

RESEARCH ARTICLE

Impacts of Metal Detector Use in Schools: Insights From 15 Years of Research*

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ABSTRACT

BACKGROUND: Multiple approaches exist, both in theory and in practice, to reduce young people's risk of violent victimization when they are in school. Among these approaches, a growing number of school districts are choosing to install metal detectors. We sought to review the literature available on the impacts of metal detectors on school violence and perceptions about school violence.

METHODS: We conducted an extensive literature search, including databases for the medical, public health, sociology, and political science literature. Of 128 papers that met our search criteria, 7 studies met inclusion criteria for the literature review.

RESULTS: Each of the papers reviewed utilized data that originated from self-report surveys. Four of the studies consisted of secondary analyses of national databases, with the other 3 utilizing local surveys. The studies varied as to the outcome, ranging from student/staff perceptions of safety at school to student self-reports of weapon carrying and/or victimization, and showed mixed results. Several studies suggested potential detrimental effects of metal detectors on student perceptions of safety. One study showed a significant beneficial effect, linking metal detector use to a decrease in the likelihood that students reported carrying a weapon while in school (7.8% vs 13.8%), without a change in weapon carrying in other settings or a decline in participation in physical fights.

CONCLUSION: There is insufficient data in the literature to determine whether the presence of metal detectors in schools reduces the risk of violent behavior among students, and some research suggests that the presence of metal detectors may detrimentally impact student perceptions of safety.

Keywords: violence; injury prevention; public health.

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Over 2500 youth between the ages of 10 and 19 years were victims of homicide in 2006—the second leading cause of death in the United States for this age group.¹ For every homicide, approximately 161 adolescents (estimated total = 406,000) are treated in emergency departments for nonfatal assault-related injuries during the same year.² Youth violence is clearly a critical public health problem in need of effective prevention strategies.

During every school day, 1 in 5 Americans can be found within a school building,³ a setting which our society has committed to maintaining as a safe location for young people to learn. Additionally, exposure to violence in schools is a significant predictor of future aggression in both girls and boys,⁴ and

exposure to even low-level violence in school is known to negatively impact school performance⁵ and students' trust in interpersonal relationships.⁶ Therefore, educators, policy makers, researchers, and families share an interest in understanding and reducing risk for violence on school property.

Data from the Centers for Disease Control and Prevention's (CDC's) School Associated Violent Death (SAVD) study indicate that about 1% of all homicides of school-aged youth in the United States occur while on school property, on the way to/from school, or while at or in transit to or from a school-sponsored event. Despite the nature of some high-profile events, the majority of school-associated homicides are much like homicides that occur outside of school. They

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involve 1 victim and 1 perpetrator and they are often motivated by a dispute about a romantic relationship, drugs, money, or gangs.³ SAVD data also show that rates of school-associated student homicides in the United States have declined since the early 1990s.²

Although school-associated homicides are rare and rates have decreased in recent years, preventing violence at schools remains an important priority because associated behaviors, such as student fighting and weapon-carrying at school, are common and have far-reaching consequences. The 2007 Youth Risk Behavior Survey data (YRBS), collected from over 14,000 high school students throughout the United States, indicate that 12% of students reported being in one or more physical fights on school property in the previous 12 months and 6% reported carrying a weapon on school property at least once in the past 30 days. Many students (8%) report being threatened or injured with a weapon on school property at least once in the prior year.⁷ These exposures contribute to the risk for serious or fatal injury and can result in considerable fear among students, parents, and teachers. In fact, the YRBS data indicate that the proportion of students missing at least 1 day of school in the previous month because they felt unsafe either at school or on the way to or from school has increased linearly from 1993 to 2007. The 2007 data indicate that 1 in 18 students (6%) reported missing at least 1 of the previous 30 school days because of safety concerns.

The 53 million students who attend US schools each year are not the only group placed at risk when school violence occurs; nearly 6 million teachers or staff members are employed in the nation's 114,000 schools.⁸ Approximately 7% of teachers reported being threatened by a student and 3% of teachers reported being attacked during the 2003/2004 school year.⁹

To ensure the safety of students, school districts often institute a variety of measures, including the installation of metal detector systems. Data from the 2006 School Health Policies and Programs Study indicate that approximately 10% of middle and senior high schools use metal detectors, and the proportion of elementary schools using metal detectors more than tripled between 2000 (1.2%) and 2006 (4.4%). Metal detector systems require an investment in both the equipment (walk-through or handheld machines) and appropriately trained staff. The Cleveland public school system estimated a cost of \$3.7 million to incorporate walk-through metal detectors and X-ray scanners in each of 111 public schools. This estimate includes 1 detector per 500 students, and the hiring of 50 full-time armed security guards and 150 part-time security guards.¹⁰

Given the limited financial and personnel resources available for the prevention of youth violence in schools, schools must select strategies that are most likely to be effective. The purpose of this review is to

summarize the body of literature regarding the impact of metal detectors on school violence and perceptions about school climate.

