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Exposure to drug trafficking and school truancy: Empirical evidence from Costa Rica

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ABSTRACT

Exposure to crime and violence associated with drug trafficking has been shown to have negative consequences on students' health, peer relationships, and educational outcomes. However, little attention has been devoted to analyzing the effects of exposure to drug trafficking on students' truancy behavior, a critical outcome with a high cost at an individual and societal level. This study investigates the connection between exposure to drug trafficking (an increasingly common form of chronic crime and subsequent violence in Latin America) and school truancy in Costa Rica. To do so, we use a unique and comprehensive microdata set that merges detailed information on a specific measure of exposure to drug trafficking (cocaine seizures) and socioeconomic characteristics of Costa Rican districts with student and school data from the Programme for International Student Assessment (PISA). In total, we obtain a sample of 4,584 students in secondary education attending 195 schools in 147 districts. Using logistic regression, we find that students in districts with higher exposure to drug trafficking (measured by cocaine seizure rate) are more prone to school truancy. This finding suggests that strategies to tackle school truancy should consider a neighborhood context perspective.

1. Introduction

School absenteeism constitutes a serious concern for policymakers and international organizations (OECD, 2019a; Thornton et al., 2013). While school absenteeism can result from a variety of reasons (including medical conditions), Heyne et al. (2019) distinguish non-problematic (authorized) and problematic (unauthorized) absenteeism. These authors define truancy as the situation when: (1) "a young person is absent from school for a whole day or part of the day, or they are at school but absent from the proper location [...]"; (2) the absence occurs without the permission of school authorities; and (3) "the young person typically tries to conceal the absence from their parents" (Heyne et al., 2019:16). Internationally comparable data from the Programme for International Student Assessment (PISA) indicate that 27 % of students at the age of 15 years reported they had skipped classes in the two weeks before the test (OECD, 2019a). In Latin American countries, this problem is particularly severe: on average, 46.3 % of students in this region reported that they had skipped classes.

This study aims to analyze the relationship between school truancy and a particularly salient issue in Latin America: exposure to criminal

activity associated with drug trafficking. We address this under-researched issue taking Costa Rica as a case study. We use a unique and comprehensive microdata set that merges socioeconomic characteristics of Costa Rican districts (including detailed information on a specific measure of exposure to drug trafficking, that is, cocaine seizures) with student and school data from the Programme for International Student Assessment (PISA). By so doing, our research provides two main methodological contributions. First, our data set allows us to account for a wide range of input measures, including student, family, school, and neighborhood characteristics. The absence of some of these elements may have obscured prior evidence. Second, our study uses a specific and objective measure of drug trafficking: cocaine seizures. Previous empirical studies used an indirect measure (homicide rates) or subjective measures (e.g., crime measures reported by residents or school directors). By considering indirect or subjective measures of drug trafficking, previous analyses focused on the consequences of drug trafficking, or the perceptions of it, but not on objective evidence on drug trafficking itself. Besides, we offer empirical evidence on the relationship between school truancy and drug trafficking specific to the Latin American context. This region has been traditionally

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underrepresented in the literature on the effects of crime on school attendance despite being the region with the highest rates of criminal violence in the world.

Based on the uniqueness of these data, to the best of our knowledge, this study is the first empirical analysis of the relationship between a specific measure of drug trafficking (cocaine seizures) and school truancy. To explore this issue, Costa Rica constitutes an ideal case of study. The country, located in Central America, has experienced an alarming increase in both cocaine trafficking and crime (Comisión Técnica Interinstitucional sobre Estadísticas de Convivencia y Seguridad Ciudadana, 2017; United Nations Office on Drugs and Crime, 2019; Vo, 2018). Nearly half of all homicides in the country are linked to the trade of illegal narcotics (Bureau of International Narcotics and Law Enforcement Affairs, n.a.). Since 2010, Costa Rica has been included in the US Department's list of major drug-producing and drug-transiting countries (The White House, 2010; 2022). In the international cocaine market, Costa Rica has a vital role in cocaine transshipment for the United States, the world's largest drug consumer, and European cocaine markets (McSweeney, 2020). Moreover, Costa Rica is one of the countries in Latin America that provides the most accurate statistics. Data available in this country allow us to connect internationally comparable information on school truancy and a specific measure of drug trafficking.

The results of this study show that truancy increases for students attending schools located in districts with higher cocaine seizure rates. This evidence indicates that not only school factors but also neighborhood factors are essential for understanding truancy and developing interventions to address it. From these results, this study contributes to different strands of literature. First, it extends the knowledge of the determinants of school truancy. Second, it contributes to the literature on how neighborhood environments relate to students' academic success and behavior. Third, it adds to the interdisciplinary literature on the effects of exposure to crime and violence on education by focusing on a dimension (truancy) with high costs and critical implications at the individual, school, and societal levels. Truants are more likely to fall behind in class, to decline in their socio-psychological development (including experiencing peer relationship difficulties), and to have lower academic achievement. These effects are more likely if truancy becomes persistent (Thornton et al., 2013; Wilson et al., 2008). Students who persistently miss school have a higher risk of dropout (Kearney, 2007; Ripamonti, 2018; Thornton et al., 2013) and might face economic and social consequences in the short and long term: restricted opportunities for further education, training, and employment (Thornton et al., 2013), and an increased risk of suffering unemployment, poverty, and social exclusion (Ekstrand, 2015; Heyne et al., 2019; Ovink, 2010; Wilson et al., 2008). Truancy has been found associated with future risky behaviors such as tobacco, alcohol, and drug use (Heyne et al., 2019; Ready, 2010), as well as worse future health outcomes (Ekstrand, 2015; Rankine et al., 2022). Truants also face a higher risk of suffering social and emotional problems in adulthood (Kearney, 2007; Thornton et al., 2013; Wilson et al., 2008).

Truancy affects not just individual truants themselves, but also other students' learning processes. When truants return to class, they are more likely to be disruptive, appear disengaged, or demand teachers' attention, and can generate adverse reactions among their peers. Among teachers, truants generate increased work, frustration, and a negative impact on their ability to plan and prepare the classes (Thornton et al., 2013; Wilson et al., 2008). Beyond school, truancy negatively affects the whole community in terms of public safety (Eastman et al., 2007). Truants are particularly prone to delinquent behavior in youth (Heyne et al., 2019; Wilson et al., 2008). In the long term, truant students also have a higher risk for adult criminality (Ekstrand, 2015; Kearney, 2007). As a result, truancy makes more people vulnerable to crime: as perpetrators or, most likely, as victims (Smink and Heilbrunn, 2006). Given the adverse consequences of truancy, policymakers are increasingly devising strategies to tackle this problem (OECD, 2019a). In parallel, researchers are developing insights that can help one to understand the

causes of truancy and improve school attendance (Thornton et al., 2013). Both policymakers and researchers have traditionally focused their attention on individual, family, and school factors associated with truancy. Despite recent evidence suggesting that neighborhood environment can shape youth behavior (e.g., Burdick-Will, 2013), empirical models that consider the effect of neighborhood aspects on truancy are limited.

