UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

The Hidden Costs of Violence:

Evidence from Explosions and Shootings in Close Proximity to Schools and Their Impact on Educational Performance in Sweden

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Abstract

This thesis examines how shootings and explosions affect sixth-grade students' performance on Sweden's national mathematics exam. Using school-level panel data from 2018 to 2024, excluding Covid-affected years, we analyze how proximity to violent events influences the share of students receiving a passing grade. We find a negative and statistically significant association for shootings, while explosions show negative but insignificant effects. Our analysis shows that spatial proximity to violence has a stronger impact on performance than timing relative to the exam. We find no evidence that exam attendance changes in response to violent events, pointing to psychological stress as the most credible mechanism. We observe suggestive, though not statistically significant, gender heterogeneity, where shootings appear to have greater impact on boys, while explosions seem to affect girls more, possibly reflecting differing psychological or social responses shaped by gender norms, exposure, or perceived safety. This study contributes to the literature by providing evidence from Sweden, a high-income country, unlike most prior research focused on lower-income countries.

Keywords: Violence, Educational performance, Psychological stress, Sweden

* We thank our supervisor, Sanna Bergvall, for valuable discussions and guidance.

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1. Introduction

"32 explosions in 28 days", "Mass shooting in Örebro – eleven people dead", "Criminals exploit school choice – to maintain power over drug sales", "15-year-old boy shot classmate in the face in school bathroom", "Three people shot dead in central Uppsala", "Dad shot in the head – in front of his twelve-year-old son".[1] These are just a few of the headlines that have shaken Sweden in the past year. Once considered a safe, high-income country, Sweden is now experiencing an upward trend in shootings and explosions, unlike most of Europe. In recent years, Sweden has experienced 2,491 shootings, of which 359 were fatal, ranking the nation among the European countries with the highest number of shootings per year (Mondani & Rostani, 2023; SVT, 2025*b*). This development has turned Sweden into a cautionary example, far from its former image as a safe, high-welfare state, and has sparked political debate concerning law enforcement policies, segregation, social integration, and youth crime prevention. In addition to the immediate implications for public safety, there is growing concern about how being in close proximity to violent crimes may affect everyday life, particularly for children.

One worrying concern is the growing involvement of younger children in organized crime. Criminal networks exploit the fact that minors face lighter penalties by recruiting them to commit crimes and maintain territorial control (The Swedish Police Authority, 2024). Schools have become key environments in this strategy, with more "high-ranked" members strategically assigning younger recruits to specific schools to maintain control over local areas (Faraj *et al.*, 2025). This raises concerns about whether the presence of such networks and the persistent threat of violence might disrupt the school climate, create stress or fear, and hinder students' learning and concentration. Recent data show that around 16% of Swedish primary school students attended a school near at least one shooting within 500 meters in the past three years. This figure rises to 50% in cities like Stockholm and Malmö (Hedström *et al.*, 2022). Over 40% of shootings with injuries or fatalities occur near preschools or schools, with even higher rates in urban areas (Chamy *et al.*, 2021). Such exposure likely undermines students' sense of security, potentially affecting academic performance through anxiety, routine disruptions, or reduced teacher effectiveness.

[1] These news articles are, in order of appearance, from Tanaka *et al.* (2025), SVT (2025*a*), Faraj *et al.* (2025), Nordström (2025), Hernwall and Bergkvist (2025), and Karlsson *et al.* (2024); see reference list for full citations.

This paper studies the impact of shootings and explosions in close proximity to schools on educational outcomes by using a unique, novel dataset built with data obtained from The Swedish Police Authority, containing detailed records of violent incidents, and the Swedish National Agency for Education. We have precise information on the date and location of shootings and explosions close to exam dates. Our main outcome variable is the share of students receiving a passing grade on the written national exams in mathematics. In addition, we examine how the effects vary by distance and timing relative to the national exam.

Focusing on sixth-grade students, our empirical strategy exploits within-school variation over time for students obtaining a passing grade, and how violent events close to exam dates impact exam performance for these students. Next, we evaluate how the effect differs depending on distance and time before the exam. Then we perform the same analysis on a subsample of schools located in urban areas, where exposure to violent events is more frequent, to explore whether the effects differ across contexts. In addition, we evaluate possible mechanisms like exam attendance, and run placebo tests to check the robustness of our results, which confirms the validity of our empirical model.

We find a significant negative effect of shootings on educational performance for our baseline model, including violent events within 1,000 meters six weeks before the first written national test in mathematics, and find that the negative effect on the share of students obtaining a passing grade decreases in magnitude when the spatial distance is increased, but the timing before the exam does not significantly affect the results in our setting. Specifically, we find that the passing rate for students decreases by 1.8% for a shooting within 1,000 meters, six weeks before the exam. For explosions, we set our baseline model to 1,500 meters and six weeks to account for the lower frequency of violent events, and we find that they are associated with negative coefficients, but the main effects are not generally statistically significant. Moreover, the effects become stronger when the violent events occur closer in both space and time to the exams, suggesting that nearby and recent violence has a greater impact on students' performance.

Additionally, we evaluate potential mechanisms and heterogeneity within our results. We find no evidence that exam attendance changes in response to violent events, pointing to psychological stress as the most credible mechanism. We also observe suggestive gender heterogeneity, where shootings impact boys to a larger extent, while explosions affect girls more, though these results are not statistically significant. This pattern may reflect differing psychological or social responses shaped by gender norms, exposure, or perceived safety.

There are few studies estimating the relationship between local violence and educational outcomes. Monteiro and Rocha (2017) find that gunfights in Rio de Janeiro's favelas negatively affect fifth-grade students' math scores, with stronger effects when violence is intense, prolonged, or close to exam dates. Similarly, Michaelsen and Salardi (2020) show that homicides near schools in Mexico shortly before standardized tests impair students' performance, and highlight the importance of timing and proximity. Koppensteiner and Menezes (2021) document that homicides in São Paulo reduce math scores and school attendance, suggesting that local violence disrupts both academic achievement and engagement.

Building on the existing literature, we contribute by evaluating the effect of not only shootings on educational performance, but also explosions, which, to our knowledge, are an unexplored form of violence. Although Sweden is a high-income welfare state characterized by its robust safety net, it has recently, as previously emphasized, experienced an alarming rise in explosions linked to the criminal milieu. To address this gap, we go beyond existing studies as we incorporate both shootings and explosions, leveraging detailed spatial and temporal variations in our data. This allows us to capture a broader range of violent events and to provide more detailed insights into how different forms of violence affect educational performance. Additionally, we contribute by evaluating potential heterogeneous effects and exploring the mechanisms underlying the observed relationships, offering a more nuanced understanding of how localized violence may impact students' educational performance.

Our findings carry important policy implications. Since psychological stress emerges as the most likely mechanism through which violent events affect exam performance, our results call for targeted mental health interventions in schools and a strategic allocation of resources. These include trauma-informed psychological services, gender- and context-sensitive support programs, and rapid-response counseling teams following violent incidents. Disadvantaged and understaffed schools are more vulnerable to the effects of violence, highlighting the importance of targeted funding. Moreover, as explosions increasingly impact schools outside traditional high-risk areas, policy responses must expand to ensure that all students have access to safe and supportive learning environments.

The remainder of the paper is organized as follows. In Section 2, we provide background on the escalating violence; Section 3 presents some previous literature; Sections 4, 5, and 6 present the theory, data, and empirical strategy, respectively; Section 7 presents the results; Section 8 concludes.

2. Institutional Background

In recent years, Sweden has experienced a significant increase in gun violence and explosions tied to gang crime. Many European countries have seen a decline in gun violence since 1990, while Sweden's trend diverged around 2013 with a steady rise in fatal shootings (Hradilova Selin & National Council for Crime Prevention, 2021). Over the past few years, Sweden has ranked among the highest in Europe in terms of gun-related deaths, with approximately four deaths per million inhabitants, compared to the European average of 1.5. The increase in fatalities is particularly pronounced among young men aged 20-29, who are disproportionately affected by gun violence (Hradilova Selin & National Council for Crime Prevention, 2021). Figure 1 presents the annual distribution of shootings, including the number of injured and fatalities, while Figure 3, Panel A, illustrates the geographical distribution of shootings across municipalities.

In the late 2010s and early 2020s, criminal networks became more fragmented, and violence became more unpredictable and widespread. One of the most notable trends is the involvement of younger individuals in violent events. Teenagers are recruited to carry out violent acts on behalf of more established criminals (Swedish National Council for Crime Prevention, 2025*a*). This shift has contributed to a normalization of extreme violence among youth and further increased the challenges for vulnerable municipalities, where gang violence is most common (Swedish National Council for Crime Prevention, 2025*b*).

Parallel to the increase in shootings, explosions have become a growing concern. In January 2025, Sweden experienced 37 explosions in only 28 days, highlighting the intensity of violent events (Tanaka *et al.*, 2025). Explosions are often used as a way to threaten and intimidate others in the ongoing criminal conflicts, making these neighborhoods feel even more unsafe. Different from gun violence, which primarily targets individuals, explosions often result in damage to property. They can create a more general sense of fear and instability among residents. Figure 2 displays the distribution of explosions from 2018 to 2024, while Figure 3, Panel B, shows the distribution of explosions across municipalities from 2021 to 2024.

The increase in gun violence, but also explosions, raises concerns about its broader societal impacts, particularly on children and adolescents. Schools, as the central institutions in local communities, may be negatively affected by violent events that occur close by. Previous research indicates that violence and insecurity can disrupt the school environment, leading to teacher absenteeism, school closures, and reduced student performance (Monteiro & Rocha, 2017; Brück *et al.*, 2019).

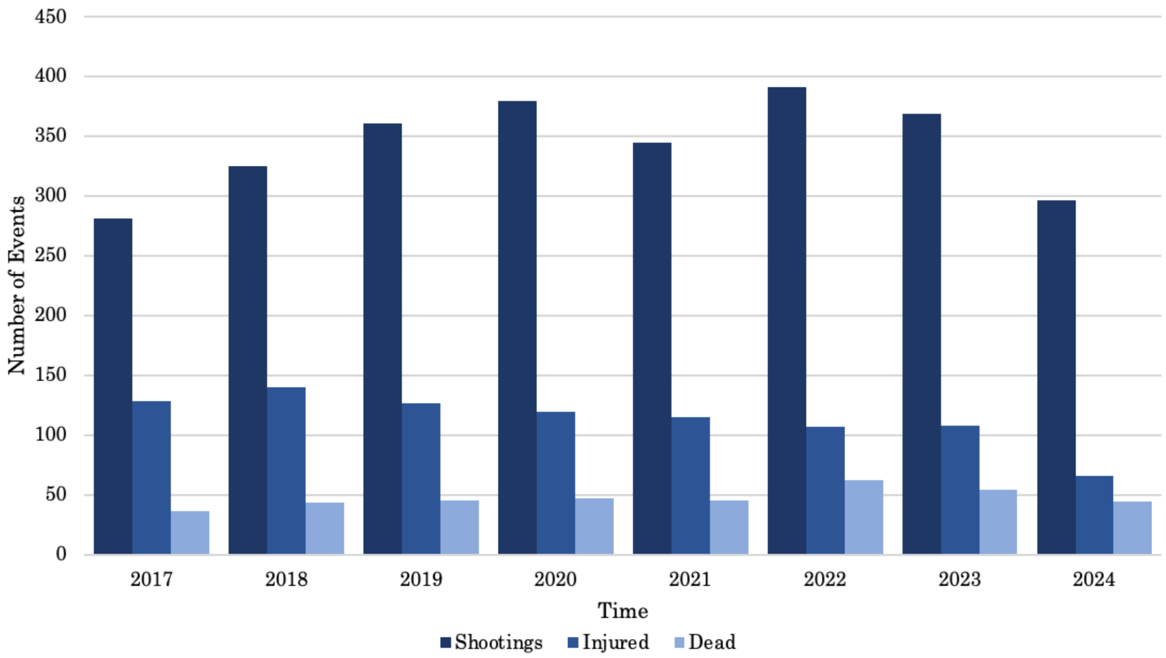


Figure 1: Shootings, Injuries, and Fatalities, 2017-2024

Note: Figure 1 shows the number of shootings, shootings with injured victims, and deadly shootings between 2017 and 2024. Source: The Swedish Police Authority (2025).