METHODS

Criteria for Considering Studies for This Review

A broad literature search was conducted. Studies reviewed included those that involved students, teachers, or principals in public or private school settings, and in elementary, middle, or high schools. The primary focus of the review was on studies that assessed perceptions related to metal detectors, or the impact of metal detectors on violence-related behaviors; studies could examine screening methods that utilized either walk-through or wand-style metal detectors.

Search Methods for Identification of Studies

We conducted a search for published articles as well as conference proceedings and abstracts in multiple electronic databases (listed below); the search was limited to articles published in English. We also reviewed all commonly linked Web sites for links and references to published articles and searched the reference lists of both included and excluded articles, as well as reference lists of other review articles pertaining to school violence.

The following databases were searched electronically: PubMed, PsycInfo, EMBASE, CINAHL, ERIC, Social Services Abstracts, Sociology Abstracts, Health and Safety Science Abstracts, PILOTS, and Global Health. We used the following search terms both individually and in all combinations: (metal detector* or weapon* detect* or x-ray scanner* or wand detector*) and (school* or campus* or educational police* or student*), with the last search performed on April 4, 2008.

RESULTS

One hundred and twenty-eight articles met the search criteria and were retrieved and reviewed. Articles that did not pertain to research studies or to the school setting, or did not include research questions pertaining to the use/presence of metal detectors were excluded. Conversely, to maximize breadth, all articles that included metal detectors, either as part of a larger survey or as part of a composite measure of school security, were included in the final review, as were a wide range of sampling and study designs.

Of the studies reviewed, 7 met inclusion criteria. These included 5 studies that examined perceptions related to metal detectors and 2 that focused on associations between metal detectors and violent behavior (Table 1).

Table 1. Summary of Articles Included in the Literature Review

Article	Aim	Sample	Method	Results
Ginsberg and Loffredo ¹¹	Assess the violence-related attitudes and behaviors among teenagers 15-19 years old	A representative sample of students in all New York City Public Schools	Self-administered questionnaire	Students at schools with metal detector programs were less likely to carry a weapon in school (7.8% vs 13.6%) and going to and from school (7.7% vs 15.2%) There was no difference in the rate of weapons carrying outside of school, or the prevalence of threats or violence.
Brown ¹²	To assess the attitudes of students regarding "hard control methods," such as security officers and metal detectors	A convenience sample of 230 students in public schools in Brownsville, TX	A written survey administered to students at school	To the statement, "Police/security officers should search students with metal detectors," 57% of girls answered "Yes," as opposed to only 40% of boys (49% of the total group answered yes).
Gastic ¹³	To study the effect of school safety measures on students' perceived safety	A nationally representative study (The National Longitudinal Study of Adolescent Health, Waves 1 & 2)	Self-administered survey followed by in-home interviews	Students who were exposed to "safe-school" policies such as the presence of security guards and metal detectors were likely to report feeling less safe in their schools
Garcia ¹⁴	To assess the opinions of school safety administrators regarding the effectiveness of various school safety measures	A convenience sample of 41 school safety administrators across 15 states	A mailed, written survey	Over half (55%) of administrators felt that metal detectors were "somewhat" or "very" effective "overall" Thirty-two percent felt that metal detectors were somewhat or very effective at reducing violent crime Fourteen percent felt that they were somewhat or very effective at reducing drug crimes. Thirty-two percent of administrators from districts which utilized metal detectors felt that it was effective for reducing or minimizing crime
Schreck ¹⁵	To identify factors that increase students' risk of being victims of theft or violence in schools	A randomized national study (The 1993 National Household and Education Survey)	Telephone survey	No association between the use of metal detectors in a student's school and that student's risk of theft or physical assault
Mayer and Leone ¹⁶	To examine the relationship between school safety practices, school disorder, and student perceptions	A randomized, national survey (The 1995 School Crime Supplement to the National Crime Victimization Survey)	A mailed, written survey	Increased use of physical and personnel-based security measures were associated with increases in students' perceptions of school disorder
Mayer ¹⁷	To refine the earlier analysis (Mayer, 1999) and establish directionality and a causal relationship	A randomized, national survey (The 1995 and 1999 School Crime Supplement to the National Crime Victimization Survey)	A mailed, written survey	Replicated earlier findings that connected increased use of school safety measures with increased student perceptions of school disorder Researchers were unable to establish the directionality between these constructs