However, not only school truancy and dropout can increase criminality. In the opposite direction, crime may also affect educational development within exposed areas. Children and adolescents are especially vulnerable (Brown and Velásquez, 2017; Jarillo et al., 2016): exposure to crime during this crucial developmental period may lead to educational deficits, resulting in long-term consequences at individual and societal levels. This is particularly relevant in Latin America and the Caribbean, a region highly exposed to chronic crime. Even though Latin America and the Caribbean contain only 8 % of the global population, this region accounts for one-third of the recorded homicides in the world (Arjona, 2021). In this region, interpersonal violence is the main cause of premature death among young people, while non-lethal violence leads to additional costs to individuals and communities through its consequences on health, human capital accumulation, and financial costs of public and private security (Blume, 2021; Moser and McIlwaine, 2006; Sauls et al., 2022; Valdivia and Okowí, 2021).

In Mexico and Central America, violence linked with illicit drug trade has risen sharply in recent years, reaching unprecedented levels. This drug-related violence has been associated mainly with the cocaine trade, given that most organized criminal groups obtain a significant proportion of profit from this drug (United Nations Office on Drugs and Crime, 2019). Both direct and indirect exposure to local neighborhood crime has been shown to have detrimental consequences on students' mental and physical health, peer relationships, and academic achievement. Unfortunately, surprisingly little is known about its consequences on truancy behavior, an educational outcome with critical implications for educational and career opportunities, and well-being. As highlighted by Monteiro and Rocha (2017), more evidence is needed on the detrimental impacts of criminal activities associated with drug trafficking on the population of the affected areas, including those on the provision of a basic public good such as schooling and accumulation of human capital.

The rest of the paper is structured as follows. Section 2 explains the insights from the literature on the effects of crime and violence on education (in particular, in the Latin American context). Section 3 describes the data and method used in our analysis. Section 4 reports the main results, the heterogeneity analysis, and the robustness check. Section 5 discusses the findings. Section 6 concludes and describes the main implications of the paper.

2. The influence of crime on education

The consequences of crime are far beyond the casualties of those involved in criminal activity and its victims. Negative spillovers appear in conflict areas and may have detrimental effects on the provision of public goods, including education (Monteiro and Rocha, 2017). Jarillo et al. (2016) describe three main mechanisms by which crime can affect educational processes. The first mechanism is the effect of crime on students' psychological condition. People living in violent environments face multiple stressors, which in the case of students can hinder learning and the socialization process linked to educational attendance (Gimenez et al., 2021). Exposure to violence has been found to significantly impact students' conduct problems at school and anxiety. Children living in areas with chronic violence are more prone to psychobiological problems such as concentration and sleeping problems, posttraumatic stress disorder, and depression (Bowen and Bowen, 1999). Moreover, attending schools in areas highly exposed to violence has been found to increase the probability of suffering peer physical aggression at school (Gimenez et al., 2021), which in turn is a significant determinant of school attendance (Dunne et al., 2013) as well as participation in

criminal activities in the future (Wallinius et al., 2016).

The second mechanism described by Jarillo et al. (2016) is the effect of crime on economic activity. As crime may increase the immediate payoff that adolescents can obtain from participation in criminal activities, it increases the opportunity costs of education. Moreover, criminal activity may erode the economic activity in the exposed areas, lowering educational returns and reducing families' financial capacity, which may have a negative impact on their schooling decisions. Thus, crime would particularly affect students from disadvantaged backgrounds, who are more prone to live in neighborhoods highly exposed to criminal activity and whose families' schooling decisions are more vulnerable to the economic impact of crime.

The third mechanism described by Jarillo et al. (2016) is related to school supply: crime and violence may deteriorate the quality of the education provided in highly exposed areas. For instance, Brück et al. (2019) found that the Israeli–Palestinian conflict deteriorates education supply in Palestinian high schools by increasing class overcrowding. Moreover, crime could increase teachers' absenteeism and turnover, as well as principals' turnover and even temporary closure of school activities.

Several empirical studies have analyzed how exposure to violence and crime affects educational processes, including school attendance and academic outcomes, both in developed and in developing countries (Gimenez and Barrado, 2020; Justino et al., 2014; Woldehanna et al., 2021). In the case of Latin America, empirical analyses on the impact of chronic criminal violence on education have emerged in recent years, facilitated by the increasing availability of data and driven by the rise of violent criminal activity associated with drug trafficking (*narcoviolence*).

Jarillo et al. (2016) analyzed the impact of violence related to drug trafficking in Mexico on educational achievement, measured from national tests on students' outcomes in mathematics in elementary and secondary education. These authors used information on firearm-related murders by locality and year to construct indicators on drug-related turf war exposure and turf war persistence. They found that exposure to and persistence of violence reduced test scores in mathematics, particularly in secondary schools where street gangs were nearby. The effects were significantly higher in poor urban settings. These authors explained the connection between drug-related violence and lower educational outcomes as being due to higher teacher absenteeism and turnover as well as higher student truancy and tardiness. They also argued that other factors that may contribute to the relationship between the presence of gangs near schools and lower educational outcomes are a higher incidence of violence inside the classroom, a higher engagement of students in the criminal world, and a higher incidence of student recruitment into drug cartels.

Monteiro and Rocha (2017) analyzed the impact of gunfights between drug gangs in Rio de Janeiro (Brazil) on educational achievement, measured by national tests on students' outcomes in mathematics in elementary education. To do so, these authors exploited variation across time and neighborhoods in data on criminal activities reported by residents. They found that students' scores in mathematics were lower in years in which they were exposed to drug battles. This effect was higher if violence was more intense or lasted for a more extended period, and depended on the distance between the school and the location of the conflict. These authors explained these results considering mechanisms from the supply side: gang-related violence was associated with higher teacher absenteeism, principal turnover, and temporary school closings.

Deole (2018) analyzed the impact of violence in and around schools on educational outcomes among primary and secondary school students in Brazil, measured by national test scores in mathematics. To do so, this author used information on incidents reported by school directors in a national survey. He found that violent incidents, drug usage, and possession of weapons in and around the school have a negative impact on educational outcomes. This author highlighted two effects of violence that would explain its negative impact on educational outcomes: the

effects on students' psychological stress and the effects on both teachers' and students' disengagement of their responsibilities.

Márquez-Padilla et al. (2019) studied the effects of military operations against drug trafficking organizations in Mexico (which led to violent confrontation and an increase in homicides) on schooling decisions. To do so, the authors analyzed changes in school enrollment and homicide rates in Mexican municipalities. They found that the increase in homicide rates had only some effects on the number of students enrolled in each municipality but no effects on enrollment rate. They suggest that this finding arises from violence leading many families to migrate to less exposed municipalities.

Over a longer timeframe, Fergusson et al. (2015) examined the impact of violence in Colombia during the mid-20th century on the educational attainment of the exposed cohorts. To do so, these authors exploited variations in exposure to the conflict across Colombian municipalities. They found that individuals exposed to violence during their schooling years, but also those exposed to violence before their schooling years, experienced a significant decrease in years of schooling. They also identified negative effects of violence on the structural transformation of the country, as the exposed cohorts were more likely to be employed in economic sectors less intensive in qualified labor.

More recently, Michaelsen and Salardi (2020) analyzed the impact of drug-related violence on students' outcomes (also measured from national tests) in urban elementary schools in Mexico. To do so, these authors used data on homicides and their distance to schools. They found that the most significant impacts of violence on students' outcomes resulted from homicides committed close to schools during the week prior to the tests. This effect increased if either the proximity between homicides and schools or the levels of violence were higher. These authors attributed these effects to the acute psychological stress generated by violence among students who had experienced it close to them.

