweight was included as a control variable. In Wave 1, participants were asked, "Please tell me whether you have learned about each of the following things in a class at school: The problems of being overweight." Response options included "Yes" or "No."

2.1.2 Analysis

Descriptive analyses were first calculated for the dependent variable, program variable, and control variables in the analytic sample (see **Table 1**). The total number of observations included in the sample was 10,062 (Wave 1 N = 6,008, Wave 2 N = 4,054). Summary statistics were also obtained for the time-variant variables across waves (see **Table 2** for Wave 1 statistics and **Table 3** for Wave 2). The study's model started with the basic statistical specification as follows:

$$Y_{ti} = \beta_1 + \beta_2 X_{ti} + \beta_3 P_i + \delta Z_i + \mu_i + \epsilon_{ti}, \tag{1}$$

where the dependent variable was BMI. X's included time-variant variables at the individual level such as TV hours. P denoted the time-invariant program variable, which was the health information about the importance of exercise. Z's included time-invariant variables such as gender and race. The time-invariant error, μ_i, accounted for unobserved factors such as different levels

of motivation among individuals. The time-varying error, ϵ_{ti}, encompassed errors arising from measurement and omitted variables.

Linear Regression Model. OLS with cluster correction was used as the preliminary analysis. However, this method raised several concerns regarding potential biases in the results. First, the participation in the program (i.e., learning about the in-school health information) might be endogenous. It was possible that the unobserved motivation affected both the program participation decision and the outcome (i.e., BMI). Additionally, the frequency of attending physical education classes could similarly be endogenous, affecting both exposure to health information and BMI. Secondly, due to the dataset's longitudinal nature, residual autocorrelation might stem from correlated multiple observations on individuals with unobservable characteristics. Lastly, clustering of schools may impact health behaviors due to social and regional factors. Thus, alternative estimation methods were necessary to address these concerns in a multilevel panel model, ensuring the removal of potential sources of errors and providing a more accurate analysis of the data.

Correlated Random Effects Estimator. The correlated random effects method was utilized to counter the impact of time-invariant unobservable factors, such as motivation, that could influence both program participation and health outcomes. This approach effectively controlled for potential endogeneity in exposure to the program variable and other control variables. Moreover, it efficiently accounted for the inherent clustering within schools, a common feature in observational data. Building on the basic model specified above, the model of correlated random effects estimator became (T = 2):

$$Y_{ti} = \beta_1 + \beta_2 X_{ti} + \beta_3 P_i + \delta Z_i + \lambda \bar{X}_i + \eta_i + \epsilon_{ti}$$
$$\mu_i = \lambda \bar{X}_i + \eta_i$$
$$\bar{X}_i = 1/T_i \sum_{t=1}^{T_i} X_{ti}$$

In the correlated random effects model, the time-invariant error was assumed to be a function of the average values of the time-variant variables, X_{ti}'s. The model was then estimated by random effects method. A robust version of the Hausman test was conducted to test the endogeneity of the treatment variable. The hypotheses were presented below:

$$H_0 : \lambda = 0$$
$$H_a : \lambda \neq 0$$

Table 1. Characteristics of Study 1 sample (N=10,062)		
#	VARIABLES	Mean (SD / %)
1	Age	16.21 (1.66)
2	Male	4,917 (48.9%)
3	White	6,829 (67.9%)
4	African American	2,379 (23.6%)
5	Asian	417 (4.1%)
6	Grade level	9.76 (1.58)
7	TV hours	14.36 (12.15)
8	Sleep hours	7.72 (1.37)
9	Exercise times	1.65 (1.03)
10	Physical education	2.52 (1.59)
11	Exercise to lose weight	4,391 (43.7%)
12	Learned problem of obesity	5,984 (59.5%)
13	Learned importance of exercise	9,283 (92.2%)
14	BMI	22.55 (4.45)

2.2 Results

Descriptive Statistics

Table 1 illustrates the composition of the full analytic sample, comprising 10,062 adolescents, with a near-equal gender distribution (49% male, 51% female). The majority identified as White (68%), followed by African American (24%). On average, participants were 16 years old during Wave 1, and the mean grade level was 9. On average, participants in the sample spent 14.4 hours per week watching TV and reported an average sleep duration of 7.7 hours per day. Their mean engagement in general exercise was 1.6 times in the week before the questionnaire. Around 44% reported exercising for weight control within that week. They attended physical education classes at school approximately 2.5 days per week. About 60% of participants gained awareness of the consequences of obesity through the in-school health advocacy program. The majority (92%) indicated learning about exercise importance at school. Across the two waves, participant characteristics such as TV and sleep hours, as well as exercise amounts, exhibited minimal differences (see **Table 2** and **Table 3** for detailed statistics).

