Does Being Old-for-grade in High School Predicts Sexual Risk Behaviors, Beyond Grade-level Effects?

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Abstract

PURPOSE: The prevalence of adolescent risk behaviors varies by age and grade level in school, both of which are proxies for physical and social development. Adjusting for both age and grade would be ideal but is ill advised because of collinearity. We developed a variable to assess "relative age" (i.e., old for grade vs. age normative) and estimated grade and old-for-grade status in association with sexual risk behaviors.

METHODS: Data are from the 2017 National Youth Risk Behavior Survey. We conducted weighted multivariable logistic regression models and reported prevalence ratios to estimate associations between grade, old for grade, and sexual risk behaviors among 9th-11th graders.

RESULTS: Being old for grade (vs. age normative) was associated with a higher prevalence of sexual risk behaviors, particularly for ninth graders.

CONCLUSIONS: Adjusting for relative age is a feasible way to increase precision in estimation of grade-related differences in sexual risk behaviors.

Introduction

The prevalence of sexual behaviors among adolescents increases with age and grade level, as such behaviors become more developmentally appropriate [1,2]. When examining predictors of sexual risk behaviors and associated outcomes, it is common to adjust for developmental stage to account for normative age changes and isolate the relationships of interest. This is typically accomplished by including age or grade as a control variable in a statistical model. Although both age and grade levels are strongly and independently associated with sexual risk behaviors in adolescence [1,3], it is statistically inappropriate to adjust for both because

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Implications and Contributions

Grade is a key indicator of social, sexual, and physical development. Among adolescents, within-grade age differences may confound associations between grade and sexual risk behaviors. Using age relative to grade (i.e., "old for grade" vs. not) as a proxy can increase precision of estimates of the association between grade and risk behaviors.

they are closely related to each other. However, accounting for one but not the other introduces bias into estimates. Adjusting for grade alone may result in misestimation, particularly for youths who are not the normative age for their grade because it may underappreciate the predictive role of age and biological development. On the other hand, adjusting for age alone may underappreciate that grade-specific social norms shape risk behaviors. Considering the influence of age relative to grade level is a practical, though underused, option for simultaneously considering risk associated with both age and grade. In studies of high school students, adjusting for relative age would likely enhance precision of estimates that represent the association between grade and sexual behaviors.

Adolescents who are older than their same-grade peers may have a risk profile more similar to those in the next grade up (their same-age peers) rather than their same-grade peers. In this study, we developed a measure of "old-for-grade" status to determine its association with sexual risk behaviors. This measure is used as a proxy to assess the effect of age relative to the grade level. We hypothesized that being older than the normative age for one's grade, i.e., "old for grade," would be associated with increased risk for sexual risk behaviors.

Methods

Data are from the 2017 National Youth Risk Behavior Surveillance, a biennial survey of U.S. high school students. The Youth Risk Behavior Surveillance used a three-stage cluster sampling design to produce a nationally representative sample of 9th-12th graders; there were 14,765 students in 144 schools across 36 states [4]. Sample weights were applied to account for nonresponse and to ensure results represent the population.

Old-for-grade status was the predictor variable, and results were reported by grade level. We created a measure of age for grade based on U.S. Department of Education recommendations: Ninth graders older than 15 years, 10th graders older than 16 years, and 11th graders older than 17 years were classified as old for grade. Ninth graders aged 14 or 15 years, 10th graders aged 15 or 16 years, and 11th graders aged 16 or 17 years were classified as normative [5]. Age-for-grade status could not be derived for the 12th graders because the highest response option for "age" in the questionnaire was "18 years old or older." Thus, we excluded the 12th graders from the study. Respondents with missing age-for-grade status were also excluded. We did not include age as a study variable because of its strong correlation with grade (Cramer's V=0.67) [6] and the variable old for grade is entirely a function of age and grade.

Outcome variables included the following three sexual risk behaviors: (1) any lifetime sexual intercourse ("Have you ever had sexual intercourse?"); (2) four or more lifetime sexual partners ("During your life, with how many people have you had sexual intercourse?"); and (3) sexual activity within the past 3 months ("During the past 3 months, with how many people did you have sexual intercourse?"). All three variables were binary; students who reported no lifetime sexual intercourse were included in the "no" group for measures of sexual partners and recent sexual activity.

First, we used a three-way frequency table to estimate the weighted prevalence of each sexual behavior by old-for-grade status within each grade. Then, we built weighted multivariate logistic regression models with interactions between grade and old for grade to estimate the grade-specific odds ratios of each sexual behavior for old-for-grade students (vs. age-normative students). Models were presented by grade and were adjusted for sex and race/ethnicity (i.e., American Indian/Alaska Native, Black, Asian, Native Hawaiian/Pacific Islander, White, Hispanic/ Latino (any race) and multiracial. We present prevalence ratios as the measure of effect [7]. This study is exempt from Institutional Review Boards (IRB) oversight. Analyses were conducted using the survey data analysis procedure in SAS 9.4 [8].