Perceptions Associated With Metal Detectors

In a large, national study, Gastic utilized data from Waves 1 and 2 (years 1994 and 1996) of The National Longitudinal Study of Adolescent Health, a representative study of youth in grades 7-12.¹³ Her study assessed the associations between school safety interventions (including metal detectors, security guards, and school uniforms) and students' perceptions of their personal safety while at school. She examined the interactions between student-level characteristics, school-level characteristics, school

safety interventions, and student safety attitudes. The dependant variable, "student safety climate," was derived from the average of student responses to 2 questions regarding their safety at school (B. Gastic, Personal communication, September 2008).

This study found that at schools in which the principal reported a higher-than-average level of school problems, the presence of metal detectors had no significant association with student safety climate. However, in schools with an average level of principal-reported student problems, metal detectors' presence

had a significant negative association ($b = -0.17$, respectively) with perceived safety (ie, the presence of metal detectors was associated with a lower perception of safety).

In another study evaluating the association between metal detectors and student perceptions, Mayer and Leone utilized data from the 1995 National Crime Victimization Survey School Crime Supplement (NCVS-SCS), a national phone survey of students aged 12 to 19 years, to create a statistical model evaluating the relationship between 4 constructs: "System of Law" (a construct representing student knowledge of school rules), "Secure Building" (a composite measure based on physical and human components of school safety, including metal detectors and security guards), "School Disorder" (a construct which reflects the degree of violence and perceived disruption in the school), and "Individual Self-Protection" (a construct reflecting the students' experiences of and feelings about school violence, and actions they take to minimize the threat to themselves).¹⁶ Their analysis suggests that increased use and implementation of physical and personnel-based security measures is directly correlated with increased student perceptions of violence in the school, as measured by the "Individual Self-Protection" construct, as well as increased measures of "School Disorder."

In a subsequent, related analysis, Mayer repeated this modeling approach with the 1999 NCVS-SCS, utilizing the same 4 constructs. This study included only those students who were in grades 6 through 12 and who attended a public high school for at least 4 of the 6 months prior to participating in the survey ($n = 5656$).¹⁷ The results replicated the earlier finding that secure building strategies were positively associated with elevated measures of school disorder, but the authors were unable to establish the directionality of the associations between these constructs.

Brown performed a survey of student opinion regarding school security during in the 2000-2001 school year.¹² This study assessed the opinions of a convenience sample of 230 students attending high schools in the Brownville, Texas Independent School District. The survey consisted of 7 questions regarding students' perceptions of the effectiveness and impact of different school safety measures. Only 1 of these questions focused on metal detector use, stating: "Police and security officers should use metal detectors to search students." Students were asked to respond either affirmatively or negatively to each statement presented. Slightly fewer than half of the students (48.7%) responded affirmatively to this statement, with 56.9% of female students agreeing with the statement compared with 40% of male students. This study did not probe further to assess the reasons why

the majority of the student population did not feel that metal detectors should be used.

Garcia surveyed a convenience sample of 41 school safety administrators (SSA) from 15 states.¹⁴ The administrators surveyed were selected based on recommendations of participants in the 1999 National School Security Officer's Forum sponsored by the US Department of Education's Safe and Drug Free Schools Program. The study contained numerous questions pertaining to school safety and violence prevention, a segment of which focused on metal detectors.

When asked about the overall effectiveness of metal detectors, 55% of SSA stated that the metal detectors were either "somewhat effective" or "very effective." Conversely, only 32% of SSA stated that the metal detectors were either somewhat or very effective at reducing violent crime, and 14% and 5%, respectively, felt that they were effective for preventing drug crimes and property crimes. Among districts using metal detectors, only 32% of respondents thought that this type of technology was effective in preventing or minimizing crime.