Finally, Gimenez and Barrado (2020) analyzed the relationship between crime and educational achievement in secondary education in Costa Rica, using the information on students' outcomes in mathematics, reading, and science from international tests (obtained from PISA). These authors measured crime at the district level from data on homicide rates by district. They found that the homicide rate in a district was negatively associated with students' outcomes in all the domains (mathematics, reading, and science). This effect was especially higher among students in districts with a lower level of social development.

In sum, there is increasing evidence of the impact of crime and violence on education in the specific context of Latin American countries. However, in the existent studies crime is measured by available information on its consequences (i.e., homicides or homicide rates in Gimenez and Barrado, 2020; Jarillo et al., 2016; Márquez-Padilla et al., 2019; Michaelsen and Salardi, 2020), or from information on criminal activity reported by residents (Monteiro and Rocha, 2017) or school directors (Deole, 2018). The main contribution of our paper to this literature is twofold. First, it presents a study on the relationship between education and a specific objective measure of criminal activity associated with drug trafficking: cocaine seizures. Second, it focuses on a different dimension of education rather than educational outcomes: school attendance (truancy). Substantial literature from a wide range of disciplines suggests that physical avoidance is one of the primary mechanisms for responding to unsafe environments (for a review, see Burdick-Will, 2013). As Burdick-Will (2013) points out, residents in violent areas do not want to be exposed (as victims or as witnesses) to violent crimes and prefer to stay at home. Information about dangerous areas or violent events spreads quickly across the neighborhood via the police presence or social and familial networks. Awareness of these crimes could discourage students from attending school or playing outside (Burdick-Will et al., 2019). Moreover, exposure to crime can change the perceived costs and benefits of attending school. As a result, students who feel threatened are less likely to invest in school (Harding, 2009). By increasing students' exposure to violence and psychobiological disorders, increasing the opportunity costs of education, reducing

the returns of education, or reducing the quality of education in highly exposed areas (following Jarillo et al., 2016), crime may reduce the incentives for school attendance, and increase truancy (Harding, 2009).

3. Method

3.1. Data

For our analysis of the relationship between school truancy and exposure to drug trafficking in Costa Rica, we used data from three different sources. First, educational data came from the 2015 edition of PISA for Costa Rica. PISA is an international evaluation carried out every three years by the Organization for Economic Co-operation and Development (OECD), which tests the skills of 15-year-old students in reading, mathematics, and science. In addition to the cognitive questionnaire, PISA provides extensive information about the characteristics of the students, their households, their schools, and their learning experiences (OECD, 2016). Among these data, the PISA data set contained information concerning truancy and its student- and school-level predictors, which was crucial for this paper. The PISA data set was representative of the target population (15-year-old students throughout the country attending educational institutions in grades 7 and higher) at the country level. In the 2015 edition of PISA for Costa Rica, the sample consisted of 6,866 students from 205 schools. After the elimination of outliers, and considering the presence of missing data from students and managers leaving questions unanswered, the final data set contained information for 4,584 students (2,345 females and 2,239 males) clustered in 195 schools distributed in 147 Costa Rican districts.

Second, to merge the educational data with the drug trafficking data, we needed to know the geolocation of the schools participating in PISA. This information, not common when using PISA data, was provided by the Ministry of Education of Costa Rica. This allowed us to identify the administrative districts where the participating schools were located and, then, to link the PISA data set with data about drug trafficking in the district where each school was located.¹ The information about drug trafficking was proxied through the kilos of cocaine seizure per 100,000 inhabitants, calculated from data provided by the National Drug Information and Statistics Unit of the Costa Rican Institute on Drugs, which is part of the Ministry of the Presidency. These data were available for 2015, which required merging it with the 2015 PISA round instead of previous or later rounds.

Fig. 1 shows the average district data of truancy and the seizures of kilos of cocaine per 100,000 inhabitants for the districts where the schools participating in PISA 2015 were located. In Costa Rica, 41.95 % of the students (40.55 % of females and 43.41 % of males) claimed to have skipped one or more lessons in the last two weeks of school. There are big differences among districts, ranging from 7.14 % in the district of Nosara to 78.26 % in Cajón. The district mean of seizures was 1,054 kilos per 100,000 inhabitants, with seizures ranging from 13,978 kilos per 100,000 inhabitants in the district of San Marcos to 13,980 in Mata Redonda.

We completed this unique data set with data on the socioeconomic characteristics of the districts where the schools were located. This information came from the Ministry of National Planning and Economic Policy of Costa Rica (MIDEPLAN, its acronym in Spanish).

¹ In 2015, Costa Rica was administratively divided into 481 districts. These were the smallest administrative units into which the country was divided. This allowed us a very high level of disaggregation. No observations were lost in the merging process, given that we had information on the location of every school participating in PISA and the cocaine confiscated in every district where the schools were situated. However, not all the districts in Costa Rica had schools that took part in PISA. Therefore, our sample was limited to the 147 districts with at least one school participating.

3.1.1. Measures

3.1.1.1. Dependent variable. PISA 2015 questionnaire included two measures of students' truancy behavior. PISA asked students to report the number of times they had skipped single lessons and the number of times they had skipped whole school days during the two weeks prior to the assessment. However, as Keppens and Spruyt (2018) point out, the measure that refers to playing truant for at least a day has a short time frame, leading to an underestimation of the occasional truancy. Following these authors, we focus exclusively on the variable of skipping single lessons.

Our dependent variable was based on the question "In the last two weeks of school, how often did you skip single lessons?" (PISA code ST062Q02TA). Options were: "none" (58.05 % of students); "one or two times" (34.14 %); "three or four times" (6.09 %); "five or more times" (2.73 %). As Yang and Ham (2017) point out, ordinal logistic regression must satisfy the "parallel lines" assumption (slope coefficients are the same across all response categories). However, the results of the test of parallelism rejected the null hypothesis, suggesting that this assumption was violated. For this reason, following these authors, we converted the variable into a dichotomous one, distinguishing students into two groups: variable = 0 if the student responded "none" lessons were skipped (58.05 % of students), and variable = 1 in the rest of the cases (41.95 %).

3.1.1.2. Control variables. Control variables included student, school, and district characteristics and are based on the literature on the determinants of truancy, given the information available in PISA.

Student and school characteristics: unlike authorized absenteeism, truancy commonly depends on students' decisions and attitudes. As such, it is much more prevalent in secondary education than in elementary levels once students gain the autonomy to make their own decisions (Ready, 2010). Truancy is a risky and detrimental behavior for the individual (Ekstrand, 2015). As schools are expected to play a role in creating and maintaining social order, truancy represents an escape from institutional control (Ovink, 2010).

