Age-Within-School-Class and Adolescent Gun-carrying

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ABSTRACT. Background. Intentional injuries (suicide and homicide) are a leading causes of morbidity and mortality in the United States. Firearms cause ~70% of these fatal intentional injuries. Risk factors associated with gun-carrying in adolescent populations include male gender, smoking, alcohol use, drug use, and number of sexual partners. Current knowledge of these and other risk factors has provided limited benefit because many are no more obvious to the clinician a priori than is the tendency to carry guns. Increasing relative age of a student within school class is an easily measured parameter that has been associated with behavioral problems, absenteeism, negative self-image, and high dropout rates.

Objective. To characterize the association between relative student age-within-class and tendency to carry firearms.

Design. The Massachusetts Youth Risk Behavior Survey, which collects data on demographic characteristics, risk behaviors, and health outcomes.

Participants. A randomly selected group of 3153 Massachusetts students in grades 9 through 11.

Primary Outcome Measure. The odds of firearms-carrying comparing older to average-age and younger students.

Results. Using multivariate logistic regression, seven risk factors predicted gun-carrying with statistically significant results: older age-within-class (OR: 2.12; 95% CI: 1.09–4.12), male gender (OR: 4.95; 95% CI: 3.01–8.15), black race (OR: 2.49; 95% CI: 1.20–5.14), gang membership (OR: 7.22; 95% CI: 4.51–11.56), missing school out of concern for safety (OR: 2.50; 95% CI: 1.30–4.80), seeking medical treatment after a fight (OR: 4.47; 95% CI: 2.56–7.78), and fighting without seeking medical treatment (OR: 7.22; 95% CI: 4.51–11.56), entering medical treatment after a fight (OR: 5.73; 95% CI: 3.09–10.60).

Conclusion. Older 9th-, 10th-, and 11th-grade students are more likely than their classmates to carry firearms. This information may prove helpful in identifying high-risk students and targeting prevention strategies.

Knowledge of these risk factors has provided limited benefit in the clinical setting despite a growing body of work showing the effectiveness of violence-prevention strategies. Many of the risk factors are no more obvious to the clinician a priori than is the tendency to carry guns. For example, the clinician may have no knowledge of the adolescent’s sexual or drug habits. In fact, of the risk factors cited, male gender is the only objectively measurable characteristic that can be assessed easily and that has proved consistently to be associated with gun-carrying.

More objective and readily accessible characteristics are needed to target high-risk groups to help clinicians engage in prevention strategies. Although direct questioning regarding gun-carrying may be the most efficient means of assessing the adolescent’s behavior, issues such as patient trust or time constraints increase the need for alternate means of evaluation.

The parameters of age and grade are easily mea-
ured and have been evaluated separately regarding their association with gun-carrying, with inconclusive results. Some populations showed an increase in weapon-carrying with increasing grade; in others, decreases in weapon-carrying with grade were noted. The discrepancies could be attributed in part to differences in the populations under study and, for school-based studies, the tendency for high-risk students to drop out as they age. Researchers have not examined age and grade together when describing gun-carrying.

In the field of education, researchers use median age for grade as an index to isolate the effect of age from that of grade. Increasing relative age of a student within the class has been associated with increasing behavioral problems, absenteeism, negative self-image, and increased rate of dropout. In contrast, the younger students in a grade have a lower rate of problem behavior and better self-image. Class age range stems from birth date within the calendar year, parental decision to delay the start of school, illness, grade retention (“failing a grade”), and other factors. Older students within a class are more likely to be nonwhite than white, male than female, and immigrant than native-born. Because older students are more likely to have failed a grade than are average-age students, it is sometimes assumed that increasing age within a class is a proxy for poor academic performance. Recent research has shown that older students within a class are at risk for dropout, absenteeism, and behavior problems, independent of academic achievement. Poor self-esteem and social isolation from peers have been suggested as potential causes.