Multivariate Analyses

Table 4 presents findings from two models assessing the influence of the in-school health program—specifically, health information emphasizing the importance of exercise—on adolescents' BMI. Model 1, employing OLS, and Model 2, utilizing the correlated random effects method, show compelling results. The analyses indicate a significant treatment effect of health information about exercise on BMI. Specifically, students exposed to information on the importance of

Table 2. Characteristics of Study 1 sample in Wave 1 (N=6,008)		
#	VARIABLES	Mean (SD / %)
1	TV hours	14.81 (12.24)
2	Sleep hours	7.8 (1.40)
3	Exercise times	1.63 (1.05)
4	Physical education	2.66 (1.35)
5	Exercise to lose weight	2,641 (43.9%)

Table 3. Characteristics of Study 1 sample in Wave 2 (N=4,054)		
#	VARIABLES	Mean (SD / %)
1	TV hours	13.68 (11.91)
2	Sleep hours	7.62 (1.33)
3	Exercise times	1.66 (1.01)
4	Physical education	2.31 (1.89)
5	Exercise to lose weight	1,751 (43.2%)

exercise experienced a significant reduction of 0.633 ($p < 0.01$) in BMI, on average, compared to those without this exposure during their school experience. While general exercise, TV hours, and sleep hours were significant predictors of BMI in Model 1, their significance disappeared after correcting for standard errors in Model 2. It should be noted that learning about the consequences of overweight and exercising to lose weight had positive effects on BMI, indicating that engaging in these behaviors actually led to weight increase; the counterintuitive results are discussed below.

2.3 Discussion

The current study investigated the impact of in-school health information regarding exercise on adolescents' BMI. Using the correlated random effects estimator, the results highlighted a significant reduction in BMI among those exposed to information emphasizing the importance of exercise in school. Future research might expand this exploration by examining diverse health indicators beyond BMI, offering a more comprehensive understanding of how exercise-related information impacts adolescent health.

The findings suggest that learning about the consequences of being overweight and engaging in weight loss exercises led to an increase in BMI, which aligns with some concerns raised about potential negative consequences of health programs at school. Some argue that interventions influencing adolescents' eating and physical activity might increase instances of eating disorders by triggering anxiety about body image and promoting dietary restraint Neumark-Sztainer (2005). To mitigate these potential negative effects, the delivery of health content should be done

Table 4. Analyses results		
VARIABLES	Model 1	Model 2
Exercise to lose weight	2.523***(0.0869)	0.130**(0.0608)
Exercise times	-0.200***(0.0411)	-0.0173 (0.0278)
Grade level	-0.0736(0.0662)	0.0540(0.104)
TV hours	0.0231***(0.00353)	-0.00252(0.00261)
Sleep hours	-0.0802**(0.0315)	0.0302(0.0225)
Importance about exercise	-0.684***(0.160)	-0.633***(0.198)
Consequences of overweight	0.623***(0.0878)	0.617***(0.109)
Male	0.806***(0.0853)	0.874***(0.106)
Physical education	-0.0335(0.0268)	0.0172(0.0156)
White	-0.857***(0.148)	-0.811***(0.182)
African American	0.0933(0.159)	0.171(0.195)
Asian	-1.697***(0.235)	-1.636***(0.287)
Age	0.514***(0.0626)	0.0789(0.488)

Note: Model 1 presents the results of OLS; Model 2 presents the result of correlated random effects estimator.

cautiously, avoiding stigmatization of certain adolescent groups and preventing coercion into undesired health activities O'Dea (2005). One preventive strategy could involve teaching adolescents critical-thinking skills regarding beauty standards and body images, as suggested by a meta-analysis study Le et al. (2017). Incorporating this strategy into in-school health advocacy programs could enhance health literacy and correct health-related beliefs.

While Study 1 shed light on the impact of in-school health information about the importance of exercise on adolescents' weight status, it is crucial to delve into other health information and behaviors for a comprehensive evaluation of the health advocacy program at school. Hence, Study 2 was designed to investigate the influence of a distinct component of the health advocacy program on addictive substance use, specifically smoking. Together, these studies aim to provide a more holistic review and a deeper understanding of the program's effectiveness in shaping diverse health outcomes and behaviors among adolescents.