The literature on the determinants of truancy has predominately focused on student background and school characteristics and climate (Thornton et al., 2013). As regards students' characteristics, as summarized in OECD (2019a), truancy varies mainly according to gender, socioeconomic level, and location of schools: boys, students from disadvantaged family backgrounds, and urban residents are, in most countries included in PISA, more prone to truancy (see also Gottfried, 2014; OECD 2016; and Ready, 2010). Regarding the family background, parents' involvement and attitudes, as well as broader variables at the family level, play a significant role in students' attitudes towards truancy (Escario et al., 2022; OECD, 2019a; Thornton et al., 2013). Students with poor attendance often come from families experiencing unfavorable social circumstances, conflict, or poor cohesion. Ready (2010) highlights that disadvantaged students would suffer stronger negative effects from chronic absences from school and, for this reason, school attendance rates are crucial for achieving the equalizing effects of schooling. As students learn social skills from their peers, the quality of social interaction with them plays a crucial role (Thornton et al., 2013). As these authors explain, school climate and engagement refer to students' perceived degree of support regarding their academic and non-academic needs. Students who like school and feel more engaged are less prone to truancy and other disciplinary problems. Positive relationships with peers and teachers are key for encouraging students to attend school regularly (Dunne et al., 2013; OECD, 2019a; Woldehanna et al., 2021). OECD (2019a) also highlights a positive association between school attendance and both the value that students give to schools and the disciplinary climate at school. On the contrary, students who suffer bullying tend to have a more negative attitude towards going to school, and are more prone to truancy (Dunne et al., 2013). As described

- A. Percentage of students who skipped one or more lessons in the last two weeks of school
- B. Seizures of kilos of cocaine per 100,000 inhabitants

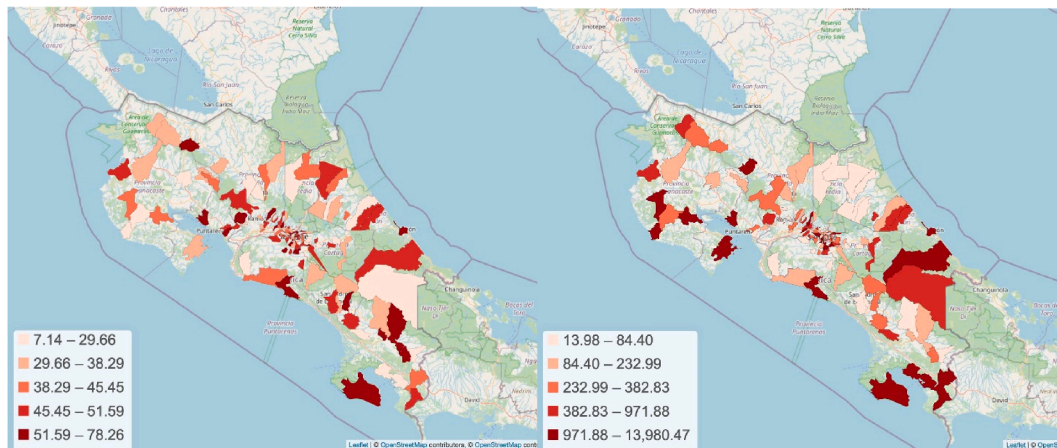


Fig. 1. District average of truancy and confiscations of kilos of cocaine per 100,000 inhabitants of the Costa Rican districts in which the schools that took part in PISA 2015 were located. Note: We provide the district mean in both variables for convenience in their graphical representation. However, since the academic information was disaggregated at that level, the estimates used students as the estimation unit.

by Kearney (2007), psychological difficulties such as depression, anxiety, introversion, fear, and a need to gain attention from others are associated with truancy. Lack of friends and bad relationships with teachers are, together with fears of being bullied and lack of school engagement, relational factors that increase the propensity to become a truant (OECD, 2019a).

In our study, we used the variables and composed indexes provided by PISA for student and school characteristics as control variables. Statistical properties and details about the construction of these measures can be found in the PISA 2015 Technical Report (OECD, 2017). We considered age, gender, country of birth, parents' highest occupational status, parents' highest level of education, parents' emotional support, peer physical aggression, students' satisfaction with life, feeling socially connected at school, and school disciplinary climate. As regards individual and demographic characteristics linked to the likelihood of skipping school, which we included as control variables, the variable AGE measured the age of each student (our total sample's average value was 15 years and 9 months; it ranged from 15 years and 4 months to 16 years and 3 months, with a standard deviation of 3 months). The gender was given by the variable with the PISA code ST004D01T (51.16 % of the sample were girls and 48.84 % boys). The variable country of birth was measured by the variable ST019AQ01T. Students were asked "In what country were you born?" with the answering categories "Country of test" (96.27 % of the sample), and "Other country" (3.73 %).

Parents' highest occupational status was measured by the index of highest occupational status of parents built by PISA (code HISEI). The highest occupational status of parents corresponds to the higher International Socio-Economic Index of Occupational Status (ISEI) score of either parent or the only available parent's ISEI score. The average value of the parents' highest occupational status was 46.37. It ranged from 11 to 89, with a standard deviation of 21.25.

Parents' highest level of education was measured by the index of the highest education level of either parent (code PARED) built by PISA, which expresses it in an estimated number of years of schooling (PARED). The average value of the parent's education index was 12.94. It ranged from 3 to 16, with a standard deviation of 3.80.

Parents' emotional support was measured by the index provided by PISA (code EMOSUPS). PISA asked the students about their perceived emotional support from their parents, which included items on whether parents are interested in school activities, support the student's

educational efforts and achievements, support students when they are facing difficulties at school, and encourage them to be confident. The average value of the parent's emotional support for the sample was 0.40. It ranged from -3.08 to 1.10 , with a standard deviation of 0.94.

Peer physical aggression was measured by the question "During the past 12 months, how often have you had the following experience in school? I got hit or pushed around by other students" (PISA code ST038Q07NA). Students might find it relatively difficult to distinguish between "few times a month" and "once a week or more," and the variation between the two categories might reflect different interpretations of the question. So, following Gimenez et al. (2021) we built a dummy variable equal to zero if the student responded "Never or almost never" (92.08 % of the students), and equal to one in the rest of the cases (7.92 % of the students).

Students' life satisfaction level was measured by the question "Overall, how satisfied are you with your life as a whole these days?" (code ST016). Responses were limited to integers ranging from 0 (not at all satisfied) to 10 (completely satisfied). The average value of the student's life satisfaction level was 8.20. It ranged from 0 to 10, with a standard deviation of 2.10.

Feeling socially connected at school was measured by the index of sense of belonging at school built by PISA (code BELONG). PISA constructed this index using students' responses on whether they agree ("strongly disagree," "disagree," "agree," "strongly agree") with the following school-related statements (ST034): "I feel like an outsider (or left out of things) at school"; "I make friends easily at school"; "I feel like I belong at school"; "I feel awkward and out of place in my school"; "Other students seem to like me"; and "I feel lonely at school." Positive values on this scale mean that students reported a greater sense of belonging at school than did the average student across OECD countries. The average value of the sense of belonging index for the sample was -0.14 . It ranged from -3.15 to 2.64 , with a standard deviation of 1.21.

Disciplinary climate at school was measured by the index of disciplinary climate (code DISCLISCI) built by PISA. PISA constructed this index using students' responses to a trend question about how often ("every lesson," "most lessons," "some lessons," "never or hardly ever") the following happened in their science lessons: "Students don't listen to what the teacher says"; "There is noise and disorder"; "The teacher has to wait a long time for students to quiet down"; "Students cannot work well"; and "Students don't start working for a long time after the lesson

begins.” Positive values on this scale mean the student enjoyed a better disciplinary climate in science lessons than the average student across OECD countries. The average value of the disciplinary climate at school for the sample was 0.16. It ranged from -2.41 to -1.88 , with a standard deviation of 0.92.