Violence-Related Experiences and Behaviors

Ginsberg and Loffredo performed the earliest study examining the use of metal detectors in schools, as part of a larger study of violence-related behaviors among high school students.¹¹ Researchers developed a self-administered questionnaire that was distributed to a representative sample of 2100 students in 9th through 12th grade in the New York City Public Schools. This study found that over the 30 days prior to the survey, students who attended schools with metal detector programs were less likely than students in schools without metal detectors to carry weapons in school (7.8% vs 13.6%) or in transit to school (7.7% vs 15.2%), but were equally likely to carry a weapon "anywhere" (21.6% vs 21.2%). The survey did not show a difference between students in schools with and without metal detector programs in rates of self-reported received threats (35.7% vs 36.2%) or physical fights in school (7.5% vs 7.8%) or physical fights "anywhere" (26.2% vs 24.4). The authors note that the outcomes rely on student self-reports and it is possible that students in schools with metal detectors may be less likely to disclose weapon carrying on school property than students attending schools without metal detectors.

In another study assessing the association between the presence of metal detectors and student experiences of crime, Schreck et al performed a secondary analysis of the 1993 National Household and Education Survey School Safety and Discipline component (NHES-SSD) to examine a variety of community and school risk factors for student schoolyard victimization risk.¹⁵ This study used data on 6418 students, in grades

6 through 12. The dependent variable, "Individual Victimization at School," was coded to reflect whether students reported any of the following: theft from the respondents' locker or desk, theft accompanied by physical force, and physical assault. The authors then analyzed the association between individual-, family-, school-, and community-level factors and student risk of victimization at school. The finding most relevant to this literature review was the lack of a statistically significant association between the presence of metal detectors in the school and any of the 3 forms of student victimization. Students in schools with metal detectors were just as likely to report victimization as those in schools without metal detectors.

DISCUSSION

We reviewed the existing literature regarding the effects of school metal detector use on rates of school violence and on student and staff perceptions of safety. Our search included medical and public health as well as sociological, social services, and educational databases, among others. The findings present a mixed, complex, and sometimes contradictory picture of the impact of metal detector use in schools. The strongest evidence supporting the use of metal detectors in schools comes from the Ginsberg and Loffredo comparison of reports from students in New York schools with and without metal detectors. While the lower rates of weapon carrying reported by students attending schools with metal detectors is encouraging, the implications of this finding are limited, given that the authors did not evaluate the association between metal detector use and weapon-related outcomes, such as rates of gun violence and weapon-related injuries. The lack of a pre-post study design and the reliance upon self-report data make it impossible to determine if the data reflect actual differences in gun carrying or if the findings reflect a reporting bias, with students in schools with metal detectors less likely to disclose carrying weapons. Furthermore, a sizeable proportion of students in schools with metal detectors (7.8%) still reported carrying a weapon in school and students in these schools were at equal risk of threats and fights as students in schools without metal detectors; this raises the possibility that those students most intent on using a weapon to threaten or injure another person may be undeterred by the presence of metal detectors. The lack of a protective effect on victimization is replicated by Schrek, who found that the presence of a metal detector program at a child's school was not associated with students' risk of being robbed or physically attacked at school.

With regard to student perceptions related to metal detector use, we found that less than half of students sampled from Brownville, Texas thought that police and security officers should use metal

detectors to search students.¹² Moreover, data from a nationally representative sample of middle and high school students showed that in schools with principals reporting an average level of student problems, the presence of metal detectors was associated with lower student perceptions of safety.¹³ Similarly, 2 sequential analyses of the NCVS-SCS by Mayer and Leone determined that higher levels of school security measures (including metal detectors and guards) were associated with increased school disorder (including violence and perceived disruption). Crystal Garcia's study indicated that only 32% of SSA felt that metal detectors were either "effective" or "very effective" for reducing violent crime at school. Students and staff may respond to metal detectors in unpredictable ways. They might perceive the metal detector program as an indication that students are carrying weapons and they can potentially react with heightened feelings of vulnerability or aggression.

Limitations

Unfortunately, these studies share a number of limitations that make it impossible to draw definitive conclusions about the impact of metal detectors. First, the fact that all of the studies are based on surveys prohibits any conclusions about objective outcomes, and raises concerns about response biases, including socially desirable responding and deliberate misreporting. Additionally, all 7 studies relied on cross-sectional data, a characteristic that makes it impossible to draw conclusions about the causal relationships between metal detector use and student behavior or perceptions about safety. The cross-sectional studies showing greater disorder in schools with metal detectors could be due to struggling schools choosing to employ metal detectors (ie, disorder leads to metal detectors), to students responding negatively to metal detectors (ie, metal detectors exacerbate fear and disorder), or to other factors, such as neighborhood gang activity, leading to both metal detector use and student disorder in schools. Additionally, the cross-sectional nature of these studies makes it difficult to separate the impact of metal detector use from other aspects of a school violence prevention program, as many of the schools with metal detectors may also have instituted the use of security guards, closed circuit video monitoring, and educational programs at the same time as the metal detectors were installed.