III. Study 2: Health Information and Smoking

Study 2 assessed the impact of in-school health information about smoking on adolescents' smoking frequencies during the transition from adolescence to adulthood. While in-school health information may shape adolescents' attitudes toward smoking and potentially change their behaviors, there are other important factors that lead to addictive substance use. First, the experience of

depressive moods has been identified as a potential determinant in adolescents' decision-making regarding smoking. Longitudinal investigations have unearthed evidence suggesting a bidirectional relationship between smoking and depression Chaiton et al. (2009). Second, as discussed in the **Theoretical Background** section, social norms may implicitly influence one's attitudes or beliefs toward health behaviors, thereby impacting the likelihood of one engaging in those behaviors. Parents, who have one of the closest relationships to their children, may heavily influence adolescents' perceptions of norms, both through their own actions and the environmental cues present within the family setting.

In summary, Study 2 is guided by three primary objectives: 1) To examine the long-term impact of in-school health intervention about smoking on adolescents as they transition into adulthood, 2) To investigate the influence of depressive moods on smoking behaviors, and 3) To assess the extent of parental influence on adolescents' substance use.

3.1 Data and Model

Study 2 also used data from Add Health, focusing on data from Wave 1, 2 ,and 4. Wave 1 data were gathered from an in-school questionnaire administered to a nationally representative sample of students in grades 7 through 12 in 1994–95. Wave 2 data were collected from the follow-up study with a series of in-home interviews of respondents approximately one year later. The Wave 4 interviews were completed in 2008, which consisted of the most recent of four in-home interviews which had followed a sample of adolescents since they were in grades 7-12. Adolescents were included in the analytic sample if they had valid information regarding the exposure to in-school health information about smoking.

3.1.1 Variables

Dependent Variable

Days of Smoking. This study used the number of days smoked as an index to represent the intensity level of the participants' smoking behaviors. Participants were asked "During the past 30 days, on how many days did you smoke cigarettes?" A number was self-reported by each participant.

Program Variable

In-school Health Information About Smoking. Information about smoking was based on participant reports of information collected during Wave 1 interviews. In Wave 1, the participants were asked, "Please tell me whether you have learned about each of the following things in a class at school: Smoking." Response options included "Yes" or "No."

Control Variables

Demographics. Demographic variables were collected during Wave 1. Demographic variables included adolescents' biological sex, age, and race. Depressive Level. Participants' general levels of depressive symptoms were measured across waves. The question on the survey listed as "How often was each of the following things true during the past week? You felt depressed." Participants responded in terms of categorical variables that indicate the level of intensity: "Never/Rarely", "Sometimes", "A lot of the time", "Most/all of the time".

Parents' Educational Levels. Parents' educational levels were measured separately. Participants were asked to indicate the highest levels of education of their moms and dads. Parents' Smoking Behavior. The participants were asked whether their mom/dad ever smoked. The study used this pair of variables as indicators of parents' smoking status.

Evidence of Smoking. This variable was collected by the question, "Was there any evidence of smoking in the household–for example, ashtrays, people smoking, cigarettes, the smell of cigarettes?" This variable is included to indicate the potential environmental factors that were not captured by parent's smoking behavior.

Family Income. In addition to parental behavior, family socioeconomic status can also affect children's health Case and Paxson (2002). Thus, family income is included to provide additional information. Collected at Wave 4, family income was included in a supplementary analysis due to limited data availability caused by sample attrition. Although its inclusion in the main model could significantly reduce degrees of freedom and potentially introduce bias, income level serves as a crucial indicator of the family's socioeconomic status and is essential for understanding health outcomes.

3.1.2 Analysis

Table 5 presents the descriptive statistics for all variables. The total number of observations included in the sample was 15, 262. OLS regression with cluster correction and sampling weight adjustment was used as the preliminary analysis for the specified model. Due to the surveys' longitudinal nature, it is common to adjust weights at each wave due to sample attrition. However, for this study, only the analytic weights from Wave 1 were used to mitigate potential biases. Please refer to the Methods section in Study 1 for model specification as well as methodological concerns regarding OLS regression. To address errors introduced by heterogeneity, the study utilized the random effects estimator with cluster correction. The model assumed exogeneity of the covariates of interest to optimize the random effects estimator's performance. Any violation of this assumption might lead to biased results.