Results

Just 4.2% (n = 471) were classified as old for grade, and the association between old-for-grade status and grade was not statistically significant (p = .07; data not shown). Sex and race/ ethnicity were significantly associated with old-for-grade status. Boys were more likely than girls to be old for grade (6.3% vs. 3.2%), and Black students were most likely to be old for grade (8.5%).

Comparing students who were old for grade with those who were not, ninth, 10th, and 11th graders were more likely to report lifetime sexual intercourse, ninth and 10th graders (but not 11th graders) were more likely to report four or more lifetime sexual partners, and ninth graders (but not 10th and 11th graders) were more likely to report being sexually active (Table 1). These associations retained statistical significance after adjustment for sex and race/ethnicity (Table 2).

Discussion

Adolescence is a dynamic developmental period marked by physical and social transitions that influence engagement in sexual behaviors. Grade is routinely used as a measure of adolescent development. Because youth enter school based on age requirements, grade is a strong proxy for age – marker of physical development. Given the social nature of adolescence, grade is also a strong marker of social changes. When adolescents are not the same age as their grade level peers, associations between grade and sexual behaviors may be confounded by age. However, the near-perfect collinearity between age and grade presents a barrier to adjusting for the effect of age in determining associations between grade and behaviors. Borrowing from education research, we present an innovative approach to simultaneously consider the role of age and grade that avoids misestimation because of the collinearity. We proposed that "old for grade" can be used as a proxy for the influence of age relative to grade level, enabling a more precise estimation of the association between grade and behavior (We do not recommend using relative age as to estimate the effect of "old for grade" above and beyond age). Results suggest that old-for-grade youth were more likely than their same-grade peers to engage in sexual behaviors, after adjustment for sex, grade, and race/ethnicity. The magnitude of the effects varied by grade and were most pronounced among ninth graders. This suggests that it may be particularly important to adjust for old-for-grade status among younger adolescents.

Sexual behavior becomes increasingly normative with age, whereas other behaviors - such as violence - may become decreasingly normative. Therefore, our findings will not apply to all adolescent health behaviors, and subsequent research should determine how relative age is related to risk for other behaviors. Problem behavior theory [9] can be applied to understand covariance of risk behaviors among old-for-grade adolescents. A notable limitation of our study is that we were unable to investigate the reasons why a student might be old for grade, which may be confounded with risk behaviors. To address this drawback, future studies could also explore relative age longitudinally, to further investigate the basis for sex and race/ ethnicity differences in old-for-grade status and also to disentangle bidirectional associations between risk behaviors and relative age (e.g., behavioral problems leading to children being held back a grade). This study has several limitations shared by survey research, such as the potential for social desirability and recall bias. In adolescent health research, grade level is routinely used to adjust for developmental stage with little regard for confounding that is introduced when students are older than their same-grade peers. Our findings indicate that those studies may be subject to omitted variable bias. Adjusting for old-for-grade status is a straightforward and feasible way to increase precision in predicting adolescent risk behaviors without substantial multicollinearity.

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Table 1.

Prevalence estimates (95% confidence intervals) of sexual risk behaviors by old-for-grade status among ninth, 10th, and 11th graders

	Ninth Graders (n=3,875)			Tenth Graders (n=3,684)			Eleventh Graders (n=3,566)		
	Old-for-grade (4.4%)	Age normative (95.6%)	*p*	Old-for-grade (4.8%)	Age normative (95.2%)	*p*	Old-for-grade (3.5%)	Age normative (96.5%)	*p*
Any lifetime sexual intercourse	40.4 (32.0, 48.8)	19.3 (16.8, 21.9)	<.0001	62.7 (50.9, 74.4)	34.8 (31.6, 37.9)	0.0005	61.2 (49.1, 73.2)	46.7 (43.7, 49.8)	0.0052
4+ lifetime sexual partners	11.6 (6.5, 16.7)	3.5 (2.3, 4.7)	0.0036	17.5 (8.7, 26.4)	6.8 (5.3, 8.3)	0.0241	14.4 (4.9, 23.9)	10.4 (8.5, 12.2)	0.3293
Sexually active in the past 3 months	28.0 (20.2, 35.9)	12.1 (10.5, 13.7)	0.0012	35.8 (23.0, 48.5)	24.4 (22.1, 26.7)	0.0977	42.2 (31.0, 53.5)	35.0 (31.9, 38.1)	0.1738

Table 2.

Risk for sexual risk behaviors among old-for-graded students versus age-normative students, by grade level

	Adjusted Prevalence Ratios (95% Confidence Intervals)					
	Ninth Graders (n=3,875)		Tenth Graders (n=3,684)		Eleventh Graders (n=3,566)	
Any lifetime sexual intercourse	2.06 (1.61, 2.56)	<.0001	1.81 (1.49, 2.09)	<.0001	1.30 (1.06, 1.52)	0.0152
4+ lifetime sexual partners	2.88 (1.57, 5.08)	0.0013	2.29 (1.50, 3.40)	0.0005	1.31 (0.69, 2.34)	0.3891
Sexually active in the past 3 months	2.31 (1.66, 3.11)	<.0001	1.49 (1.02, 2.03)	0.0427	1.21 (0.91, 1.53)	0.1755