In addition to the limitations of each individual study, this review also has a few limitations that should be considered. First, the fact that the literature search was limited to English-language studies has meant that we may have missed studies that took place in non-English-speaking countries. This may limit generalizability of our conclusions to other countries. Additionally, although we used a very broad set of

search terms and a wide range of literature databases, it is possible that other relevant research was missed. The review is limited by the specific choices of search terms, potential biases in the databases, and the reliance on articles and abstracts that were published either in journals or in conference proceedings.

Conclusion

This review highlights what is currently known about the effects of metal detectors on school violence, student behaviors, and student and staff perceptions of safety. In reviewing what is known, the questions that remain unanswered by the existing body of literature are also highlighted. Based on these findings, we conclude that there is insufficient evidence to draw a conclusion about the potential beneficial effect of metal detector use on student and staff behavior or perceptions; furthermore, some research suggests that the use of metal detectors in schools is associated with lower levels of students' perceptions of security in school and higher levels of school disorder.

Future research should use objective data and appropriate controls to evaluate the impact of metal detector use on rates of weapon carrying, violent behavior, and violence-related injuries. In addition, these studies should also assess the influence of metal detectors on both student and staff perceptions of safety. Finally, we propose that future studies should be structured to include pre-/post-analyses and, ideally, randomization of similar schools within districts to the presence or absence of metal detectors, in order to avoid the biases present in past research.

The lack of a clear conclusion for this literature review raises the question of how school districts, worried about violence on a daily basis, should respond now. Metal detector programs are expensive, and funds spent on metal detectors would not be available for other programs and strategies that have been shown to be effective at reducing youth risk for violence and promoting pro-social behaviors.^{11,15,18} School districts can help educate school staff, parents, students, and community members about the range of youth violence prevention options and the available evidence of effectiveness so that they can provide informed perspectives about which strategies best meet their unique needs. In this way, they can create long-term changes to promote nonviolence within schools.

IMPLICATIONS FOR SCHOOL HEALTH

Although metal detectors may hold an appeal because they are viewed as a quick and visible solution to school violence, schools must also weigh evidence of effectiveness and cost when determining which youth violence prevention strategies to employ. Given the

lack of clear evidence of the effectiveness of metal detectors in preventing violence as well as the significant cost, schools may wish to either incorporate metal detectors as one component of a comprehensive program, or explore alternate strategies. As stated by Ginsberg and Loffredo, "reducing the occurrence of violence in schools will require the coordination of school-based violence prevention programs with community-based organizations, parent groups, teachers, and state and local health and other agencies that serve youth." (p. 438)¹¹

Fortunately, there are many strategies that have demonstrated effectiveness in preventing or reducing youth violence and in promoting pro-social behaviors that can be implemented as part of a coordinated school health model. For example, the Blueprints project at the University of Colorado's Center for the Study of the Prevention of Violence identifies 11 model programs that meet rigorous criteria for effectiveness.¹⁹ Also, a recent systematic review of universal school-based violence prevention programs by the Task Force on Community Preventive Services found these programs were associated with a median 15% reduction in aggressive behavior among students.²⁰ The review examined a variety of types of program strategies (eg, informational, cognitive/affective, and social skills building) and program foci (eg, antisocial behavior or bullying) and reported a reduction in violent and aggressive behaviors across all types of program strategies, program foci, grade levels, and populations. Moreover, the one program that examined costs and benefits of a comprehensive prevention program that included violence prevention (ie, Seattle Social Development Project) reported a 13% decrease in violent crime, and estimated a benefit of \$3.14 for every dollar invested in the program. As a result of this review, the Task Force recommends universal, school-based programs for youth violence prevention. School officials and community decision makers can be guided by these and other summaries of the research on prevention strategies.²¹

The majority of schools in the United States offer some instruction on violence prevention. A recent survey of school health policies and programs indicates that 86% of elementary schools, 77% of middle schools, and 77% high schools require the teaching of violence prevention in a required health education class or course.²² However, the health education curriculum is only one of many ways in which violence prevention can be addressed in schools. Given the significant body of research that supports the effectiveness of primary prevention programs in decreasing rates of student aggression and violence, these evidenced-based programs provide an option for a positive, proactive action that schools can take to prevent aggressive behavior and promote pro-social behavior.^{11,15,18}

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