Table 5. Characteristics of the sample (N=15, 262)		
#	VARIABLES	Mean (SD)
1	Age	19.46(5.646)
2	Male	0.475(0.499)
3	White	0.673(0.469)
4	African American	0.241(0.428)
5	Asian	0.0391(0.194)
6	Mom's education	5.749(2.542)
7	Dad's education	5.930(2.658)
8	Depressive moods	0.475(0.740)
9	Mom's smoking behavior	0.264(0.441)
10	Dad's smoking behavior	0.449(0.497)
11	Evidence of smoking	0.397(0.489)
12	Days of smoke	0.210(0.408)
13	Information about smoking	5.570(10.78)

3.2 Results

Descriptive Statistics

Table 5 shows that the sample was comprised of 15,262 adolescents which included a relatively similar number of men (48%) and women (52%), primarily of White (67%) or African American (24%) race, and an average age of 19 years old. The mean level of parents' education was high school graduate. Most participants indicated that they never/rarely or sometimes felt depressed. 44.8% of the participants indicated that their moms had ever smoked, and 39.7% indicated that their dads had ever smoked. Among the adolescents whose mom smoked, 59% of the adolescents had ever smoked. Among the participants whose dad smoked, 57% of them had ever smoked. In addition, 21% of the participants indicated that they had found evidence of smoking in the household. On average, all participants smoked for 5.6 days; among smokers, the average was 6.5 days. A large majority received in-school health information about smoking (92%).

Multivariate Analyses

Table 6 shows the outcomes from three models evaluating the effects of in-school health information about smoking, depressive moods, environmental cues, and parental smoking behaviors on adolescents' smoking frequency. Model 1 presents OLS estimations, Model 2 employs the random effects method, and Model 3 supplements Model 1 by incorporating family income through OLS regression.

The model was independently applied at each wave to assess the impact of time-variant variables on adolescents' smoking frequency, revealing changes over time. **Table 7** details coefficients of these variables estimated by OLS across each wave. In-school health information on smoking

Table 6. Days of Smoking on key predictors.

VARIABLES	Model 1	Model 2	Model 3
Information about smoking	0.203(0.571)	0.148(0.459)	0.0143(0.0416)
Depressive moods	2.150***(0.227)	1.498***(0.172)	0.0823***(0.0176)
Mom's education	X	X	-0.00457(0.00556)
Dad's education	X	X	0.00713(0.00628)
Male	0.636**(0.304)	0.838***(0.260)	0.0747***(0.0242)
White	2.152***(0.521)	1.812***(0.417)	0.0987**(0.0472)
African American	-2.131***(0.574)	-2.107***(0.476)	-0.123**(0.0486)
Asian	-0.710(0.685)	-0.778(0.664)	0.0720(0.0757)
Mom's smoking behavior	1.052***(0.319)	1.076***(0.284)	0.0698***(0.0257)
Dad's smoking behavior	1.158***(0.295)	1.180***(0.262)	0.0844***(0.0246)
Evidence of smoking	2.576***(0.529)	2.693***(0.443)	0.0786**(0.0364)

Robust standard errors in parentheses
*** p $<$ 0.01, ** p$<$0.05, * p$<$0.1

Note: 1. Model 1 presents the results of OLS regression without income; 2. Model 2 presents the results of random effects estimator; 3. Model 3 presents the result of OLS regression with income. 4. Detailed reports of estimated coefficients of categorical variables are omitted for brevity.

Table 7. Analyses of the effects of time-variant variables across waves

VARIABLES	Wave 1	Wave 2	Wave 4
Information about smoking	-.220(.583)	.380 (.683)	.527(1.14)
Mom's smoking behavior	.996*** (.343)	.933** (.413)	1.14 (.706)
Dad's smoking behavior	.846*** (.291)	1.51*** (.421)	1.33** (.531)
Evidence of smoking	2.18*** (.637)	2.03*** (.748)	3.76*** (.868)

Robust standard errors in parentheses
*** p $<$ 0.01, ** p$<$0.05, * p$<$0.1

Note: Only variables of interest are presented.

did not significantly predict smoking frequency at any wave. Household environmental factors (e.g., evidence of smoking) most significantly predicted frequency at all waves, and the impact increased as adolescents transitioned to adulthood. Parental smoking behaviors positively predicted adolescents' smoking frequency at all waves, although mom's influence became insignificant at Wave 4.