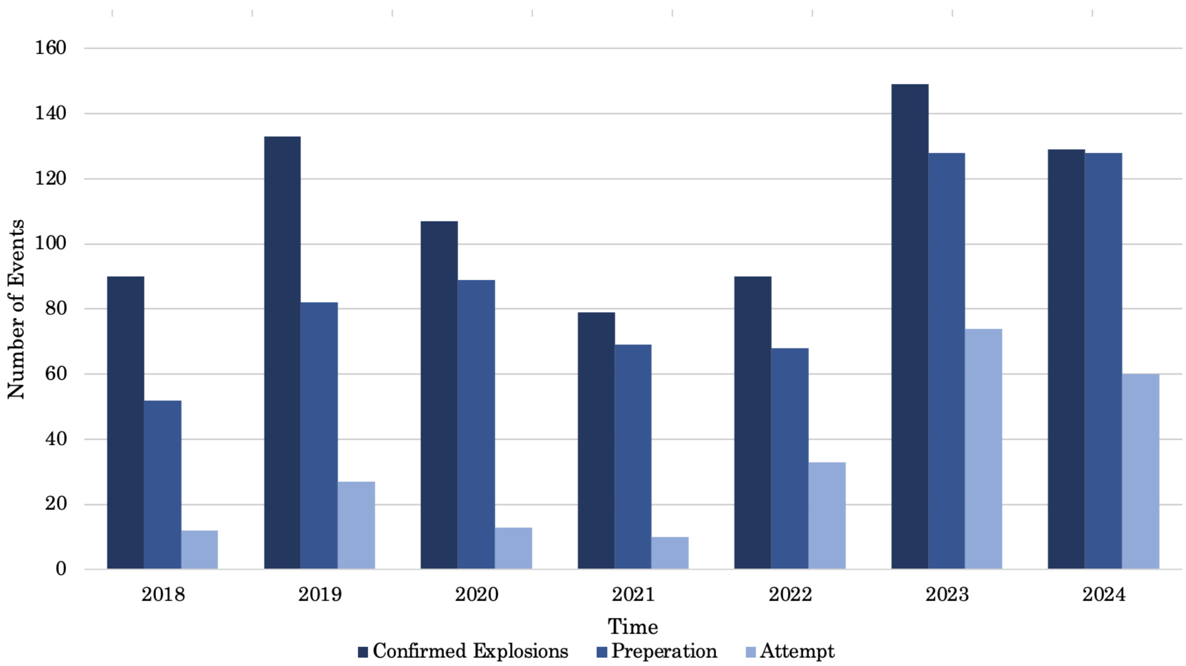
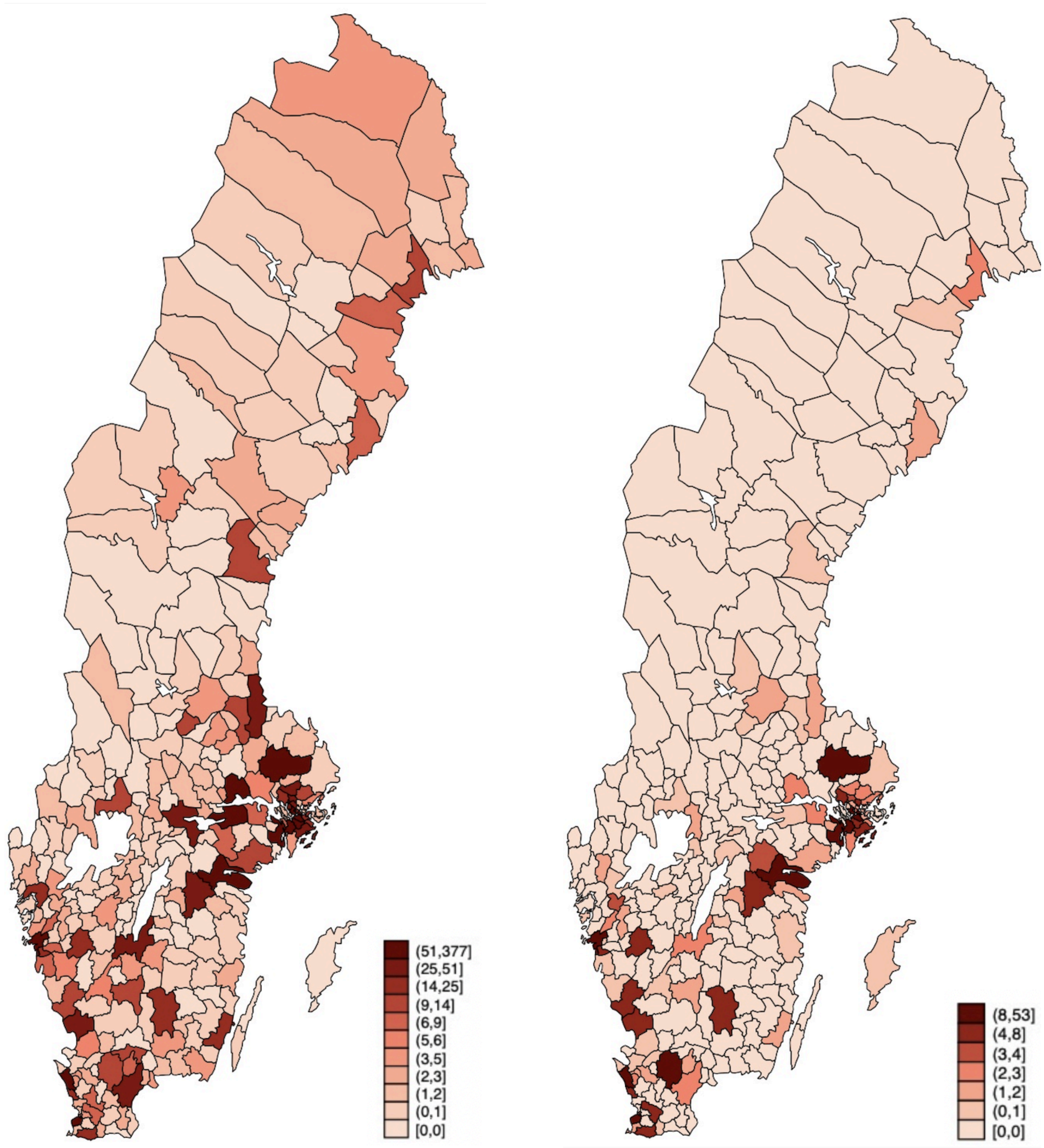


Figure 2: Explosions, Preparations, and Attempts, 2018-2024

Note: Figure 2 shows the number of confirmed explosions, prepared explosions, and attempted explosions between 2018 and 2024. Source: The Swedish Police Authority (2025).



A. Shootings 2016-2025 B. Explosions 2021-2024

Figure 3: Shootings and Explosions by Municipality over Time

Note: In Figure 3, data for shootings covers 2016 to January 2025, while data on explosions covers 2021 to 2024. Each municipality is shaded according to the total number of shootings in panel A and explosions in panel B, classified into 25 quantile-based categories. Source: The Swedish Police Authority (personal communication, January 23, 2025).

3. Literature Review

Violence and conflicts have been studied for their broad economic, social, and institutional impacts. Blattman and Miguel (2010) highlight that violence and conflicts have a severe effect on economic, social, and institutional impacts, such as the destruction of physical and human capital, disruptions to governance, and long-term institutional weaknesses.

Starting broadly, Akbulut-Yuksel (2014) provides evidence of the socioeconomic consequences of the large-scale physical destruction by the world's most costly and widespread conflict, World War II. The study shows that individuals who were of school age during the war experienced worse outcomes later in life in the form of lower earnings, poorer health, and shorter life expectancy. Further, the study identifies the loss of teachers as the key mechanism behind educational losses.

While many studies, just like Akbulut-Yuksel (2014), examine the consequences of wars, a related part of the literature focuses more on the effects of more localized violence, particularly school shootings in the US. Beland and Kim (2016) examine the short-run effect of fatal shootings in schools by using detailed student-level data. The authors argue that homicidal shootings lead to lower test scores in both English and math, as well as a decline in students enrolled in grade nine. The study does not find any significant effect on either average attendance or graduation rates, suggesting that academic performance is more sensitive to violent events than general school engagement. Further, Cabral *et al.* (2024) broaden the understanding of the consequences of school shootings by focusing not only on mass shootings but also on the full spectrum of gun violence on school grounds. They find that even shootings with no or a few fatalities can have a large impact on student outcomes. Exposure to violent events during high school can have large, long-lasting effects in the form of lower earnings. In the short run, it may affect student absenteeism. Together, these studies highlight that violent events can disrupt students' development and education.

Although violence within schools receives considerable attention, several studies have looked more broadly at how living in or near violent areas affects students' educational achievement. Justino (2011) emphasizes that conflicts and violence are important issues concerning the development challenges of the world.

Several studies examine the educational consequences of violence in specific national contexts. Monteiro and Rocha (2017) provide evidence from Brazil by investigating the negative spillover effects of gunfights in the favelas[2] of Rio de Janeiro on students' educational performance in standardized exams. The authors use panel data and leverage temporal and spatial variations of gang-related violence to estimate its causal effect on educational achievement on math scores for fifth-grade students. Their findings indicate that students in schools with greater exposure to gun violence perform statistically significantly worse in math during years of conflict.

Moreover, the study finds that the impact of violence on test scores is not uniform, instead, it varies based on the intensity, duration, and timing of violent events. The negative effect is stronger when gunfights are more intense, persist for longer periods, or occur closer to exam dates, suggesting that short-term stress and disruption to classroom learning play a crucial role in shaping academic performance.

Another study concerning violence and educational achievements is the work of Michaelsen and Salardi (2020), focusing on Mexico. They find that violence, measured by the number of homicides, has a short-term negative impact on educational performance. Specifically, homicides near schools in the week before standardized tests disrupt students' ability to perform, illustrating the immediate effects of violence. The authors highlight that violence creates immediate and intense psychological stress, which directly disrupts students' ability to concentrate, prepare, or perform well during tests. Moreover, Michaelsen and Salardi's (2020) empirical model exploits the variation and the timing of homicides relative to standardized testing dates, which allows them to investigate the effect of proximity and timing. The authors highlight that the closer and more immediate the violent event, the greater the negative impact on test scores, meaning that their results align with Monteiro and Rocha (2017), who also documented short-term declines in student performance due to exposure to violence.

In Brazil, Koppensteiner and Menezes (2021) examine whether violence, in terms of homicides, has a detrimental effect on attendance and educational outcomes in São Paulo. Their study leverages time-sensitive data on the exact timing and location of homicides, along with comprehensive records on school locations, student residences, test scores, dropout rates, school transitions, and attendance. By exploiting variation in homicide timing and proximity, they identify causal effects of local violence on school-related outcomes, including math and language standardized test scores, attendance, and drop-out rates. Specifically, they find that one additional homicide during the school year leads

[2] In the study of Monteiro and Rocha (2017), favelas refere to the slums of Rio de Janeiro.

to a statistically significant reduction in math test scores, consistent with the findings of Monteiro and Rocha (2017) and Michaelsen and Salardi (2020).

In the study of Fergusson *et al.* (2020), the authors investigate the effects of violence on human capital accumulation in Colombia. Human capital is measured by educational attainment, and in this particular setting, the violence is the civil war, which lasted between 1948 and 1953. A difference-in-difference (DiD) approach was used, and cohorts exposed to violence during their schooling were compared to older cohorts that were not. Fergusson *et al.* (2020) find that younger cohorts that were exposed to violence experienced reduced educational attainment.

Much of the existing research on the economic and social impacts of violence often focuses on civil wars, gun violence, and homicides, often in Latin American countries such as Mexico and Brazil. By contrast, Sweden, a high welfare income state, known for its robust social safety net, has had a notable rise in explosions, which, to our understanding, is underexplored in the literature[3]. As explosions are often linked to gang violence, one could believe that explosions have similar characteristics, including psychological impact and implications for public safety. To address this gap, we go beyond exploring the effects of shootings and also expand by incorporating explosions, and leverage detailed temporal and spatial variation in our data. We aim to capture more detailed insights into how violence, in the form of shootings and explosions, influences educational outcomes. Additionally, we contribute to evaluating potential heterogeneous differences and explore the mechanisms underlying any observed relationships, offering a more nuanced understanding of how different forms of violence may shape educational outcomes.