District characteristics: Neighborhood characteristics and the behavior of other residents in the neighborhood also play a significant role as determinants of truancy (Nieuwenhuis et al., (2021): adult role models, supervision, and social control, as well as neighborhood-based social networks and peers, may differ across neighborhoods. These elements can influence the behavior and attitudes of local adolescents towards education by providing different sources of information and resources as regards educational opportunities. Moreover, poor neighborhoods may have more difficulties in attracting good teachers, worsening the quality of education in these areas and increasing students’ truancy (Gottfried, 2014). In fact, as noted by Nieuwenhuis et al. (2021), differences across schools in truancy behavior are often explained by differences across neighbors, as the socio-demographic composition of schools tends to represent the socio-demographic composition of the neighborhood in which they are located.

In our study, we included three control variables representing district characteristics: urban location, a socioeconomic index, and an index of infrastructures at home.

The location has been found to be linked to school absenteeism. Some reports find that urban students tend to skip school more frequently than rural students (OECD, 2016). On the contrary, other studies focused on Latin America point out that attendance among rural students is lower (Guiskin et al., 2019), which could be explained by better infrastructure in urban areas, such as paving roads, constructing sidewalks, and providing mobility options (Gottfried, 2017; Zanoni et al., 2023).

Urban location was measured using the definition of the National Institute of Statistics and Censuses of Costa Rica. This definition uses physical and functional criteria, considering tangible items such as clearly defined quadrants, streets, sidewalks, urban services (garbage collection, street lighting), and economic activities such as industry, large businesses, and various services (INEC, 2016: pp. 13–14). The geographical delimitation was based on the administrative centers of each canton or district and was expanded compactly according to the characteristics mentioned above. In addition, other housing conglomerates outside this compact area (neighborhoods, condominiums, and other settlements), which have the same characteristics as those described for the areas described above, were also considered urban. We found that 74.67 % of our sample students attend schools in urban areas and 25.33 % in non-urban areas.

Cocaine seizures (our key independent variable) may correlate with other sources of disadvantage (Burdick-Will, 2017). If we do not control for them, the coefficient of the variable *cocaine seizures* could reflect the effects of these factors and, thereby, be biased (Gimenez and Barrado, 2020). To avoid this, our model included a *socioeconomic index* and an *index of infrastructures at home*, both measured at the district level. These two indicators accounted for a wide set of socioeconomic factors in the districts, generally believed to be correlated with criminal activity (Gimenez et al., 2021).

The *socioeconomic index* and the *index of infrastructures at home* were elaborated by the Ministry of National Planning and Economic Policy of Costa Rica (MIDEPLAN, by its acronym in Spanish). The *socioeconomic index* is built on the possibilities of the population in each district to access and enjoy a healthy life, which implies having access to proper health care and guaranteeing an adequate quality of life (MIDEPLAN, 2013: pp. 15–16). Specifically, it is built using four variables: (1) the births to unmarried teenage mothers under 19 years; (2) the proportion of children with low weight, including the percentage of children with low birth weight (<2500 g) and the percentage of 12-year-old children with low body mass index (<13.7 kg/m² for boys and 13.8 kg/m² for girls); (3) infant mortality under 5 years; and (4) access to residential

drinking water and its quality. The average value of the socioeconomic index for the districts in the sample was 75.24. It ranged from 41.23 to 98.12, with a standard deviation of 11.91.

The *index of infrastructures at home* is built on the possibilities of the population to access and enjoy a set of basic services at home in each district. In particular, it is built from two variables: (1) average monthly residential electricity consumption; (2) percentage of households with access to residential internet (MIDEPLAN, 2013: pp. 15–16). The average value of this index for the districts in the sample was 38.17. It ranged from 0.43 to 78.31, with a standard deviation of 17.39.

3.1.1.3. Focal independent variable. Exposure to drug trafficking was the key variable in the present study. This variable was measured by *cocaine seizures* at the district level, measured in terms of kilos per 100,000 inhabitants. We built this variable from data on cocaine seizures from the National Drug Information and Statistics Unit of the Costa Rican Institute on Drugs. Then, we corrected it by census population, from the National Institute of Statistics and Censuses of Costa Rica. We focused on cocaine seizures for various reasons. First, violence linked with the illicit drug trade has risen sharply in Central America in recent years. In particular, it has been mainly associated with cocaine trade, given that most organized criminal groups obtain a significant proportion of profit from this drug (United Nations Office on Drugs and Crime, 2019). Cocaine trade can hinder micro- and macroeconomic development and generates corruption and violence, with the consequences that this entails (Pearson et al., 2022). Second, as Vo (2018) points out, although Costa Rica is a relatively new entrant in the market, the amount of cocaine has increased significantly, especially since 2006, in response to interdiction efforts in Mexico and Colombia.

The cumulative distribution of the seizures followed an exponential function that was a consequence of the enormous differences in the number of seizures, from just a few grams to several tons. To avoid extreme differences that could affect the estimations and lead to biased results, we conducted a natural log-transformation of the variable.² Moreover, we performed an analysis through box plots that let us detect the presence of outliers that could bias the results. The three districts with cocaine seizure rates above the upper whisker and the three districts below the lower whisker were not included in our analysis. There were no outlier problems concerning the rest of the variables in our model. After deleting the outliers, the average seizure rate across districts was 1,054.35 kilos per 100,000 inhabitants, with a standard deviation of 2,187.66 kilos.

3.2. Analytic plan

We used a discrete logit model to determine the link between cocaine seizures and skipping lessons at school. In Equation (1), the probability of skipping lessons depends on a set of individual, family, school, and district factors:

$$P(\text{Skippinglessons}_{ijk} = 1|\mathbf{x}) = \beta_0 + \beta_1 \mathbf{X}_{ijk} + \beta_2 \mathbf{D}_k + \text{school}_{FE} + \text{district}_{FE} + \varepsilon_i \quad (1)$$

Estimates were calculated at the student level. $P(\text{Skippinglessons}_{ijk} = 1|\mathbf{x})$ represents student i -th, attending school j -th, situated in district k -th, probability of skipping lessons. This probability was determined by a set of student and school (\mathbf{X}_{ijk}), and district

² According to the *Unidad de Información y Estadística Nacional sobre Drogas* (2018), 94.87% of drug seizure events were in quantities of 0–5 g. Only 1.53% of the seizures corresponded to stashes of more than 100 g. The seizure was concentrated in the most economically and socially vulnerable areas: zones with serious deficiencies in personal rights, security, housing, labor opportunities, nutrition, infrastructures, and basic medical assistance.

characteristics (D_k). The district characteristics included four variables: the *urban location*, the *socioeconomic index*, the *index of infrastructures at home*, and our key variable, *cocaine seizures* (in logs). The model incorporated school and district fixed effects, allowing us to control for unobservable characteristics specific to each school and district that might be related to truancy. This allows us to mitigate the potential biases that may affect both the skipping lessons behavior and the independent variables included, affecting the estimators in Equation (1). ϵ_i is the error term.

The results are presented using the estimators' coefficients and odds ratios (OR). The coefficients' sign indicates the direction of the predictors' influence (positive or negative), while the OR provides information about the effect size. We calculate the OR of the estimators as the quotient between the odds that the student skips at least one lesson and the odds of not skipping any. The OR can take a value from 0 to infinity. An OR equal to 1 indicates that the probability of the event occurring is independent of the explanatory variable. As the OR diverges further from 1, either positively or negatively, it indicates a greater impact of a specific covariate on the odds of the outcome (in our case, skipping lessons).