This article uses data from the Massachusetts Youth Risk Behavior Survey Risk Behavior Survey (MYRBS) to characterize relative age-within-class as a novel risk factor for gun-carrying. We examined risk factors for being a year above the median age in class. We also re-examine previously established or suspected risk factors for gun-carrying, including gender, race, fear, fighting, and deviant behavior, to provide a clinical screening assessment of a student’s risk for firearm-carrying.

METHODS

Study Base and Sampling Technique

The MYRBS is described in detail elsewhere. Briefly, the MYRBS was administered to a randomly selected sample of Massachusetts public high school students in grades 9 through 12 from March to June 1995. A multistage sampling design was used to select a random cohort of schools and students. In the first stage, 63 of 299 eligible schools were randomly selected. Fifty-nine (94%) agreed to participate. Reasons for nonparticipation included lack of time and concurrent participation in other research projects. In the second stage, 5370 students were selected for participation (3 to 5 classrooms/school). Of students selected, 4166 surveys were collected, a student response rate of 78%, which reflects student attendance on the day of survey administration. Of the response rate for the 1995 MYRBS was 73%, the product of 78% of students responding multiplied by the 94% of schools that agreed to participate (0.94 × 0.78 = 0.73). Parents were informed of their child’s selection for the survey and asked to inform the school if they wished that the student be exempted from participation. Nine parents refused.

Survey Instrument

The survey consisted of 91 questions on demographic characteristics, risk behaviors, and health outcomes. For this analysis, information from 10 questions was used: 1) gender (male/female); 2) race (six categories); 3) grade (9 through 12 or ungraded for special education or technical programs); 4) type of community (suburban, rural, urban); 5) age in years (12 through 17, older than 18); 6) gang membership (yes/no/blank response); 7) number of absences from school in last 30 days because of concern for personal safety (five categories); 8) number of times treated by a nurse or physician after fighting, was subtracted from the number of fights in the last year. The median age in years was calculated for grades 9 through 12 (9th = 15, 10th = 16, 11th = 17, 12th = 18). Because the MYRBS collected information on student age to the nearest year only, subjects were assigned to three categories based on relationship to the median age: 1 year below median, median age for class, or 1 year older than median. The MYRBS characterized all students older than age 17 as “eighteen to 18 years old or older.” Thus, it was not possible to distinguish 12th-grade students who were older than the mean from those who were at the mean age for the class. Because the effect of age distribution within a class was the primary exposure of interest, 12th-grade students were excluded from the analysis (n = 924). Of the remaining subjects, 99% fell within 1 year of the median age. Of the 1% who did not, the range of relative age difference was from 6 years younger to 3 years older than the median. Because the vast majority of students fell in the range of 1 year older to 1 year younger than the median, it was decided to examine the effect of age as 2 binary variables, each corresponding to 1-year relative age changes from the median. Students 2 years above the median (n = 26) and 2 years below the median (n = 11) were excluded from the analysis. Alternate models (results not shown) that included these 47 subjects did not significantly change the results of the analysis. Students responding “ungraded” to question 3 (n = 6) and students who did not volunteer information on grade or age (n = 36) also were excluded. Because of a relatively large number of missing data for the question addressing gang membership (n = 267), those with blank responses were retained in a “missing” category for the final analysis. Exclusion of the blank responses did not alter the significance of effect estimates. All ordinal variables (questions 3, 5, 7, 8, and 9) were modeled as linear, categoric (where appropriate), and binary terms in the logistic regression without any change in significance of the study results.

The Woolf approximation of 95% CI was used for tabular analysis. Clustering of responses within schools and weighing of the data (using a weighing term provided by the Centers for Disease Control and Prevention (CDC) reflecting the likelihood of having been sampled and a factor compensating for different patterns of nonresponse) were accounted for using survey logistic regression software. Logistic regression not accounting for clustering or weighing factors did not produce significantly different results.