[3] A previous master's thesis by Stensson (2023) explores the link between violence and educational outcomes. We distinguish our study by using a broader definition of violence capturing both shootings and explosions, and by incorporating more recent and high-quality data through scraping and cross-checking with SVT (2025*b*; 2025*c*). Additionally, we extend the analysis with a detailed subsample for urban areas, a richer heterogeneity analysis, and a nuanced exploration of temporal and spatial dynamics. While writing our paper, we do not read Stensson (2023) to avoid being affected by it, rather we compare our studies after finishing our draft.

4. Theory and Hypothesis

The main theories related to the field of study consist of supply-side mechanisms, which involve the supply and quality of education available to students, and demand-side mechanisms, which involve how violence alters student behavior, attendance, and investments in schooling.

Starting with the supply-side mechanism, violence may cause infrastructure damage, leading to the physical destruction of schools and a reduction in the availability and quality of education (Brück *et al.*, 2019; Michalesen & Salardi, 2020). However, the extent to which infrastructure damage plays a role depends on the specific type of violence and the broader conflict context. Koppensteiner and Menezes (2021) emphasize that in the cases of conflicts like the Israel-Palestinian conflict studied by Brück *et al.* (2019), and conflict-like scenarios covered by Monteiro and Rocha (2017), infrastructure damage will likely play a larger role compared to studies investigating day-to-day violence. This aligns with Michalesen and Salardi (2020), who study day-to-day violence and find no destruction of education infrastructure.

Teacher and staff absenteeism, school closures, and disruptions can negatively affect education by making it harder to retain qualified personnel and administrators. Violence may disrupt school routines, especially during periods of intense conflict. Teacher absenteeism is particularly likely, as concerns for personal safety take priority. Monteiro and Rocha (2017) find that gang-related violence in Rio de Janeiro is significantly correlated with teacher absenteeism and principal turnover. Similar findings are reported by Brück *et al.* (2019), with both studies also linking violent periods to school closures and interruptions. In contrast, Koppensteiner and Menezes (2021) find no such effects, suggesting that more extreme violence may drive absenteeism and turnover, while lower-level day-to-day violence may have a more limited impact.

Regarding demand-side mechanisms, student absenteeism, dropout, and out-migration could be a mechanism if violence discourages students from attending school because students perceive the school environment or school path as unsafe due to fear. Parents may keep them at home on days when traveling or being in school is viewed as too risky. Koppensteiner and Menezes (2021) link student absenteeism to violence near their residents as well as on school paths, whereas Monteiro and Rocha (2017) found no increase in student absenteeism during violent conflicts. They suggest that student absenteeism may not increase because students typically live close to school, meaning that attendance is not perceived as a safety risk.

Psychological trauma and stress are the mechanisms that Michaelsen and Salardi (2020) emphasize as the most credible transmission mechanism, consistent with evidence that children exposed to violent events often exhibit post-traumatic stress disorder (PTSD)-like symptoms, including anxiety, sleep disturbance, and difficulty concentrating, which directly hinder their ability to focus on learning and performing academically (Osofsky, 1995). Even if Michaelsen and Salardi (2020) do not directly observe students' stress levels, they still view this as the most credible mechanism as they rule out several supply-side mechanisms like infrastructure damage, teacher turnover, and absenteeism, and don't think demand-side mechanisms such as student outmigration is credible given the short time horizon between violent events and exam dates.

Moreover, it's important to stress that even if exposure to violent events does not meet the clinical diagnostic criteria for Acute Stress Disorder (ASD) or PTSD, psychological stress can still affect child development. Children experiencing such subclinical levels of stress may develop anxiety, emotional dysregulation, and difficulties engaging socially (Margolin & Gordis, 2000; Osofsky, 1995).

Another demand-side mechanism is lower perceived returns to education. When students in more violent areas anticipate a more uncertain future, they may devalue the long-term benefits of schooling. Koppensteiner and Menezes (2021) find that exposure to homicides significantly affects educational outcomes, particularly for boys, and that they are more likely to drop out. The strongest evidence supporting a human capital investment mechanism stems from differential effects on educational aspirations and attitudes between boys and girls. The pronounced impact on boys across multiple educational outcomes, including dropout rates, academic achievement, and attendance, suggests that exposure to homicides significantly influences the perceived incentives to invest in human capital. Moreover, the persistence of these effects indicates that violence has long-term consequences for educational trajectories, with boys being disproportionately affected.

We hypothesize that shootings and explosions harm educational outcomes, with stronger effects the closer in time and distance the event is to the exam date, and diminishing effects as time and distance increase. The impact is heterogeneous, and we expect boys and students in disadvantaged areas to be more affected. Psychological stress, through demand-side mechanisms, is the most likely explanation for these effects.

5. Data

This section describes the data used in this paper, starting with educational data in Section 5.1, followed by data on violent events in Section 5.2 for shootings and Section 5.3 for explosions, and concluding with additional data in Section 5.4. Note that shootings are analyzed for 2018, 2019, 2022, 2023, and 2024, while explosions are limited to 2023 and 2024 due to the lack of cross-checkable data prior to 2023. For an overview of all variables, see Table A.1 in Appendix A.

5.1 Educational Data

The Swedish National Agency for Education is the central administrative authority for the public school system and is responsible for the official statistics regarding educational quality (Swedish National Agency for Education, 2025*a*). The educational data is obtained from the Swedish National Agency for Education, from multiple datasets, and covers 2018-24, with exceptions for the academic years 2019/20 and 2020/21, as the national tests were canceled because of the Covid-19 pandemic. All variables gathered are matched to the corresponding academic year. Next, the data will be discussed in detail, highlighting their specific contribution to the analysis.

The data regarding the results from the national test taken in the sixth grade for mathematics includes school-level information, with each school having a unique identifier that allows for tracking over time. Moreover, the dataset from the Swedish National Agency for Education (2025*b*) contains information regarding the share of students obtaining a passing grade, which is the main outcome variable in this paper. Additionally, the dataset includes information regarding the participation rate and the average score. These measures are provided in terms of total, as well as broken down by gender, showing the share of boys and girls. Also, in accordance with the guidelines about confidentiality from the Swedish National Agency for Education, schools with fewer than ten students per grade and data on gender where the number of students is fewer than ten are excluded and treated as missing. Furthermore, if fewer than five students fail to achieve a passing grade, the reported number of students passing is adjusted to protect individual identities.

Information on student background from the Swedish National Agency for Education (2025*c*) includes data concerning the number of enrolled students, the number of students per grade, the share of students with parents holding post-secondary education, and the share of students with foreign backgrounds[4].

[4] Foreign background refers to students who were either born abroad or born in Sweden to parents who were both born abroad.

The data on school personnel composition and qualifications is obtained from the Swedish National Agency for Education (2025*d*) and provides information on the number of teachers, the share of female teachers, the proportion of teachers with complete degrees, the student-to-teacher ratio, and the share of permanent employees. These variables will help control for teacher characteristics and staffing levels at each school.

The data on the geographical position of the schools is gathered from the Swedish National Agency for Education (personal communication, February 19, 2025) and is crucial for determining the distance between schools and nearby violent events, such as shootings and explosions. The coordinates for schools are recorded in the WGS 84 format, a global reference system (Lantmäteriet, n.d.*a*). To establish the precise location of each school unit for a given year, the coordinates were matched by year and the school's unique identification code. Initially, this process resulted in 528 missing coordinates. To reduce the number of missing observations, coordinates from previous years for a specific school were used for 483 observations, and for 23 observations, the values were manually imputed using Google Maps.[5] Ultimately, the number of missing coordinates was reduced, so there were no missing coordinates for observations where the outcome variable was available.

Lastly, data from the Swedish National Agency for Education (personal communication, January 30, 2025) regarding when the national tests were conducted were requested for each year the study covers. This information is vital for analyzing the relationship between the timing of violent events, such as shootings and explosions, and the national tests. A visual overview of the academic calendar and the eight-week data-gathering window used in our analysis is provided in Appendix B.

In Table 1, descriptive statistics for the main variables are displayed. When comparing the datasets for shootings and explosions, we note that the mean and standard deviation are similar for most variables. However, the mean for the variable share obtaining a passing grade is approximately two percentage points higher for shootings than for explosions, meaning that the passing rate has decreased in recent years. The standard deviation is lower by around 0.8. This implies that for the data on shootings, there is a moderately higher and more consistent rate of students achieving passing grades.

[5] Dummy variables were created to indicate cases where coordinates from previous years were reused or manually imputed. These indicators are included as controls in the robustness analysis to assess whether they influence the results.

Table 1: Descriptive Statistics

	Shootings (2018, 2019, 2022, 2023, 2024)		Explosions (2023-2024)	
	Mean	SD	Mean	SD
(School level)				
Share of students obtaining a passing grade	90.651	12.908	88.765	13.739
Share of students' parents with post-secondary education	59.036	16.745	60.942	16.627
Number of students in sixth grade	42.838	24.443	43.871	24.197
Number of teachers at the school	22.379	12.689	23.189	13.187
Student-to-teacher ratio	12.763	12.069	12.508	2.333
Share of female teachers	78.357	10.891	78.376	10.629
Share of teachers with a degree	85.233	11.022	86.386	10.136
Share of permanently employed teachers	88.045	10.486	88.906	9.849
(Municipality level)				
Foreign background	25.349	10.436	26.234	10.491
Mean disposable income	596.518	129.024	588.096	129.663
Total population	147,944.960	244,834.040	151,086.510	248,738.830
Total unemployed individuals	5,446.152	8,932.143	5,513.598	9,215.685
Observations	12,647	12,647	5,118	5,118

Note: "Foreign background" refers to students born abroad or born in Sweden with both parents born abroad.

5.2 Shootings

The Swedish Police Authority provides information on all confirmed shootings in Sweden from the first of January 2016, until today. A confirmed shooting is, according to The Swedish Police Authority, an incident in which projectiles have been fired from a gunpowder-charged firearm, leaving physical evidence such as bullets, shell casings, or damage to materials or individuals (The Swedish Police Authority, 2025). Alternatively, a shooting is confirmed if multiple independent eyewitnesses are involved in the event. Additionally, the shooting must be unlawful and not clearly unintentional. This data was obtained from The Swedish Police Authority (personal communications, January 23, 2025) through public records requests.

The data includes the number of shootings, the number of injured individuals, the number of fatalities per incident, the exact date of the event, as well as the coordinates of each event. The coordinates are in the format SWEREF 99, which is the official Swedish reference system for positioning (Lantmäteriet, n.d.*b*). They are converted to WGS 84 to accurately determine the spatial distance. Moreover, it is important to note that the coordinates do not represent the exact location but may deviate by a maximum of 100 meters. However, this is normal as The Swedish Police Authority doesn't give out complete coordinates due to confidentiality. To ensure that this margin of error does not affect the result or analysis, the distances will vary in the analysis.

As the data is obtained from their source system, this means that some observations may have missing coordinates, and the data may have duplicates or missing observations. To account for this and further improve the data quality, the data has been cross-checked with SVT (2025*b*), which has compiled all shootings in Sweden since 2018, along with their locations. Even if SVT (2025*b*) gathers its data from the police, they still manually complement data and cross-check with news reporting, which makes it a good source to cross-check with. The data from SVT contains, for every observation, date, location, an interactive map displaying where the shooting has occurred, the number of injured, and the number of fatalities.

As the study covers the short-term impact, shootings eight weeks prior to the first national exam of the corresponding year were collected from both data sources. Then, a comparison was carried out, and all matching observations were kept. The comparison allowed for the exclusion of shootings that received no media coverage (missing from SVT), missing observations in the police data, duplicates, and the addition of shootings without location with coordinates from SVT's map. In total, comparing the shooting observations eight weeks before the first written national exam in mathematics, the police data contained one duplicate, one observation was missing in the police dataset but present in the SVT data, and six observations were missing in SVT but present in the police data. Ultimately, 245 shootings matched between the two datasets. Out of the 245, four shootings had missing coordinates from the police dataset, and these were manually imputed with data from SVT and Google Maps. Figure 4 visualizes data for shootings over time.