Estimations were executed with Stata 18 statistical software.

4. Results

4.1. Exposure to drug trafficking and school truancy

Table 1 presents the results estimated from the binary logit model on the probability of having skipped lessons during the last two weeks. Results show the logistic regression coefficients, standard errors, p -

values, odds ratios (OR), and their confidence intervals (CI) at 95 % level.

Regarding the control variables, the results showed that the likelihood of students skipping any lesson increased with *age*, *being male*, and attending schools located in districts with a higher *index of home infrastructures*. Conversely, higher *satisfaction with life*, better *disciplinary climate*, higher *parents' emotional support*, attending a school located in *urban areas*, and attending schools in districts with a higher *socioeconomic index* reduced the odds of skipping lessons. The variables not statistically significant were *country of birth*, *parents' highest occupational status*, *parents' highest educational status*, *peer physical aggression*, and *feeling socially connected at school*.

As for our central variable of the study, we found that *cocaine seizures* were positively and significantly correlated with skipping lessons. The odds of skipping lessons were 33 % higher (OR, 1.33) for each one-unit increase in the natural log of the cocaine seizures kilos per 100,000 inhabitants while holding all other variables constant. Following the *urban areas* variable (OR, 0.026) *cocaine seizures* variable emerged as the second most influential variable in terms of effect size, with a higher effect compared with other significant variables such as (by order of importance): *age* (OR, 1.274), schools' *disciplinary climate* (OR, 0.796), *being male* (OR, 1.138), districts' *socioeconomic index* (OR, 0.864), districts' *index of infrastructures at home* (OR, 1.128), *parents' emotional support* (OR, 0.886), and students' *satisfaction with life* (OR, 0.898). These results provide evidence in support of a strong connection between cocaine seizures in the districts where schools are situated and the probability of skipping lessons. This finding corroborates the importance of neighborhood contextual factors in understanding truancy behaviors.

As estimates were carried out with information from the student

Table 1
Estimates of the binary logit model for truancy.

	C	SD	$P > z $	OR	[95 % CI]	
Fixed effects in school and districts						
Intercept	3.143	2.137	0.141	23.178	0.351	1,528.999
Student and school characteristics						
Age	0.242*	0.140	0.085	1.274	0.967	1.677
Gender						
Female	Base					
Male	0.129*	0.075	0.083	1.138	0.983	1.317
Country of birth						
Country of test	Base					
Other country	0.120	0.151	0.427	1.128	0.838	1.517
Parents' highest occupational status	0.003	0.002	0.142	1.003	0.999	1.006
Parents' highest educational status	0.007	0.011	0.523	1.007	0.985	1.029
Parents' emotional support	-0.121***	0.044	0.006	0.886	0.814	0.966
Peer physical aggression	0.122	0.133	0.360	1.129	0.871	1.465
Satisfaction with life	-0.108***	0.018	0.000	0.898	0.866	0.930
Feeling socially connected at school	-0.022	0.031	0.466	0.978	0.920	1.039
Disciplinary climate	-0.228***	0.043	0.000	0.796	0.732	0.865
District control variables						
Location						
Rural	Base					
Urban	-3.636***	0.109	0.000	0.026	0.021	0.033
Socioeconomic index	-0.146***	0.012	0.000	0.864	0.845	0.884
Index of infrastructures at home	0.121***	0.002	0.000	1.128	1.123	1.133
Focal independent variable						
Cocaine seizure rate (in logs)	0.285***	0.017	0.000	1.330	1.285	1.376
Number of observations	4,584					
Log pseudolikelihood	-21,032.296					

Source: Authors' calculations based on multiple data sets.

Notes: Dependent variable: "In the last two weeks of school, how often did you skip single lessons?". Dummy variable = 0 if the student responded "None," and 1 if the student responded "One or two times," "Three or four times," or "Five or more times." Robust standard errors were adjusted for clustering based on districts. Fixed effects were used in schools and districts. Regressions were weighted according to students' sampling probability. (***), (**), and (*) denote significance at the 1 %, 5 %, and 10 % levels, respectively. SD, standard deviation; OR, odds ratios; CI, confidence interval.

level (including students' characteristics and the characteristics of their learning environment), there were no spillovers or undetected spatial effects in close districts that could bias the estimates. This was confirmed by a Moran's test on the dependent variable that, with a value of -0.032 , led us to dismiss the presence of spatial autocorrelation at a 1 % level of significance.

4.2. Heterogeneous effects by gender

In the context of Central America, in which males tend to be more frequently involved in drug trafficking and criminality than females, one might expect the relationship between exposure to drug trafficking and truancy to vary between males and females. To check this, we included a gendered analysis, shown in Table 2, in which we estimated an interaction term between *being male* and our focal independent variable, *cocaine seizures*. We found that the interaction term was not statistically significant, which led us to rule out the existence of differences between males and females in the effect of exposure to drug trafficking on truancy.

4.3. Robustness check

As a robustness check regarding the definition of our dependent variable, we replicated the regressions with adjustments to the definition of student truancy. The dependent variable in this robustness check was based on the same question as Equation (1): "In the last two weeks of school, how often did you skip single lessons?", where options were: "none"; "one or two times"; "three or four times"; and "five or more

times." However, when we converted the variable into a dichotomous one, we modified the cutting point: a new variable was made equal to zero if the student responded "none" or "one or two times" and equal to one if the student responded "three or four times" or "five or more times." By so doing, we aim to check if the results hold when we use a more severe definition of truancy.

The new estimations can be found in Table 3. There were no substantive changes in results. The signs and significance of the variables remained consistent, except for the variable *age*, which was not statistically significant in the new estimation. Regarding our key variable, we found again that students with higher exposure to drug trafficking, as measured by the cocaine seizure rate, were more likely to incur in severe school truancy. For each one-unit increase in the natural log of the cocaine, the odds ratios of skipping lessons at least three times in the last two weeks increased by a factor of 6.41 (OR, 6.41), a substantial increase in the OR with respect to the first truancy definition.

5. Discussion

Understanding the effects of neighborhood-related factors, such as exposure to drug trafficking, on truancy behavior at school is critical for designing effective programs to prevent school truancy. However, empirical evidence on the link between exposure to drug trafficking and truancy is limited. This study addresses this underresearched issue using a microdata set that merges georeferenced information on a specific indicator of exposure to drug trafficking (cocaine seizures), socioeconomic information of Costa Rican districts, and a large sample of 15-year-old Costa Rican students and their characteristics from PISA data.

Table 2
Estimates of the binary logit model for truancy. The moderating role of gender.