RESULTS

In the bivariate analyses, male gender was associated with a doubling of the odds of being older than the median class age (Table 1). Compared with white students, the odds were 2.5 to 3.5 times greater that nonwhites were older than their classmates. The odds that rural and urban students were older than the class median were 1.5 and 3, respectively, compared with suburban students. Having carried a gun in the last 30 days, missing school out of concern for
personal safety, gang membership, and seeking medical care from a physician or nurse all were associated with a doubling of the odds of being older than other students within the same grade. Tenth and 11th-graders were no more likely to be above the median age than were 9th-graders. Having fought in the last 12 months was not associated with an increase in the odds of older-student status.

In the multivariate logistic analysis, only nonwhite race and living in an urban community were independent predictors of significantly elevated relative risk for increased age within a class. Male gender, gun-carrying, and missing school attained marginal significance. Gang membership and rural living were not independent predictors of an increased age within a class.

In the multivariate logistic regression, seven risk fac-

<table>
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<tr>
<th>Demographic Characteristic</th>
<th>N* (All Eligible Cases)</th>
<th>Percentage of Students Above Median Class Age</th>
<th>Crude OR</th>
<th>95% CI (Woolf)</th>
<th>Adjusted OR†</th>
<th>Adjusted 95% CI</th>
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<td>1583</td>
<td>16.0</td>
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<td>Grade 11</td>
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<td>20.7</td>
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<td>Missed school last 30 d out of fear for safety</td>
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<td>176</td>
<td>23.2</td>
<td>2.33</td>
<td>1.61–3.36</td>
<td>1.58</td>
<td>1.00–2.49</td>
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<td>Treated by MD or nurse after fighting in last 12 mo</td>
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<td>Fought without seeking treatment for injuries</td>
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<td>No</td>
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<td>1.00</td>
<td>—</td>
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<td>Yes</td>
<td>1155</td>
<td>12.6</td>
<td>1.13</td>
<td>0.92–1.44</td>
<td>0.96</td>
<td>0.70–1.31</td>
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</table>

* Totals do not equal 3153 in all demographic categories because of missing data.
† Adjusted by CDC weighting factor, clustering within classroom, and all covariates in the table. For adjusted analysis, 157 subjects were dropped because of missing data on one or more covariates (n = 2996).
To date, knowledge about adolescent firearms-carrying behaviors has received limited clinical attention. Risk factors such as tendency toward illicit activities, substance abuse, or sexual promiscuity are not clinically obvious and often difficult to determine. Objective determinants of risk such as age or grade are associated inconsistently with increasing and decreasing risk. This analysis focuses on easily obtainable characteristics from clinical history that can provide a useful assessment of the odds that an adolescent carries a firearm. It should be noted, however, that although age-within-school class may prove a useful objective risk factor for weapon-carrying, a careful psychological assessment still is required for patient evaluation.

The primary outcome of interest was the effect of age and grade on weapon-carrying. The finding that older students within a class carried weapons with greater frequency is consistent with research showing associations between increasing relative age and other behavioral, self-esteem, and school performance problems. A linear trend is apparent with the youngest students having the lowest odds, average-age students having intermediate odds, and oldest students at greatest odds for gun-carrying. At the same time, increasing grade tended to decrease the odds of having carried a gun, although effect estimates were statistically significant only in the bivariate analysis comparing 9th-graders with 11th-graders. One plausible explanation for a decrease in firearm-carrying with increasing grade is that students carrying guns in the lower grades drop out before advancement to higher grades.

As in results of other studies, male gender was
strongly associated with firearm-carrying, as was black race and living in an urban environment. It is unlikely that these students were carrying guns for hunting or target practice. Gang membership was the single best predictor of gun-carrying; it also was the question most likely to be left blank. The large number of nonresponses may be attributable not only to student concerns for anonymity, but also to uncertainty about whether they are actually members of a gang. Students who missed school out of concern for safety were more likely to carry guns, consistent with considerable research linking fear to weapon-carrying.15,17,18,20,21 Finally, fighting was associated with a dramatic increase in the odds of carrying a gun. Among students who had not fought in the last year, only 1% carried a firearm in the last 30 days. Among those who sought medical attention after a fight, 37% had carried a gun. This situation seems opportune for a discussion with the patient about firearms.