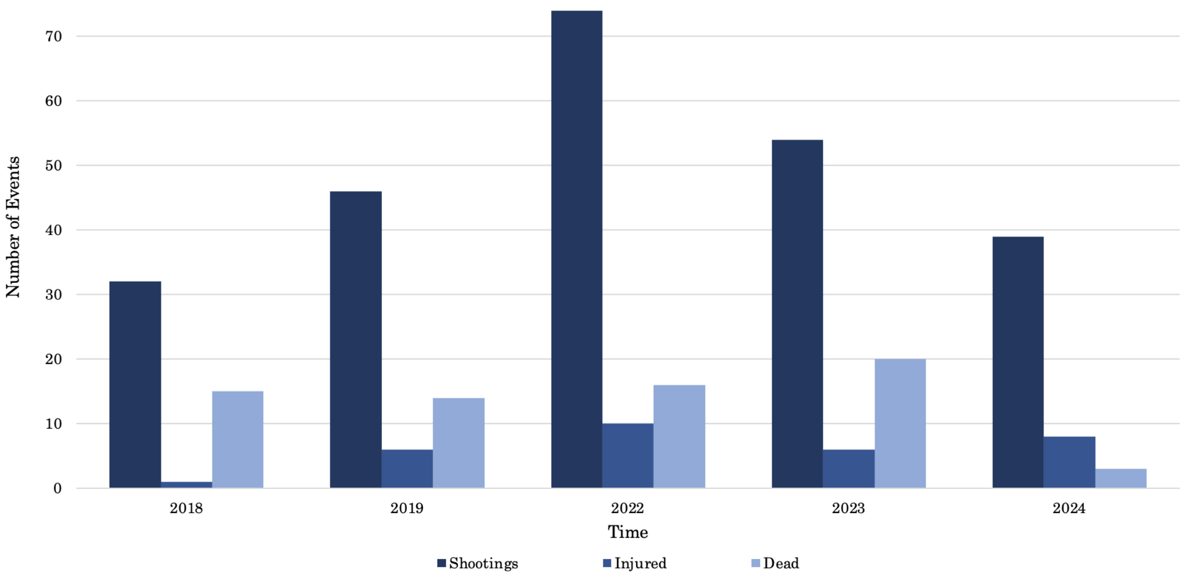


Figure 4: Shootings Eight Weeks Prior to National Math Exam

Note: Figure 4 visualizes the number of shootings, the number of shootings with injured victims, and the number of deadly shootings. Only shootings eight weeks before the first national test in mathematics for the years 2018-2024, with exceptions for 2020 and 2021, are included. The data used is obtained from The Swedish Police Authority (personal communications, January 23, 2025) and cross-checked with data from SVT (2025*b*).

5.3 Explosions

Data on explosions has been obtained from The Swedish Police Authority (personal communications, January 23, 2025) by requesting public records, which provided statistics on confirmed cases of public destruction. From this data, only explosions occurring within eight weeks before the first national test in mathematics are included in the analysis. The police data include the date and coordinates concerning confirmed explosions, and the coordinate system used by the police for explosions is RT90. Since it differs from the one used for school coordinates, these are converted to WGS 84 to accurately determine the distance between schools and explosions.

To further strengthen the data quality, the data was cross-checked with data from SVT (2025*c*), which has a detailed gathering of confirmed explosions covering the years 2023 and 2024. To obtain the necessary data from SVT, we decided that the most efficient and time-effective alternative was to scrape the data. We constructed a custom-built web-scraping script that iterated over the relevant web page containing a gathering of all explosions covering 2023-24. The script identified information like the specific date and location of all explosions and then exported it, which allowed us to cross-check the data from The Swedish Police authority (personal communications, January 23, 2025) with SVT (2025*c*).

Since only the years 2023 and 2024 could be cross-checked, these years are included in the analysis when investigating explosions. During 2023-24, there were a total of 263 explosions matching between SVT and the Swedish Police Authority, 45 explosions eight weeks before the first written national test in mathematics, 25 during 2023, and 20 during 2024.

5.4 Additional Data

To isolate the effect of violent events on educational performance, a set of control variables is included at the municipality level. We control for average income (Statistics Sweden, 2025), unemployment (Swedish Public Employment Service, 2025), the percentage of students with foreign backgrounds (Kolada, 2025), and total municipal population (Statistics Sweden, 2024*a*). The foreign background variable captures the percentage of students in grades one to nine who were either born abroad or have two foreign-born parents (Kolada, 2025). All municipality- and school-level data are matched to the corresponding academic year to ensure temporal consistency.

6. Empirical Strategy

The core focus is to estimate the short-term impact of violence, measured by shootings and explosions, on educational performance, measured by the share of students obtaining passing grades in mathematics.

The effects of violence and explosions on educational performance are estimated separately. To begin with, we first estimate the empirical model using municipality and year-fixed effects (FE) following Michaelsen and Salardi (2020), who used a similar model when conducting a nationwide study on Mexico. Using a municipality- and year-FE model allows us to mitigate the risk that potential cofounders, like unobserved socioeconomic and political conditions, impact the result. In Sweden, municipalities are responsible for funding, managing, and implementing policies in elementary schools, meaning that they play a central role in school governance. Municipalities' political and economic conditions impact the resources available to schools. Therefore, one could believe that schools within the same municipality share certain characteristics, which makes schools in the same municipality possible to compare.

The short-term effect of violence on educational performance, measured as the share of students obtaining a passing grade y_{stm}, is estimated using an Ordinary Least Squares (OLS) specification with municipality- and year-FE, as shown in Equation 1.

$$y_{stm} = \beta_1 D_{st} + Z'_{st}\beta_2 + X'_{tm}\beta_3 + \mu_m + \gamma_t + \varepsilon_{stm} \quad (1)$$

In Equation 1, s, t, and m are school, time, and municipality, respectively. Additionally, Z'_{st} is a vector controlling for time-variant school characteristics, to be specific, the share of parents with post-secondary education, the number of students enrolled in sixth grade, the number of students per teacher, the share of female teachers, the share of teachers with a university degree and share of permanently employed teachers. X'_{tm} is a vector controlling for time-variant municipality characteristics like foreign background, disposable income, unemployment, and population level. Moreover, μ_m controls for time-invariant municipality characteristics like socioeconomic conditions, local policies, and other factors that may influence educational outcomes but are time-invariant, and γ_t controls for time-invariant shocks common to all schools in the municipality. Lastly, the errors are clustered at the municipality level to allow for correlation in the residuals among schools within the same municipality over time.

The main variable of interest is D_{st}, which is a binary variable indicating whether school s in year t have experienced a violent event within radius d of the school. Put differently, D_{st} is a dummy in Equation 1 and equals one if a violent event affects school s in academic year t, and zero otherwise. In detail, D_{st} is defined as follows:

$$D_{st} = 1\left(\sum_{v}\sum_{\tau}\{d_{sv} \leq c\} \cap \{p_{e(t),\tau} \leq B\} > 0\right) \tag{2}$$

where the first summation loops over all violent events, while the second summation loops over all violent dates. Equation 2 equals one if both the spatial and temporal conditions are met. Starting with the spatial condition, where d_{sv} is the distance between school s and violent event v and has to be smaller or equal to the spatial threshold c. The temporal condition is satisfied if $p_{e(t),\tau,}$ which is the time difference between the exam date and the violent event, is smaller or equal to the time threshold B, where $e(t)$ is the exam date for academic year t, while τ is the date of the violent event.

There is a tradeoff when choosing the right temporal and spatial cutoffs. Considering the spatial cutoff, choosing a smaller radius around the school implies fewer treated observations, and there is a possibility that schools right outside the radius could experience an effect, but not be considered treated. Oppositely, choosing a too wide spatial cutoff would increase the risk of including observations as treated that are not affected by violent events. The same reasoning could be applied when choosing the temporal cutoff. A shorter temporal cutoff increases the risk of omitting violent events that have an effect, on the other hand, choosing a longer cutoff increases the likelihood of capturing irrelevant events that may have no direct impact on students' performance.

For the spatial condition in our benchmark specification, we review data from Statistics Sweden (2024*b*) regarding the average distance between schools and students´ residences. Taking into account the weighted average, mean, and median distances for all municipalities, and also considering the frequency of the violent events, we set the benchmark spatial threshold for shootings to 1,000 meters and 1,500 meters for explosions. Since explosions are less common, and only two years of observations are available, selecting a wider radius around the school compensates for the lower frequency of explosions. However, we are aware that choosing a wider radius comes at the expense of increasing the risk of including schools that may not experience an effect, but the spatial condition will be further investigated. For the temporal condition, we choose six weeks in our benchmark specifications, as it allows us to capture the short-term effect while avoiding the inclusion of longer-term impacts that may not be directly related to the event itself.

Moreover, having the possibility to vary the spatial and temporal thresholds is vital to investigate how the effect differs. Besides the main results based on the benchmark specifications, we will further evaluate how varying the spatial condition in 100-meter increments, from 1,000 to 1,200 meters and 1,000 to 800 meters for shootings, and from 1,500 to 1,800 meters and 1,500 to 1,300 meters for explosions. Additionally, the temporal condition will be evaluated by increasing and decreasing the temporal cutoff by two weeks.

We consider potential drawbacks associated with the municipality-FE model. It may introduce some bias if municipalities differ in factors not captured by the time-invariant characteristics or the control variables. For instance, municipalities with generally lower results may experience higher levels of violent events. Furthermore, schools in areas with higher crime rates may be associated with lower school performance results due to other underlying factors, and therefore, the effect might be overstated. Additionally, if schools within the same municipality differ due to other factors that are not controlled for and which can't be captured by the municipality FE, this could introduce some bias. We reason that since schools in socioeconomically disadvantaged neighborhoods are more likely to experience violent events, and these schools generally perform worse, the effect could potentially be overstated by the municipality-FE model.

To address and evaluate the potential bias, we refine our model by estimating a school- and year-FE model (see Equation 3). School FE allows us to compare the same schools over time, eliminating concerns that differences in school quality, resources, and student composition might impact the result as time-invariant school characteristics are accounted for. Consequently, using school FE eliminates the possibility that bias could occur due to that schools within the same municipality are compared with each other, as in the municipality-FE model.

$$y_{stm} = \beta_1 D_{st} + Z'_{st}\,\beta_2 + X'_{tm}\,\beta_3 + \mu_s + \gamma_t + \varepsilon_{stm} \qquad (3)$$

Different from Equation 1, Equation 3 is specified with school FE, where μ_s is controlling for time-invariant school characteristics, including school type, whether it is private or public, and school resources. Lastly, γ_t controls for time-invariant shocks common to all schools, and the standard errors are clustered at the school level to account for potential within-school correlations over time.

While this specification improves internal validity, it also comes with certain drawbacks. A potential drawback of the school-FE model is that it may reduce the variation in the data. Shootings and explosions are not evenly distributed, and since we only have data for two years on explosions, there may not be sufficient variation. This could be particularly true for smaller municipalities, where both types of violent events are less frequent, potentially leading to noisy estimates. To mitigate this concern, we construct a subsample of Sweden´s 25 largest municipalities. By focusing on these municipalities with larger population sizes and where the number of events tends to be more frequent, we expect to observe greater variation over time. By focusing on the subsample in a separate analysis, we can estimate the main specifications with more frequent events and better variation, while maintaining a sufficient level of variation in school outcomes.

Another important concern in observational studies is omitted variable bias. Violent events like shootings and explosions are often linked to the criminal milieu and specific neighborhood characteristics (Swedish National Council for Crime Prevention, 2025*a*). Since these neighborhood characteristics are difficult to fully capture using data, there might be potential problems correlated with omitted variable bias. We try to account for this as much as possible by using school-FE, where time-invariant school characteristics are accounted for.

In addition to omitted variables, reverse causality may pose a threat to identification. Schools located in violent neighborhoods may tend to have lower performance, and poor educational performance may contribute to violence, resulting in a reverse causality problem. However, as mentioned by Michaelsen and Salardi (2020) and Monteiro and Rocha (2017), this is not likely as we use sixth-grade students (11-12-year-olds) who are not likely to be a part of the criminal milieu. However, this reverse causality bias may have been a significant problem if we included students in higher grades.