	C	SD	$P > z $	OR	[95 % CI]	
Fixed effects in school and districts						
Intercept	3.088	2.152	0.151	21.94	0.323	1,489.583
Student and school control variables						
Age	0.242*	0.140	0.084	1.274	0.968	1.677
Gender						
Female	Base					
Male	0.223	0.270	0.408	1.250	0.736	2.122
Country of birth						
Country of test	Base					
Other country	0.121	0.151	0.424	1.129	0.839	1.518
Parents' highest occupational status	0.003	0.002	0.142	1.003	0.999	1.006
Parents' highest educational status	0.007	0.011	0.522	1.007	0.985	1.029
Parents' emotional support	-0.121***	0.044	0.006	0.886	0.813	0.966
Peer physical aggression	0.122	0.133	0.360	1.129	0.870	1.466
Satisfaction with life	-0.108***	0.018	0.000	0.898	0.866	0.930
Feeling socially connected at school	-0.022	0.031	0.469	0.978	0.921	1.039
Disciplinary climate	-0.228***	0.043	0.000	0.796	0.732	0.865
District control variables						
Urban location						
Rural	Base					
Urban	-3.636***	0.109	0.000	0.026	0.021	0.033
Socioeconomic index	-0.146***	0.012	0.000	0.864	0.844	0.884
Index of infrastructures at home	0.121***	0.002	0.000	1.128	1.123	1.133
Focal independent variables						
Cocaine seizures rate (in logs)	0.294***	0.031	0.000	1.342	1.264	1.425
Male × Cocaine seizure rate (in logs)	-0.016	0.044	0.714	0.984	0.903	1.073
Number of observations	4,584					
Log pseudolikelihood	-21,031.778					

Source: Authors' calculations based on multiple data sets.

Notes: Dependent variable: "In the last two weeks of school, how often did you skip single lessons?". Dummy variable = 0 if the student responded "none," and 1 if the student responded "one or two times," "three or four times," or "five or more times." Robust standard errors were adjusted for clustering based on districts. Fixed effects were used in schools and districts. Regressions were weighted according to students' sampling probability. (***), (**), and (*) denote significance at the 1 %, 5 %, and 10 % levels, respectively. SD, standard deviation; OR, odds ratios; CI, confidence interval.

Table 3
Estimates of the binary logit model for the most severe cases of truancy.

	C	SD	$P > z $	OR	[95 % CI]	
Fixed effects in school and districts						
Intercept	-9.000***	3.350	0.007	0.000	0.000	0.088
Student and school control variables						
Age	0.221	0.201	0.272	1.248	0.841	1.852
Gender						
Female	Base					
Male	0.301***	0.110	0.006	1.351	1.089	1.677
Country of birth						
Country of test	Base					
Other country	0.023	0.314	0.942	1.023	0.553	1.895
Parents' highest occupational status	0.000	0.003	0.997	1.000	0.993	1.007
Parents' highest educational status	-0.003	0.021	0.898	0.997	0.957	1.039
Parents' emotional support	-0.142**	0.070	0.041	0.867	0.757	0.994
Peer physical aggression	0.309	0.205	0.132	1.363	0.911	2.038
Satisfaction with life	-0.144***	0.030	0.000	0.865	0.817	0.917
Feeling socially connected at school	-0.009	0.048	0.845	0.991	0.902	1.088
Disciplinary climate	-0.352***	0.078	0.000	0.703	0.603	0.820
District control variables						
Location						
Rural	Base					
Urban	-1.803***	0.149	0.000	0.165	0.123	0.220
Socioeconomic index	-0.123***	0.013	0.000	0.885	0.862	0.908
Index of infrastructures at home	0.086***	0.010	0.000	1.090	1.069	1.110
Focal independent variable						
Cocaine seizure rate (in logs)	1.857***	0.215	0.000	6.406	4.204	9.763
Number of observations	3,789					
Log pseudolikelihood	-8,473.170					

Source: Authors' calculations based on multiple data sets.

Notes: Dependent variable: In the last two weeks of school, how often did you skip single lessons?. Dummy variable = 0 if the student responded "none" or "one or two times," and 1 if the student responded "three or four times" or "five or more times." Robust standard errors were adjusted for clustering based on districts. Fixed effects were used in schools and districts. Regressions were weighted according to students' sampling probability. (***), (**), and (*) denote significance at the 1 %, 5 %, and 10 % levels, respectively. SD, standard deviation; OR, odds ratios; CI, confidence interval.

The high disaggregation of our data set, representative of the population at the country level, allows us to address two main shortcomings highlighted in the literature. First, the wide variety of information included in PISA allows for accounting for potential confounders related to student truancy, such as students' feelings and attitudes towards other students, teachers, and schools' characteristics. Moreover, our data set

also allows us to account for districts' socioeconomic characteristics and mitigate the unobserved heterogeneity. Violence and illicit activities such as drug trafficking are often correlated with many socioeconomic factors that, at the same time, have been shown to have harmful effects on students' outcomes (Burdick-Will, 2013; Gimenez and Barrado, 2020). Second, our study focuses on a specific objective measure of drug trafficking: cocaine confiscations, instead of indirect (e.g., homicide rates) or subjective (e.g., self-reported) measures. On the one hand, by considering indirect measures such as homicide rates, previous analyses focused on a consequence of drug trafficking but not on drug trafficking itself. On the other hand, by using a subjective measure of drug trafficking instead of an objective measure, some previous analyses are subject to a potential reporter bias (McCoy et al., 2013).

In this study, we find that students attending schools in districts with higher exposure to drug trafficking (measured by cocaine seizure rate) are more prone to school truancy. As shown by the OR we estimate, the effect of exposure to drug trafficking in the district on the probability of truancy is higher than that of other factors at the district level (districts' socioeconomic index and index of infrastructures at home), and other factors at the school (disciplinary climate) and the student (parents' emotional support and students' satisfaction with life) levels. Only the urban or rural nature of the district shows higher effects on the probability of truancy than exposure to drug trafficking. This effect is even higher when a more severe definition of truancy (at least three lessons skipped in the last two weeks, instead of at least a single lesson) is considered. Although we cannot compare our results directly with other works due to a lack of previous empirical research about these specific variables, our finding is consistent with similar works that analyze the effects of exposure to crime and violence on school attendance. In a recent study, Rankine et al. (2022), based on a survey of high-school students in Pennsylvania, found that prior violence exposure (self-report measures of violent crimes, physical or sexual violence, and witnessed violence) was associated with school absenteeism. Burdick-Will et al. (2019), using a sample of schools in Baltimore, showed that students who have to commute to school along streets with higher incidence of violent crime (including assaults, robberies, rapes, shootings, and homicides) have higher rates of absenteeism. Similar results were found by other studies in the context of low-income or lower-middle-income countries. Justino et al. (2014) found that peaks of violence in Timor Leste had a negative impact on school attendance among children, which in the case of boys was also associated with lower primary school completion. In a study focused on Ethiopia, Woldehanna et al. (2021) found that exposure to violence both from peers and at home was associated with higher absenteeism in younger cohorts and higher school dropout in older cohorts. Given the negative consequences of exposure to crime and violence for truancy, studies such as McMillen et al. (2019) have analyzed the effectiveness of community programs in reducing violence. These studies have found that lowering violence at the neighborhood level has positive effects on student attendance.

Our results are also consistent with prior research that has shown that neighborhood characteristics such as economic level, deprivation, or crime can affect school attendance (Burdick-Will et al., 2019; Gottfried, 2014; Lei, 2022; Opara et al., 2022; Zaroni et al., 2023). Our findings support the growing literature that finds exposure to drug-related violence to have detrimental effects on overall educational attainment (Brown and Velásquez, 2017; Caudillo and Torche, 2014; Deole, 2018; Gimenez et al., 2021; Jarillo et al., 2016; Michaelsen and Salardi, 2020; Monteiro and Rocha, 2017). As highlighted by Jarillo et al. (2016), students' truancy is a key factor in explaining the negative relationship between exposure to violence and educational attainment, together with other factors such as teachers' absenteeism and turnover.