The study focused on Model 2, while Model 1 served as a comparison and Model 3 provided supplementary analysis. In-school health information about smoking did not exhibit a significant effect on adolescents' smoking behaviors. The strongest predictor was the environmental cues: the

presence of evidence of smoking in households predicted an average of 2.7 more days of smoking among adolescents. Parental smoking behaviors also significantly contributed to adolescents' smoking, with an increase of approximately one day in smoking if either mom or dad had ever smoked. Additionally, depressive moods were found to significantly predict adolescents' smoking behaviors, with participants tending to smoke an average of 1.5 more days when experiencing higher levels of depressive moods.

3.3 Discussion

Study 2 investigated the influence of in-school health information about smoking, depressive moods, parental behaviors, and evidence of smoking in households on self-reported instances of smoking using a random effects estimator. While the findings showed that health information did not significantly alter smoking behaviors, they highlighted the enduring influences such as adolescents' mental well-being, environmental cues, and parental smoking; across different phases from adolescence to adulthood, these factors consistently affected individuals' smoking behaviors. Even after adjusting for family income, parental modeling and environmental factors remained statistically significant.

IV. General Discussion

This project explored how in-school health information impacted adolescents' health measures. Study 1 showed that information on exercise importance significantly reduced adolescents' BMI. However, Study 2 did not find a significant link between in-school smoking information and smoking behaviors across adolescence to young adulthood. However, Study 2 highlighted lasting effects of parental smoking, depressive moods, and environmental cues on smoking frequencies.

This project explored the potential impact of in-school health advocacy programs on adolescents' well-being, offering four key considerations for policymakers designing interventions in school settings. First, fostering accurate health beliefs among adolescents—positively framing health behaviors like exercise and highlighting the negative consequences of harmful habits like smoking—can encourage healthier choices. Second, in-school health interventions should consider extending the delivery of health information beyond students to include other influential members of their social circles, especially their parents. Individuals who are socially close to adolescents can serve as role models for healthy behaviors. Notably, the health beliefs and behaviors of parents may have a lasting impact on their children. Third, it is crucial for in-school health programs to address mental well-being alongside physical health by providing counseling and support services. The absence of such resources may inadvertently contribute to the development of risky health

behaviors (e.g., smoking) linked to depressive moods or stress among adolescents. Lastly, creating effective environmental cues in schools can promote healthy behaviors, such as offering engaging exercise-related content to enhance adolescents' participation in physical activities. These implications provide valuable guidance for policymakers in developing comprehensive health interventions tailored to the unique needs of adolescents, contributing to the promotion of their physical and mental well-being.

4.1 Limitations

This project has several limitations. Firstly, utilizing an existing dataset restricted the inclusion of certain variables that could be vital to the outcomes. For instance, dietary behaviors, unrecorded in Add Health, might significantly affect adolescents' BMI. Additionally, social cues from sources beyond parents, like peers' health behaviors and beliefs, could influence adolescents' health decisions, including smoking. The absence of these key variables might introduce biases when interpreting the results. Second, the Add-Health dataset did not provide a comprehensive account of the in-school health advocacy program. It provided minimal insights into the specific topics covered, such as the importance of exercise. Critical details regarding the program's contextual elements, including the mode of delivery (e.g., posters or class presentations), the duration of the program, and the specific contents covered in each topic, were not available. The absence of this comprehensive knowledge regarding the in-school health program limits the implications drawn from the project's findings for future interventions.

Additional limitations stem from the project's nature. First, sample attrition affected the analyses, with only 74% of initial respondents participated in Wave 2 data collection and 60% in Wave 4. Although imputation methods and sampling weights addressed some misrepresentation due to attrition, the reduced sample size might still impact result accuracy. Second, relying on self-reported data could introduce recall bias among participants, potentially leading to systematic errors. While the statistical methods employed in both studies mitigated recall biases to some extent, this concern still merits careful consideration. Future studies could explore the efficacy of in-school health information more systematically by documenting students' attendance, health behaviors, and outcomes.

4.2 Conclusions

Exposure to health information on the importance of exercise significantly reduced adolescents' BMI. Parental smoking, depressive moods, and environmental cues had enduring impacts on smoking behaviors. The project offers key insights for policymakers designing health interventions in schools, emphasizing four crucial considerations: fostering accurate health beliefs among ado-

lescents, extending health information to influential figures like parents, addressing mental well-being, and creating effective environmental cues. However, the project faces limitations, such as constrained variable inclusion and a lack of comprehensive information about the in-school health program. To overcome these limitations, future studies should conduct detailed evaluations of in-school health programs, contributing to evidence-based interventions that effectively enhance the physical and mental well-being of adolescents in school environments.

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