Moreover, we acknowledge that measurement error may bias the result, and we find three main sources of such errors. First, the data concerning both explosions and shootings are due to confidentiality not geocoded precisely. The police, therefore, do not specify the last 100 meters, which reduces the precision. Second, missing school coordinates were imputed using Google Maps, and to assess whether this affects the results, we conduct additional robustness checks to evaluate the influence of these imputations on the estimates. The third source of measurement error is related to exam integrity. We try to reduce this potential measurement error by specifically looking at violent events prior to written exams, as we believe that oral exams in math are easier to spread, as not all students do it simultaneously. Further, the National Agency for Education has strict guidelines for handling situations where there are suspicions of cheating or confirmed leaked copies of exams that involve backup editions of the exam.

Having addressed identification concerns, we now turn to the underlying mechanisms driving the observed effects. When it comes to attributing the estimated effect to a specific mechanism, the main reasoning is that the most likely mechanism to identify is the psychological stress caused by exposure to shootings and explosions. Given that we are evaluating short-term effects and focusing on a six-week temporal window, we argue that several mechanisms can be ruled out. Following the reasoning of Michelsen and Salardi (2020), we deem supply-side mechanisms such as principal and teacher turnover as unlikely, as violence during our short temporal window minimizes the chance for these mechanisms to occur. Additionally, supply-side mechanisms include destruction and school closure, but as day-to-day violence is less likely to result in temporal closure compared to more severe violence, like armed conflicts, this is also ruled out. Regarding demand-side mechanisms, we deem student attendance as the most likely mechanism to be identified. However, we are able to test for this, as we have data on the exam attendance for each school.

7. Results

In this section, we first estimate the impact of shootings and explosions on the share obtaining a passing grade. We present models using both municipality- and school-FE. Thereafter, we further investigate how distance to and time since the violent event affect the outcome variable. Lastly, we conduct a sensitivity analysis, present results considering the potential mechanisms behind the effect, and perform robustness checks.

7.1 Main Result

Table 2 contains results for both types of violent events. We estimate separate model specifications and vary the level of fixed effects between the municipality and school levels. Additionally, for each level of FE, we run the model with and without controlling for school and municipality characteristics.

Regarding all estimates in Table 2, we observe negative results, indicating that both types of violent events are negatively associated with educational performance, holding all else constant. Starting from the left, the first two models have municipality- and year-FE, while they vary in terms of controls. We observe a large drop in magnitude when including controls, indicating that schools in the same municipality differ in terms of school characteristics, which correlate with both violence and educational performance, highlighting the importance of including control variables.

Moreover, in columns 3 and 4, we instead use school FE besides controlling for year. The change in magnitude is not as large when including controls in column 4, indicating that the model, already by controlling for time-invariant characteristics, accounts for much of the variation. Notably, the R-squared for the school- and year-FE model is higher compared to the municipality- and year-FE model, indicating an improved model fit. The model, including municipality- and time-FE, compares schools within municipalities, whereas the school- and year-FE model compares the same school over time, making it the preferred specification.

Using our preferred specification for shootings, displayed in column 4 in Table 2, we find that a shooting, within 1,000 meters, six weeks before the first written national exam in mathematics, is associated with a decrease of around 1.6 percentage points in the share of students receives a passing grade, while the average passing grade is around 90.64%. Given the mean that receives a passing grade, this corresponds to a relative decrease of 1.81%.[6]

[6] The relative change is calculated by dividing the coefficient by the mean share of students receiving a passing grade (–1.641 / 90.642 = –1.81%).

Moving on to explosions, we notice a decrease in absolute values between columns 5 and 6, indicating that when estimating the model with the municipality- and year-FE, the inclusion of control variables has a large effect on the estimates. Models 7 and 8 are specified using school- and year-FE, where the former model is specified without controls, differently from the latter. Similar to the corresponding models for shootings (columns 3 and 4), we notice a similar change from including controls, indicating that the model already accounts for time-invariant school characteristics, absorbing much of the variation. However, different from before, the standard errors in columns 7 and 8 are higher and no longer statistically significant, meaning they should be interpreted with caution. As we only have two years of data, the model may lack sufficient variation to produce statistically significant results. However, we still observe indications of an effect, which is why we consider column 8, which has school- and year-FE as our preferred specification. We further investigate this later in section 7.2, "Sensitivity Analysis".

Table 2: Main Result

	Dependent Variable: Share Receiving a Passing Grade							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Shooting (1,000m, 6w)	-6.026***	-2.596***	-1.731**	-1.641**				
	(1.083)	(0.586)	(0.742)	(0.739)				
Explosion (1,500m, 6w)					-4.655**	-2.603***	-2.049	-1.982
					(1.808)	(0.903)	(1.617)	(1.620)
Observations	12,647	12,647	12,245	12,245	5,118	5,118	4,680	4,680
Mean (Share Receiving a Passing Grade)	90.651	90.651	90.642	90.642	88.765	88.765	88.483	88.483
Control Variables		✓		✓		✓		✓
Time FE	✓	✓	✓	✓	✓	✓	✓	✓
Municipality FE	✓	✓			✓	✓		
School FE			✓	✓			✓	✓
R squared	0.136	0.355	0.587	0.593	0.150	0.375	0.736	0.739

Note: The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses. For models with municipality FE, standard errors are clustered at the municipality level; for models with school FE, standard errors are clustered at the school level. Where included, controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Moreover, our preferred specification indicates that holding all else constant, experiencing an explosion within 1,500 meters, six weeks before the first written national test in mathematics, is associated with a decrease in obtaining a passing grade of around two percentage points. However, as previously mentioned, the effect should be interpreted with caution. Lastly, we note that the effect of explosions, relative to the mean share of students obtaining a passing grade, is slightly higher at 2.24%, compared to 1.81% for shootings. This suggests that explosions may have a stronger relative impact on student performance, despite being less frequent. One possible explanation could be that the nature of an explosion, which may affect more people and is often used to provoke fear, results in a larger impact compared to shootings, which could be perceived as more targeted.

7.1.1 How Distance Matters

Table 3 builds on our preferred specification from Table 2, containing school- and year-FE, and displays estimates of how the magnitude changes when the distance is varied. In panel A of Table 3, we investigate how distance matters for shootings, while in panel B, we investigate how distance matters for explosions.

Table 3: How Distance Matters

	Dependent Variable: Share Receiving a Passing Grade				
	(1)	(2)	(3)	(4)	(5)
	A. Shootings				
Shooting (800m, 6w)	-1.661**				
	(0.841)				
Shooting (900m, 6w)		-1.345*			
		(0.748)			
Shooting (1,000m, 6w)			-1.641**		
			(0.739)		
Shooting (1,100m, 6w)				-1.022	
				(0.667)	
Shooting (1,200m, 6w)					-0.731
					(0.618)
Observations	12,245	12,245	12,245	12,245	12,245
Mean (Share Receiving a Passing Grade)	90.642	90.642	90.642	90.642	90.642
Controls	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓
School FE	✓	✓	✓	✓	✓
	B. Explosions				
Explosion (1,300m, 6w)	-2.743*				
	(1.647)				
Explosion (1,400m, 6w)		-2.252			
		(1.714)			
Explosion (1,500m, 6w)			-1.982		
			(1.620)		
Explosion (1,600m, 6w)				-1.836	
				(1.632)	
Explosion (1,700m, 6w)					-2.037
					(1.524)
Observations	4,680	4,680	4,680	4,680	4,680
Mean (Share Receiving a Passing Grade)	88.483	88.483	88.483	88.483	88.483
Controls	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓
School FE	✓	✓	✓	✓	✓

Note: The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses. Standard errors are clustered at the school level. Controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

Starting with shootings, we notice a declining effect as the distance from the school increases (see Table 3, panel A). We have visualized this declining effect in Figure C.1 in Appendix C. Moreover, we observe that the standard error increases and the estimates become insignificant after 1,000 meters. Beyond this range, the standard errors increase, indicating that the impact of shootings is localized, affecting students who are more directly exposed to or aware of the event. Overall, this spatial pattern suggests that the proximity to violence is an important factor influencing educational outcomes.

Moving on to the estimates for explosions (panel B of Table 3), we observe a declining trend as the distance from the school increases (with exception of 1,700 meters). This trend is also visualized in Figure C.2 in Appendix C. Moreover, the lack of significance beyond 1,300 meters could be due to the lack of precision and degree of exposure as the radius is increased. Schools further away from the explosion may be less directly affected, suggesting that, as in the case with shootings, explosions have a localized effect. However, these findings should be interpreted with caution, given the wider confidence intervals and limited number of explosion events in the dataset.

7.1.2 How Time Matters

In the following section, we build on our preferred model and vary the temporal condition. In Panel A of Table 4, we present results using our baseline specification while varying the time window to four, six, and eight weeks before the exam date, meaning that column 2 corresponds to the main result. We observe that all estimates are negative, and the estimates for six and eight weeks are similar in magnitude and significance, while the estimate is smaller, in absolute terms, for four weeks and insignificant. This could be due to observations that experience a shooting shortly after the four-week mark being misclassified as untreated, making it more difficult to detect an effect. This result indicates that the temporal condition may not play as big of a role as the spatial, for shootings in our setting.

Looking at the estimated coefficients for explosions in panel B, Table 4, we observe a negative declining trend that is more pronounced compared to how the temporal condition affects shootings. This means that the effect of explosions on student performance appears to weaken more consistently as the time between the event and the exam increases, suggesting a stronger time sensitivity in the case of explosions. However, the estimates are not statistically significant and should therefore be interpreted with caution. This temporal pattern is visualized in Figure C.1 for shootings and Figure C.2 for explosions in Appendix C.

Table 4: How Time Matters

	Dependent Variable: Share Receiving a Passing Grade		
	(1)	(2)	(3)
	A. Shootings		
Shooting (1,000m, 4w)	-1.527*		
	(0.838)		
Shooting (1,000m, 6w)		-1.641**	
		(0.739)	
Shooting (1,000m, 8w)			-1.504**
			(0.693)
Observations	12,245	12,245	12,245
Mean (Share Receiving a Passing Grade)	90.642	90.642	90.642
Controls	✓	✓	✓
Time FE	✓	✓	✓
School FE	✓	✓	✓
	B. Explosions		
Explosion (1,500m, 4w)	-2.165		
	(1.773)		
Explosion (1,500m, 6w)		-1.982	
		(1.620)	
Explosion (1,500m, 8w)			-0.580
			(1.489)
Observations	4,680	4,680	4,680
Mean (Share Receiving a Passing Grade)	88.483	88.483	88.483
Controls	✓	✓	✓
Time FE	✓	✓	✓
School FE	✓	✓	✓

Note: The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses. Standard errors are clustered at the school level. Controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

7.2 Sensitivity Analysis

Except for only using share obtaining a passing grade as the primary outcome variable, we additionally test if our result holds when using average points as the outcome variable. The same regressions are utilized as before, except that we are using the average score as the outcome variable. The results are displayed in Table D.1 in Appendix D and show that the estimates are negative, as expected, but insignificant. A plausible explanation is that students who are already on the margin of receiving a passing grade have a higher tendency to be negatively impacted. Consequently, while the share of students obtaining a passing grade is reduced, the overall average score remains largely unchanged according to the results. This may indicate that the effect is not universal, but rather, concentrated among the weaker students.

As previously mentioned and visualized in Figure 3, shootings and explosions are not evenly distributed, and since we are only able to investigate two years for explosions, there may be the case that the variation is not enough. This could be the case as smaller municipalities may not provide enough variation, as both types of violent events are less common, which can lead to noisy estimates. To further investigate this, we focus on our sample's top 25 most populated municipalities, which we will refer to as the urban sample. However, this approach raises concerns regarding the representativeness of the sample. If shootings and explosions are concentrated in large municipalities, the findings may not be generalizable to smaller municipalities or rural areas. Descriptive statistics for the urban sample are displayed in Table D.2 in Appendix D and show some notable differences, as expected. For example, schools in urban municipalities tend to be larger, the student-teacher ratio is higher, students' parents are more likely to have post-secondary education, and the share of students with a foreign background is greater. Within the 1,000-meter and six-week window, the base sample includes 340 treated schools, while the urban sample includes 291. For explosions, using a six-week and 1,500 meter window, 95 schools are treated in the base sample compared to 45 in the urban sample. The differences in the descriptive statistics and amount of treatment observations are reasonable but important to acknowledge, as they differ from the base sample. By focusing on larger urban areas, where violent events are more common, we investigate how larger variation in the data impacts the result.