Effect estimates from the analysis are presented in two forms, as crude ORs and ORs obtained from multivariate regression models. Both the crude and adjusted OR have specific interpretation for those interested in the students who carry guns. Practitioners who encounter patients in circumstances such as in the emergency department often are limited in their ability to fully assess relevant risk factors, especially those drawn from sensitive aspects of the patient’s history. A physician treating a child for injuries sustained during a fight may know little else about the patient. Under these circumstances, the crude OR may be the most useful assessment of the child’s risk for carrying a firearm. However, the crude OR is inaccurate in assessing the causality of each risk factor on weapon-carrying, but it is more accurate in assessing overall risk. When the opportunity to define the adolescent’s risk profile presents itself more fully, the adjusted ORs should prove more accurate. Interventions then can be focused with attention to the potential causal role attributed to individual components making up total risk.

Although the MYRBS uses a large population-based dataset, there remains the potential for biased results. Students absent on the date the survey are not a random subset of the overall population. Adolescents who do not attend school typically have higher rates of risky behavior than those who do.31 Another problem is that the MYRBS relies entirely on self-reports. Although self-reports of criminal activity are considered reliable,46 informal analyses also were performed to evaluate the possibility that deliberate misrepresentation contributed greatly to the results. Analyses included eliminating respondents who reported engaging in all or almost all risky behaviors listed in the survey, engaged in the highest levels of the risky behaviors, and reported inconsistent results (for example, where the number of times seeking medical treatment after a fight was greater than the number of total times fought). Inconsistent responses and reports of extremely high risk-taking behavior made up <0.5% of all surveys included in the analysis; their elimination did not change the results appreciably.

Age is only measured to the nearest year; a student age 17 might be from 1 day to 365 days older than a student age 16. This type of error in measuring students age is a random error that depends only on the student’s birthday and not on any characteristic of the survey. Measurement errors in the exposure variable (such as relative age in this case) have been shown to weaken the association of interest, as long as the measurement errors are random.47 A better measurement of age might demonstrate a larger OR for the association.

Uncontrolled confounders pose an additional concern in the interpretation of the study results. Limited data were available to describe socioeconomic, demographic, and academic performance. Socioeconomic factors likely play a role in such associations as that seen between black race and weapon-carrying. The association between race and homicide rates sometime disappears when factors related to poverty are included in the analysis.48 The focus of this article was on known or suspected risk factors for weapon-carrying. It is possible that additional confounding by such variables as alcohol or drug use or other risk-taking behavior might account for the relationship between relative age and weapon-carrying.

The risk factors presented provide information about the association, not causality. For example, it is possible that students who are older than their classmates feel isolated and have low self-esteem, which lead to gun-carrying. It also is possible that carrying handguns creates a sense of isolation, which subsequently causes the student to fall behind in school. Similar statements could be made for most of the associations noted in the analysis. Despite the statistically significant relationship, relative age alone is a limited screening tool for weapon-carrying (sensitivity, 25%; specificity, 89%). In other words, only 25% of students older than the median age reported carrying a weapon in the last 30 days. Of students at the median age or younger, 89% denied carrying a weapon in the last 30 days. Predictive values, which are functions of prevalence, illustrate that relative class age has different interpretation depending on the population of adolescents. When applied to the overall population of survey respondents, the proportion of students older than the class median that carried weapons was 12% (positive predictive value).

In the same group of students, 95% of those at the median age or younger did not carry weapons (negative predictive value). When applied to the population of students who received medical treatment after fighting, the proportion of students older than the class median that carried weapons was 57% (positive predictive value). Among students receiving medical care for fighting related injuries, 67% of those at the median age or younger did not carry weapons (negative predictive value).

This study provides information on risk factors for adolescent gun-carrying. Of particular interest is the association between relative class age and carrying a firearm. Older freshmen, sophomores, and juniors are more likely than their classmates to engage in this type of illegal and high-risk behavior. Such informa-
tion can be useful to clinicians seeking to help high-risk adolescents.

REFERENCES

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