Eight additional results that we have obtained align with the literature examining the determinants of student truancy. Similarly to previous studies, we find that males have a higher probability of skipping lessons compared with females (OECD, 2019b). Our analysis also

explores whether the relationship between exposure to drug trafficking and truancy varies between male and female students, and we find no significant differences in this regard. While males could be more frequently involved in drug trafficking activities and criminality, both males and females may be similarly exposed to the other mechanisms by which crime can affect educational processes, described by Jarillo et al. (2016): effects on violence linked to criminal activities on students' psychological condition, and detrimental effects of crime on both financial capacity of families and the quality of the supply of education. Although, as far as we know, previous research explicitly examining the moderating role of gender in the relationship between exposure to drug trafficking and school truancy does not exist, our results are consistent with similar works that have analyzed gender differences in the effect of exposure to violence on educational outcomes using administrative data (Burdick-Will, 2013, 2017, and Burdick-Will et al., 2019; Gimenez and Barrado, 2020; Monteiro and Rocha, 2017).

Regarding other student and school characteristics included in our model, consistently with previous literature we find that students were less likely to skip schools the better the *disciplinary climate*, the higher the value of *parents' emotional support*, and the stronger the sense of *life satisfaction* is. As for district characteristics, our results show that students attending schools in *rural* areas are more prone to truancy. Previous studies focused on Latin American countries have pointed out that better infrastructure in urban areas can explain why urban students skip school less frequently than rural students do (Guisquin et al., 2019; Zanoni et al., 2023). Moreover, we find that students attending to schools located in districts with higher *socioeconomic index* have a lower probability of skipping lessons. Poor neighborhoods may have more difficulties in attracting good teachers, worsening the quality of education in these areas and increasing students' truancy (Gottfried, 2014; Nieuwenhuis et al., 2021). Finally, the *index of infrastructures at home* was found to increase the risk of skipping lessons. It should be noted that access to the internet at home is one of the two components of this index. Recent research has found that excessive time spent on internet activities might increase truancy (Anthony et al., 2021; Austin and Totaro, 2011).

6. Conclusions

A growing literature is concerned about whether, and how, exposure to violence and crime affects educational processes and outcomes. This study provides empirical evidence on the link between exposure to a particularly salient form of crime (drug trafficking, measured by cocaine seizures) and truancy among secondary school students in Costa Rica. Our results show that students attending schools in districts with higher exposure to drug trafficking (measured by cocaine seizure rates) are more prone to truancy, after controlling for student, family, school, and district characteristics.

This study has several limitations, which foresee avenues for future research. The first limitation is related to the measurement of truancy. Our variable, obtained from PISA 2015, is based on the question "In the last two weeks of school, how often did you skip single lessons?". Some authors highlighted that this short time frame might underestimate truant behavior: occasionally, truants cannot be captured in the sample, while the short time frame also reduces the probability that a student reports having skipped lessons at least five times or more (Keppens and Spruyt, 2018). Moreover, as Sälzer and Heine (2016) highlight, PISA does not allow one to distinguish whether the lessons were missed due to exogenous reasons such as illness or emergencies or whether students missed classes intentionally. Second, our dependent variable on truancy and some of the control variables at the student level are self-reported measures. Self-reported measures could be biased: the inadequate interpretation of the questions and the inability to remember their affective experiences without disproportionately weighting certain irrelevant events could reduce the reliability of the measures (Lucas, 2018). Despite the limitations of self-reported variables, it has been found that

students' responses are close to truancy rates in school records (Khata-poush and Hallfors, 2000, cited in Frissell et al., 2004). Third, our paper focuses on a sample representative of the Costa Rican population, which limits the external validity of the conclusions beyond that setting. We cannot confirm that the relationships documented here would apply to other countries. However, understanding the relationship between drug trafficking and truancy behavior in Costa Rica can shed light on the causes of school truancy in other similar places, particularly in the context of Latin America. Further research in this area could test the relationship between drug trafficking and truancy in other countries as new databases with information on education, crime, and socioeconomic variables become available. Fourth, data on cocaine seizures, the socioeconomic index, and the index of infrastructures at home refer to the districts where the schools are located. In Costa Rica, they correspond to the districts where the students live in most cases, but not in all (Gimenez et al., 2018). While the conditions in the district where a school is located may certainly affect students' truant behavior, it could also be affected by the conditions in the districts where students live and in those that students pass through when going from home to school (Gimenez et al., 2018). Finally, the cross-sectional nature of our data did not permit the examination of truancy behavior over time nor make strong claims of causality. More in-depth work could be conducted to investigate the channels that may mediate the effect of exposure to drug trafficking on truancy. This requires an in-depth qualitative analysis of the most affected neighborhoods. Also, longitudinal information could help further elucidate the mechanisms behind this relationship and establish causality.

Notwithstanding the limitations, the present study provides policy-relevant information. Due to the cross-sectional nature of our data, we could not conclude that an increase in truancy was caused by drug trafficking exposure. However, our findings indicate a close statistical relationship between both dimensions. Exposure to drug trafficking is shown to be linked to school truancy, which, in turn (especially when truancy becomes persistent), can have deep negative individual and social consequences, as truancy is a strong predictor of low educational outcomes (Thornton et al., 2013; Wilson et al., 2008), school dropout (Kearney, 2007; Ripamonti, 2018; Thornton et al., 2013), and future economic (Ekstrand, 2015; Heyne et al., 2019; Ovink, 2010; Wilson et al., 2008), health (Ekstrand, 2015; Rankine et al., 2022) and emotional (Kearney, 2007; Thornton et al., 2013; Wilson et al., 2008) problems among truants, and has also negative effects on learning outcomes of peers (Thornton et al., 2013; Wilson et al., 2008) and public safety in the community (Ekstrand, 2015; Heyne et al., 2019; Kearney, 2007; Wilson et al., 2008). The link between drug trafficking and school truancy can even be a significant mechanism to add to the negative impact of violence on hindering the structural transformation of a developing country (see Ferguson et al. (2020) for a long-term study on this issue focused on Colombia). In addition, as violence and drug trafficking are often more prevalent in poor neighborhoods with worse socioeconomic conditions, drug trafficking and its link to school truancy could also constitute a critical factor in perpetuating poverty and inequality.

The results support the conceptualization of truancy as a multilevel phenomenon affected not only by factors at the student or at the school level but also by conditions at the neighborhood level. These findings have important implications for understanding how neighborhoods shape youth behavior. As the main implication, the policy agenda towards increasing school attendance should include local-community strategies to improve the conditions in the surrounding neighborhoods, including reducing drug trafficking. Truancy prevention programs have been increasing in recent years; however, most interventions have focused on the individual and school factors (Gottfried, 2014), and the role of neighborhoods may need to be addressed. Implementing programs that simultaneously consider the different contexts of students (family, school, and neighborhood characteristics) and go beyond the school walls is critical to designing effective intervention strategies.

CRedit authorship contribution statement

Beatriz Barrado: Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization. **Marcos Fernández-Gutiérrez:** Writing – review & editing, Writing – original draft, Investigation. **Gregorio Gimenez:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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