By limiting the sample, we aim to capture a context with a greater frequency of violent events, thus increasing the variation. Table 5 presents the estimates for the urban sample analysis. For shootings (columns 1-4 in Table 5), the significance of all estimates is similar to those reported for the main result (in Table 2), but the magnitudes are somewhat higher, with a decrease of 2.38% in relation to the mean share receiving a passing grade for the sample. This can likely be explained by the fact that these municipalities experience larger variations in violent events, reinforcing the observed effects.

The estimates regarding explosions (columns 5-8 in Table 5) differ more notably from the main result, as they become significant and substantially larger for the urban sample, with a decrease of 5.07%, in relation to the mean share receiving a passing grade for the sample. This is likely because the base sample includes several years of data on shootings, but only two years of data on explosions. With fewer observations, the estimates for explosions are more sensitive to sample restrictions. In contrast, the longer time coverage for shootings likely contributes to more stable estimates that are less affected by changes in the sample, which may explain the smaller differences in results for shootings.

Table 5: Sensitivity Results - Urban Sample

	Dependent Variable: Share Receiving a Passing Grade							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Shooting (1,000m, 6w)	-6.737***	-2.665***	-2.202***	-2.087**				
	(1.189)	(0.597)	(0.816)	(0.813)				
Explosion (1,500m, 6w)					-3.814	-3.398**	-4.477**	-4.482**
					(2.419)	(1.300)	(2.101)	(2.177)
Observations	4,764	4,764	4,662	4,662	1,930	1,930	1,804	1,804
Mean (Share Receiving a Passing Grade)	90.001	90.001	90.007	90.007	88.600	88.600	88.385	88.385
Control Variables		✓		✓		✓		✓
Time FE	✓	✓	✓	✓	✓	✓	✓	✓
Municipality FE	✓	✓			✓	✓		
School FE			✓	✓			✓	✓
R-squared	0.103	0.398	0.626	0.630	0.099	0.397	0.756	0.760

Note: The urban sample only includes the top 25 most populated municipalities in Sweden. The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses. For models with municipality FE, standard errors are clustered at the municipality level; for models with school FE, standard errors are clustered at the school level. Where included, controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

Further, we analyze how distance and time affect the result of the urban sample. The results are presented in Table D.3 and Table D.4, in Appendix D, but the implications will be discussed here.

For shootings, the effect weakens with distance, similar to the base sample, where it starts to decline around 1,000 meters and becomes insignificant beyond 1,100 meters. In contrast, for explosions, the effect of distance is stronger, with the size of the effect decreasing as distance increases, and the estimates remain statistically significant compared to the base sample, except for 1,600 meters where significance holds at the 10% level.

Regarding timing, for shootings, we notice similar estimates in terms of sign, significance, and size for the urban sample as for the base sample. However, for explosions, both the size and significance of the estimates increase notably compared to the base sample. This suggests that the greater variation in the urban sample has a stronger influence on the results for explosions than for shootings.

7.3 Mechanisms and Heterogeneity

The following section explores the mechanisms through which these results may arise and examines heterogeneity within the sample.

First, we start by investigating if exam attendance, V_{stm}, is a driver as it is regarded as one of the most common mechanisms according to Michaelsen and Salardi (2020), and follow their approach (see Equation 4).

$$V_{stm} = \beta_1 D_{st} + Z'_{st}\,\beta_2 + X'_{tm}\,\beta_3 + \mu_s + \gamma_t + \varepsilon_{stm} \qquad (4)$$

Similar to previous equations, s, t, and m are school, time, and municipality, respectively. Z'_{st} is a vector containing time-variant school characteristics such as the number of enrolled students, student-teacher ratio, share of teachers with degrees, while X'_{tm} is a vector controlling for the same municipality time-invariant characteristics as before, which are: population, income, foreign background, and unemployment. As before, year- and school-FE are accounted for, where μ_s is the school FE, and γ_t is the time FE.

Table 6 displays estimates of how both types of violent events affect attendance separately. For shootings (panel A of Table 6), no evidence can be found, either when specifying the model with municipality- and year-FE or using school- and year-FE. Similar results are found for explosions (panel B of Table 6), where no evidence that attendance is a driver could be found. We also evaluate mechanisms for the Urban sample, and find similar results, see Table D.5 in Appendix D.

Table 6: Evaluating if Attendance is a Mechanism

	Dependent Variable: Exam Attendance	
	(1)	(2)
	A. Shootings	
Shooting (1,000m, 6w)	0.386	0.100
	(0.255)	(0.388)
Observations	12,647	12,245
Mean (Exam Attendance)	93.655	93.664
Controls	✓	✓
Time FE	✓	✓
Municipality FE	✓	
School FE		✓
	B. Explosions	
Explosion (1,500m, 6w)	-0.400	-0.396
	(0.712)	(0.885)
Observations	5,118	4,680
totalt deltagit	93.112	93.128
Controls	✓	✓
Time FE	✓	✓
Municipality FE	✓	
School FE		✓

Note: The dependent variable in all columns is Exam Attendance. Robust standard errors are in parentheses. For models with municipality FE (column 1), standard errors are clustered at the municipality level; for models with school FE (column 2), standard errors are clustered at the school level. Controls are: number of students enrolled (school level), student-teacher ratio (school level), share parents with post secondary education (school level), share of teachers with a university degree (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

These findings suggest that attendance, which by Koppensteiner and Menzes (2020) is regarded as the most likely mechanism through which violence affects educational outcomes, is not likely to be the channel in our context. Instead, a plausible explanation would be psychological stress in line with Michaelsen and Salardi (2020), who argue that the possibility of violent events near schools induces emotional distress, sleep disturbance, fear, or anxiety among students. These psychological effects can impair cognitive functions such as focus, memory, and concentration, thereby hindering academic performance, even if students are physically present in school.

The implications of the spatial and temporal results in relation to psychological stress are considered next. For shootings, the results for the spatial variation decline notably after 1,000 meters, indicating that students more directly exposed are more likely to be affected academically as they have a greater chance of suffering psychological stress. In contrast, explosions show a clearer pattern where the effect decreases as time increases, which could be due to that explosions are perceived as more disruptive or unpredictable, triggering greater psychological stress when they occur close in time to exams. This also suggests that the effect is more short-lived, as the result shows that when the temporal condition widens, this emotional impact diminishes, allowing students more time to recover and refocus.

To better understand whether boys and girls are differently affected by violence, as well as whether certain school environments are more vulnerable, we conduct a heterogeneity analysis using gender-specific outcome variables along with various socioeconomic and demographic characteristics. This type of analysis is common in the literature, although we are to some extent limited by the fact that we do not have access to individual-level data, as in other published papers on similar topics. The analysis is therefore conducted at the school level, which reduces precision, but still captures meaningful variation across schools.

We begin by examining whether the effects of shootings and explosions differ when using gender-specific outcome variables. Specifically, we use the share of boys receiving a passing grade and the share of girls receiving a passing grade. For these variables, we have different amounts of observations, as not all schools share data for individual gender due to confidentiality. The overall negative effect on the share of students passing is statistically significant (see column 1, panel A in Table 7), but the variation across gender (columns 2-3, panel A in Table 7) is not statistically significant and should therefore be interpreted with caution. However, as the estimate for boys is negative, it indicates that shootings may have a larger effect on boys. Regarding explosions (see columns 2-3, panel B in Table 7), the estimates for girls are negative, while it's positive for boys (but not statistically significant and should therefore be interpreted with caution), indicating that explosions may have a larger effect on girls.

We also explore heterogeneity based on several socioeconomic and demographic characteristics. We specifically look at the share of students with parents who have post-secondary education, the share of students with foreign backgrounds, and average income, as well as school-level factors such as students per teacher, and broader contextual factors like population levels. For these variables, we split the sample based on the median value and run the baseline regression separately for schools above and below the median. We note that this approach reduces variation in the data and, in some cases, leads to singleton observations being dropped, which may reduce statistical power.

For shootings (Panel A in Table 7), the results indicate that schools with lower levels of parental post-secondary education and higher shares of students with foreign backgrounds are more negatively affected. Furthermore, schools located in areas with higher income and population levels, which can be interpreted as more urban environments, also tend to experience stronger negative effects. This pattern is consistent with the distribution of shootings shown in Figure 3, where such events are more common in urban areas.

Turning to explosions, the results indicate that schools in more urban areas, defined by higher levels of income, parental post-secondary education, and population, are more likely to be negatively affected. Unlike shootings, explosions appear to have a greater impact on schools with a lower share of students with foreign backgrounds. This may indicate a shift in the spatial and social pattern of violence, suggesting that explosions increasingly affect schools in more traditionally less vulnerable areas.

Lastly, schools with a higher student-to-teacher ratio seem to be more negatively affected by violent events, which indicates that limited teacher capacity may hinder schools' ability to support students post-violent events.

Table 7: Heterogeneity Analysis

	Share Obtaining a Passing Grade			Parental Post-secondary Education		Foreign Background		Population Level		Income		Student-to-Teacher Ratio	
	Total	Girls	Boys	Low	High	Low	High	Low	High	Low	High	Low	High
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
A. Shootings													
Shooting (1,000m, 6w)	-1.641**	0.019	-0.448	-2.109*	-1.165	-0.228	-2.484**	0.469	-1.915**	0.303	-2.836***	-0.673	-1.758*
	(0.739)	(0.738)	(0.865)	(1.179)	(0.774)	(0.932)	(0.998)	(2.093)	(0.789)	(1.377)	(0.898)	(1.150)	(1.042)
Observations	12,245	7,727	7,817	5,911	6,022	6,353	4,076	6,073	6,133	5,838	5,759	5,760	5,617
Mean (Share Receiving a Passing Grade)	90.642	95.956	95.993	85.969	95.142	92.969	84.233	90.642	90.652	89.592	91.702	88.708	92.580
Net change in percent	-1.810	0.020	-0.467	-2.453	-1.224	-0.245	-2.949	0.517	-2.112	0.338	-3.093	-0.759	-1.899
Control Variables	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
School FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
B. Explosions													
Explosions (1,500m, 6w)	-1.982	-3.388	-1.225	-0.428	-3.148**	-2.310	-1.990	0.636	-4.080*	-1.026	-2.913	0.750	-5.092***
	(1.620)	(2.526)	(1.993)	(2.853)	(1.324)	(1.571)	(2.112)	(2.394)	(2.167)	(3.163)	(1.833)	(2.640)	(1.846)
Observations	4,680	2,382	2,534	2,180	2,478	2,274	2,468	2,298	2,410	2,348	2,026	2,012	1,988
Mean (Share Receiving a Passing Grade)	88.483	94.312	94.723	82.800	93.450	90.309	86.870	87.846	89.033	87.195	89.973	85.966	90.929
Net change in percent	-2.240	-3.592	-1.293	-0.517	-3.369	-2.558	-2.291	0.724	-4.583	-1.177	-3.238	0.872	-5.600
Control Variables	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
School FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses and clustered at the school level. Controls are: number of students enrolled (school level), share parents post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

7.4 Robustness

In line with similar previous research, we perform a placebo test to check whether shootings and explosions have any effect on student performance when they occur after the exam date. Since such events take place after students have already completed their exams, they should not induce psychological stress or otherwise influence outcomes, and thus, no effect should be found. We base the test on our main regression specification, including control variables as well as year and school FE. Specifically, for shootings, we define the placebo variable as whether a shooting occurred within 1,000 meters and six weeks after the first written national mathematics exam. The same approach is applied to explosions, using a 1,500-meter radius.

In Table 8, we present our results regarding our placebo test. We find no statistically significant association between violent events occurring after the exam date and student performance, which supports the validity of our empirical strategy. Similar results for the urban sample are shown in Table D.6, Appendix D.

Table 8: Placebo Test

	Dependent Variable: Share Receiving a Passing Grade
	(1)
	A. Shootings
Shooting (1,000m, 6w, POST)	0.199
	(0.705)
Observations	12.245
Mean (Share Receiving a Passing Grade)	90.642
Control Variables	✓
Time FE	✓
School FE	✓
	B. Explosions
Explosion (1,500m, 6w POST)	0.040
	(1.596)
Observations	4.680
Mean (Share Receiving a Passing Grade)	88.483
Control Variables	✓
Time FE	✓
School FE	✓

Note: The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses. For models with municipality-FE, standard errors are clustered at the municipality level; for models with school-FE, standard errors are clustered at the school level. Controls are: number of students enrolled (school level), share parents with post-secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), foreign background share (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality-level). *** p<0.01, ** p<0.05, * p<0.1.

Additionally, we rerun the main regressions by replacing the municipality-level share of foreign background with a school-level measure, which reduces the observat- ions but yields similar results. Lastly, controlling for manually imputed values does not impact the result (see Appendix E, Table E.1).

8. Conclusion

Previous research has primarily focused on the impacts of violence on educational outcomes in developing countries such as Mexico and Brazil. In contrast, we investigate how shootings and explosions, in the context of Sweden, affect the performance on the national test in mathematics, and how the effect differs based on gender and socioeconomic factors. Using a detailed dataset, we explore how the effects vary across gender and socioeconomic groups, as well as under different temporal and spatial conditions.

We find that shootings have a statistically significant negative effect on test performance, particularly when they occur closer to the school or shortly before the exam. Specifically, shootings are associated with a 1.8% decrease, and explosions with a 2.2% decrease, in the share of students receiving a passing grade. Even if explosions show negative associations, the results in the full sample are generally not statistically significant. However, both forms of violence show stronger effects when the spatial threshold is reduced, meaning that violent events closer to schools have greater educational impacts. Temporal proximity matters more for explosions, while the effect of shootings remains consistent over time.

Our findings are reinforced in the urban subsample, where shootings continue to have a negative and statistically significant effect, and explosions also become statistically significant, while their effect remains negative. We attribute this to greater variation within the urban sample, which includes 85% of shootings and about half of the explosions. The trends when altering the spatial and temporal conditions are consistent with the main sample, with the impact of explosions clearly declining with distance and disappearing around six weeks after the event.

To better understand the mechanisms at play, we investigate potential pathways and sample heterogeneity. We find that school attendance does not appear to change in response to violent events, suggesting that psychological stress emerges as the most credible mechanism, consistent with Michaelsen and Salardi (2020). We also find suggestive patterns of gender heterogeneity, where shootings appear to have a larger effect on boys, while explosions seem to affect girls to a larger extent, though these gender-specific effects are not statistically significant. This pattern suggests that the different forms of violent events may impact students through unique psychological or social channels, which may differ due to gender norms exposure levels, or perceived safety. Socioeconomic factors further shape vulnerability to violence. Schools with lower parental education and higher shares of students with foreign backgrounds are disproportionately affected by shootings. For explosions, vulnerability is more pronounced in urban schools and the strongest effects are found in schools with a lower proportion of students with foreign backgrounds, highlighting that explosions increasingly affect schools outside traditionally high-risk demographics. Additionally, schools with high student-to-teacher ratios are more prone to have negative impacts from violence.

While the results should be interpreted with caution, they highlight the importance of tailoring specific policy responses. Given that we have found, in line with previous studies, that psychological stress appears to be the central pathway, a key priority should be to strengthen schools' mental health support systems. This includes the expansion of trauma-informed psychological services, the development of gender- and context-sensitive support programs, and the establishment of rapid-response counseling teams following incidents of violence. Special attention should be given to students on the margin, who appear to be the most vulnerable to adverse effects.

In addition to interventions regarding mental health, we also suggest strategic funding as a key intervention, as disadvantaged and understaffed schools are more likely to experience impacts from violent events. Therefore, comprehensive action plans for responding to local violence should be developed to ensure that school personnel and support systems are prepared to manage the psychological aftermath of violent events. We also deem broader preparedness measures as particularly important, considering that explosions particular affect a wider range of school contexts beyond traditionally high-risk demographics.

Our analysis suggests that the effects of violence on educational outcomes are not short-lived, as altering the temporal condition in our analysis does not significantly alter the effect for shootings. This opens the door for future research to explore cumulative exposure, such as the number of violent events over a semester, or to assess the long-term educational or psychological effects of repeated exposure to violence in students' local environments.

While Sweden differs from more extensively studied countries in this research topic, our study contributes to the growing literature on the educational impact of local violence by providing evidence from a high-income country. We show that both shootings and explosions near schools have an impact on educational performance. We argue that the heterogeneity of effects across gender and socioeconomic background underscores the importance of tailored policy responses. Psychological stress emerges as the most likely mechanism as we test for and rule out attendance. Taken together, our findings highlight the urgent need for preventative strategies and responsive interventions that ensure safe and supportive learning environments for all students.

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Appendix

Appendix A: Overview of Variables

Table A.1: Overview of Data

Type of Data	Variable	Level	Source
Educational	Share of students obtaining a passing grade	School	Swedish National Agency for Education (2025*b*)
Educational	Participation rate in national test	School	Swedish National Agency for Education (2025*b*)
Educational	Average score in national test	School	Swedish National Agency for Education (2025*b*)
Educational	Share of students with post-secondary educated parents	School	Swedish National Agency for Education (2025*c*)
Educational	Share of students with foreign backgrounds	School	Swedish National Agency for Education (2025*c*)
Educational	Number of enrolled students and per grade	School	Swedish National Agency for Education (2025*c*)
Educational	Number of teachers	School	Swedish National Agency for Education (2025*d*)
Educational	Share of female teachers	School	Swedish National Agency for Education (2025*d*)
Educational	Share of teachers with a degree	School	Swedish National Agency for Education (2025*d*)
Educational	Student-to-teacher ratio	School	Swedish National Agency for Education (2025*d*)
Educational	Share of permanently employed teachers	School	Swedish National Agency for Education (2025*d*)
Educational	School coordinates (WGS 84)	School	Swedish National Agency for Education (personal communication, February 19, 2025)
Educational	National test dates	School	Swedish National Agency for Education (personal communication, January 30, 2025)
Shootings	Number of shootings	Event-level	The Swedish Police Authority (personal communication, January 23, 2025), SVT (2025*b*)
Shootings	Date of shooting	Event-level	The Swedish Police Authority (personal communication, January 23, 2025), SVT (2025*b*)
Shootings	Coordinates (SWEREF 99)	Event-level	The Swedish Police Authority (personal communication, January 23, 2025), SVT (2025*b*)
Explosions	Number of explosions	Event-level	The Swedish Police Authority (personal communication, January 23, 2025), SVT (2025*c*)
Explosions	Date of explosion	Event-level	The Swedish Police Authority (personal communication, January 23, 2025), SVT (2025*c*)
Explosions	Coordinates (RT90)	Event-level	The Swedish Police Authority (personal communication, January 23, 2025), SVT (2025*c*)
Educational	Foreign background (grades 1–9)	Municipality	Kolada (2025)
Educational	Mean disposable income	Municipality	Statistics Sweden (2025)
Educational	Unemployment	Municipality	Swedish Public Employment Service (2025)
Educational	Total population	Municipality	Statistics Sweden (2024*a*)

Appendix B: Visualization of School Calendar and Data Gathering Period

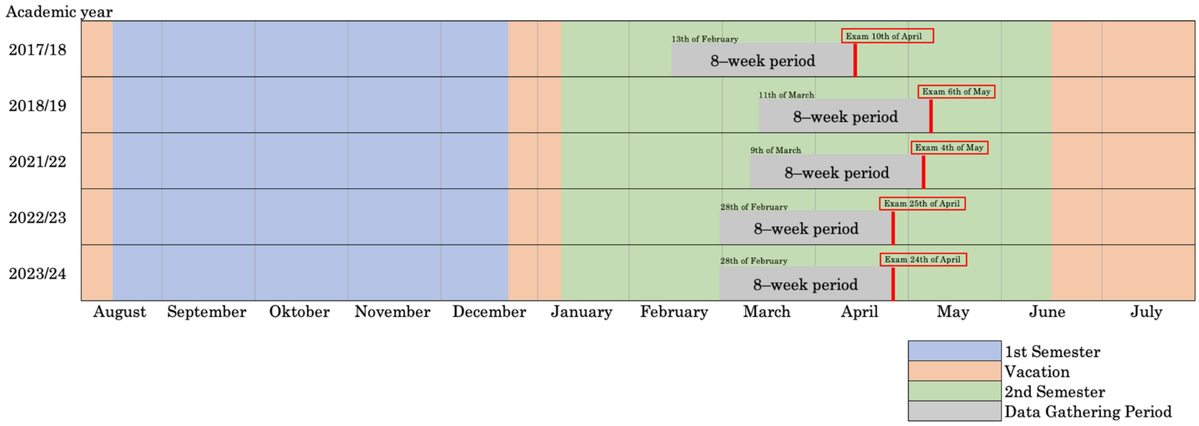

Figure B.1: Overview of the Academic Year and Data Gathering Periods

The academic year in Sweden typically begins in mid to late August with the first semester, which continues until mid to late December. This is followed by a winter break, usually lasting from late December to early or mid-January. The second semester begins in January and includes exam periods in April or May. The academic year concludes in mid-June, when students begin their summer vacation, which lasts until the next school year begins in August.

For our analysis, we collected data during the eight weeks leading up to the first written national test in mathematics. This eight-week window is illustrated in Figure B.1.

As a simplification, we have not verified the exact start and end dates of each semester for every academic year. Instead, the figure presents a generalized representation of the typical Swedish academic year.

Appendix C: Figures of Shootings and Explosions

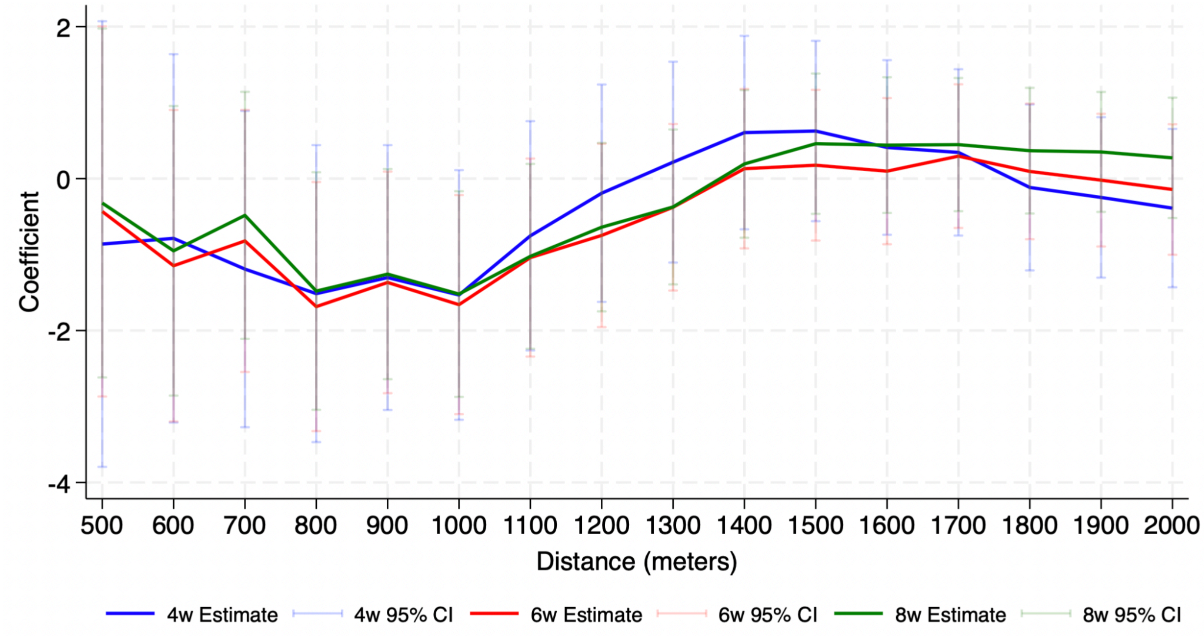

Figure C.1: Shootings over Time and Distance

Note: The figure displays estimated coefficients for the impact of shootings on the share of students receiving a passing grade, plotted by distance from the incident (in meters) and time window prior to the national math exam (4, 6, and 8 weeks). The blue, red, and green lines represent the estimates for the 4-, 6-, and 8-week windows, respectively. The corresponding 95% confidence intervals are shown in bright blue (4 weeks), bright red (6 weeks), and bright green (8 weeks).

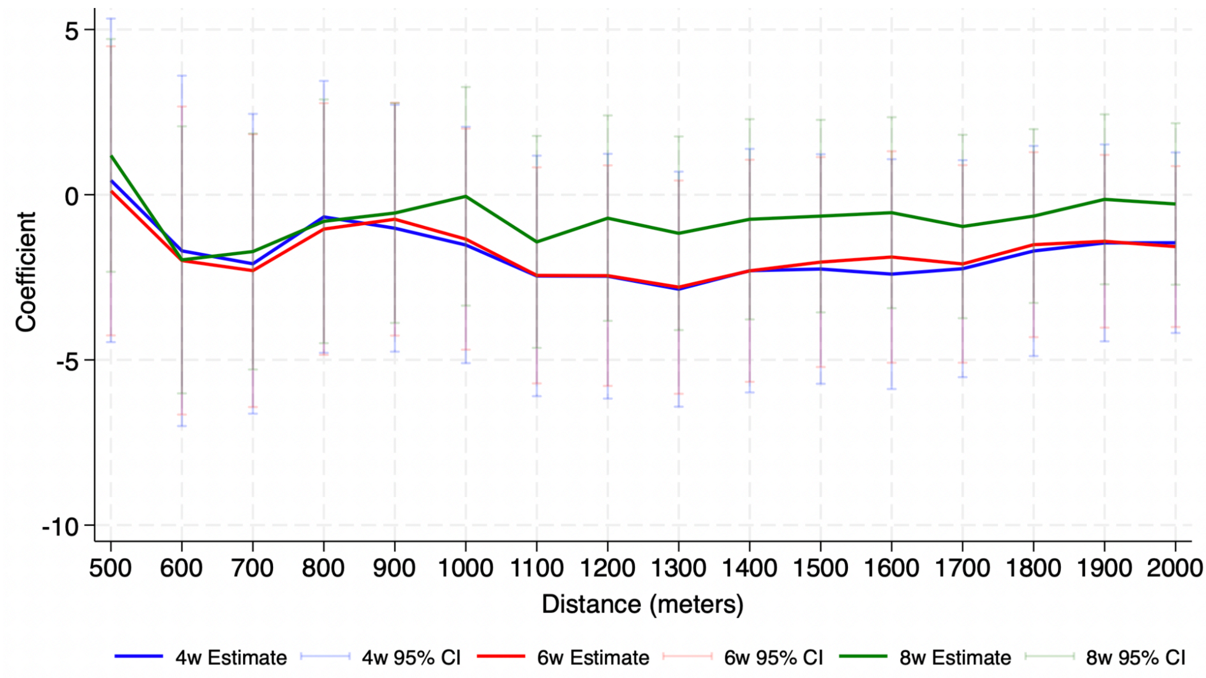

Figure C.2: Explosions over Time and Distance

Note: The figure displays estimated coefficients for the impact of explosions on the share of students receiving a passing grade, plotted by distance from the incident (in meters) and time window prior to the national math exam (4, 6, and 8 weeks). The blue, red, and green lines represent the estimates for the 4-, 6-, and 8-week windows, respectively. The corresponding 95% confidence intervals are shown in bright blue (4 weeks), bright red (6 weeks), and bright green (8 weeks).

Appendix D: Sensitivity Analysis

Table D.1: Using Average Exam Score as Dependent Variable

	Dependent Variable: Average Score
	(1)
A. Shootings	
Shooting (1,000 m, 6w)	-0.060
	(0.107)
Observations	12,245
Median average point	11.844
Controls	✓
Time FE	✓
School FE	✓
B. Explosions	
Explosion (1,500 m, 6w)	-0.171
	(0.225)
Observations	4,680
Median average point	11.426
Controls	✓
Time FE	✓
School FE	✓

Note: The dependent variable is Average Score. Robust standard errors are in parentheses and clustered at the school level. Controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

Table D.2: Descriptive Statistics for the Urban Sample

	Shootings (2018, 2019, 2022, 2023, 2024)		Explosions, 2023-2024	
	Mean	SD	Mean	SD
(School level)				
Share of students obtaining a passing grade	90.001	13.409	88.600	13.839
Average point	11.945	2.427	11.604	2.356
Share of students' parents with post-secondary education	63.38	18.163	65.254	18.087
Number of students in sixth grade	48.511	26.603	50.082	26.397
Number of teachers at the school	26.343	14.165	27.504	14.683
Student-teacher ratio	13.333	3.932	13.145	2.404
Share of female teachers	75.923	10.945	75.911	10.616
Share of teachers with a degree	85.795	11.107	87.378	10.026
Share of permanently employed teachers	88.866	10.108	89.907	9.122
(Municipality level)				
Foreign Background	32.185	9.254	33.187	9.040
Mean disposable income	607.963	91.392	595.171	89.025
Total population	335810.920	318985.820	342416.070	323278.680
Total unemployed individuals	12760.055	11187.625	12998.72	11598.605
Observations	4764	4764	1930	1930

Note: "Foreign background" refers to students born abroad or born in Sweden with both parents born abroad.

Table D.3: How Distance Matters for the Urban Sample

	Dependent Variable: Share Receiving a Passing Grade				
	(1)	(2)	(3)	(4)	(5)
	A. Shootings				
Shooting (800m, 6w)	-1.995**				
	(0.916)				
Shooting (900m, 6w)		-1.786**			
		(0.822)			
Shooting (1,000m, 6w)			-2.087**		
			(0.813)		
Shooting (1,100m, 6w)				-1.502**	
				(0.728)	
Shooting (1,200m, 6w)					-1.044
					(0.680)
Observations	4,662	4,662	4,662	4,662	4,662
Mean (Share Receiving a Passing Grade)	90.007	90.007	90.007	90.007	90.007
Controls	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓
School FE	✓	✓	✓	✓	✓
	B. Explosions				
Explosion (1,300m, 6w)	-6.399***				
	(2.230)				
Explosion (1,400m, 6w)		-5.563**			
		(2.407)			
Explosion (1,500m, 6w)			-4.482**		
			(2.177)		
Explosion (1,600m, 6w)				-4.261*	
				(2.241)	
Explosion (1,700m, 6w)					-4.170**
					(2.078)
Observations	1,804	1,804	1,804	1,804	1,804
Mean (Share Receiving a Passing Grade)	88.385	88.385	88.385	88.385	88.385
Controls	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓
School FE	✓	✓	✓	✓	✓

Note: Sub-sample only includes the 25 largest municipalities in Sweden. The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses. Standard errors are clustered at the school level. Controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

Table D.4: How Time Matters For the Urban Sample

	Dependent Variable: Share Receiving a Passing Grade		
	(1)	(2)	(3)
	A. Shootings		
Shooting (1,000m, 4w)	-1.604*		
	(0.902)		
Shooting (1,000m, 6w)		-2.087**	
		(0.813)	
Shooting (1,000m, 8w)			-1.940**
			(0.787)
Observations	4,662	4,662	4,662
Mean (Share Receiving a Passing Grade)	90.007	90.007	90.007
Controls	✓	✓	✓
Time FE	✓	✓	✓
School FE	✓	✓	✓
	B. Explosions		
Explosion (1,500m, 4w)	-4.757**		
	(2.393)		
Explosion (1,500m, 6w)		-4.482**	
		(2.177)	
Explosion (1,500m, 8w)			-1.517
			(1.937)
Observations	1,804	1,804	1,804
Mean (Share Receiving a Passing Grade)	88.385	88.385	88.385
Controls	✓	✓	✓
Time FE	✓	✓	✓
School FE	✓	✓	✓

Note: Sub-sample only includes the 25 largest municipalities in Sweden. The dependent variable in all columns is the share of students receiving a passing grade. Robust standard errors are in parentheses. Standard errors are clustered at the school level. Controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

Table D.5: Evaluating Attendance as a Mechanism for the Urban Sample

	Dependent Variable: Exam Attendance	
	(1)	(2)
	A. Shootings	
Shooting (1,000m, 6w)	0.441	0.278
	(0.282)	(0.424)
Observations	4,764	4,662
Mean (Exam Attendance)	93.412	93.446
Controls	✓	✓
Time FE	✓	✓
Municipality FE	✓	
School FE		✓
	B. Explosions	
Explosion (1,500m, 6w)	0.431	-0.060
	(0.846)	(1.227)
Observations	1,930	1,804
totalt deltagit	93.063	93.110
Controls	✓	✓
Time FE	✓	✓
Municipality FE	✓	
School FE		✓

Note: Sub-sample only includes the 25 largest municipalities in Sweden. The dependent variable in both columns is Exam Attendance. Robust standard errors are in parentheses. For models with municipality FE(column 1), standard errors are clustered at the municipality level; for models with school FE (column 2), standard errors are clustered at the school level. Controls are: number of students enrolled (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

Table D.6: Placebo Test for the Urban Sample

	Dependent Variable: Share Receiving a Passing Grade	
	(1)	(2)
A. Shootings		
Shooting (1,000m, 6w, POST)	0.350	0.666
	(0.807)	(0.806)
Observations	4,764	4,662
Mean (Share Receiving a Passing Grade)	90.001	90.007
Control Variables	✓	✓
Time FE	✓	✓
Municipality FE	✓	
School FE		✓
B. Explosions		
Explosion (1,500m, 6w POST)	-0.794	-1.037
	(0.949)	(2.061)
Observations	1,930	1,804
Mean (Share Receiving a Passing Grade)	88.600	88.385
Control Variables	✓	✓
Time FE	✓	✓
Municipality FE	✓	
School FE		✓

Note: Sub-sample only includes the 25 largest municipalities in Sweden. The dependent variable in all columns is Exam Attendance. Robust standard errors are in parentheses. For models with municipality FE (column 1), standard errors are clustered at the municipality level; for models with school FE (column 2), standard errors are clustered at the school level. Controls are: number of students enrolled (school level), share parents with post-secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.

Appendix E: Additional Robustness Checks

Table E.1: Additional Robustness Checks

	Dependent Variable: Share Receiving a Passing Grade	
	(1)	(2)
	A. Shootings	
Shooting (1,000m, 6w)	-1.638**	-1.726**
	(0.737)	(0.738)
Imputed values	1.188	
	(0.888)	
Share Foreign Background		-0.044
(School-level)		(0.041)
Observations	12.245	10.637
Mean (Share Receiving a Passing Grade)	90.642	89.586
Control Variables	✓	✓
Time FE	✓	✓
Controlling for imputed values	✓	
Foreign Background (school-level)		✓
School FE		✓
	B. Explosions	
Explosion (1,500m, 6w)	-1.982	-1.875
	(1.621)	(1.630)
Imputed values	0.727	
	(5.665)	
Share Foreign Background		0.117
(School-level)		(0.136)
Observations	4.680	4.128
Mean (Share Receiving a Passing Grade)	88.483	87.541
Control Variables	✓	✓
Time FE	✓	✓
Controlling for imputed values	✓	
Foreign Background (school-level)		✓
School FE		✓

Note: The dependent variable in all columns is Exam Attendance. Robust standard errors are in parentheses. For models with municipality FE (column 1), standard errors are clustered at the municipality level; for models with school FE (column 2), standard errors are clustered at the school level. Controls are: number of students enrolled (school level), share parents with post secondary education (school level), number of teachers (school level), student-teacher ratio (school level), share of teachers with a university degree (school level), share female teachers (school level), share permanent employed (school level), share foreign background (municipality level), disposable income (municipality level), population (municipality level), and unemployment (municipality level). *** p<0.01, ** p<0.05, * p<0.1.