

Determinants of violence on public transportation from the perspective of a small city in the global south[☆]

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ABSTRACT

Both actual and perceived insecurity are relevant factors explaining the travel experiences of public transportation users, particularly women. Therefore, avoiding violence during public transportation trips is essential for improving the quality of service. Through a survey carried out in Ocaña, a small city located in Colombia, where passengers travel in minibusses, shared taxis, and motorcycle taxis, we modeled the incidence and frequency with which people experience different types of violence on public transportation. Binomial models were estimated to determine which variables influenced the probability of experiencing at least one episode in the last year, and Poisson regression models were estimated to determine which factors influenced the number of episodes experienced. The results show that the occurrence and number of episodes are higher for women, particularly for episodes related to sexual violence, and increase with higher access, waiting, and travel times for all modes. Model results demonstrate the relevance of public transportation route design to reduce exposure to violence, particularly at night, where it is feasible to operate with time-scheduled services to reduce waiting times.

1. Introduction

The service quality provided by public transportation is a key component of urban mobility, particularly for disseminated and/or low-income urban populations for whom it may represent their primary and sole mode of transportation. Public transportation is also an efficient way of reducing travel costs incurred by private modes such as cars and negative externalities such as pollution and noise (Rizzi and De La Maza, 2017). A public transportation system that complies with basic safety and security standards would help provide means to perform duties related to work, education, medical attention, and goods shopping. Cities that achieve reliable public transportation services tackle a significant barrier between different socioeconomic classes and, in so doing, foster greater inclusion and economies of scale (Ingvarson and Nielsen, 2018). In addition, strategically planned and properly operated

public transportation systems may reduce car traffic and thus emissions, contributing to cleaner air and more sustainable urban environments (Litman, 2015).

Because traveling by public transportation is cheaper than driving a car, an efficient public transportation service can enhance mobility for low-income individuals, contributing to transport justice (Gössling, 2016). The challenge for authorities is for individuals to stop perceiving private transport as outperforming public transportation (Steg, 2003). Thus, beyond being a transport option, public transportation systems have become an indispensable public utility of first need and a critical element of urban infrastructure, underpinning the daily existence of many individuals, especially those with the highest dependence on such services.

Despite their relevance to urban mobility, public-transport systems often face significant challenges, including violence and crime, which

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can deter people from using them, affecting their overall quality of life. Therefore, this study aims to identify and analyze the determinants of violence on public transportation in Ocaña, a small city in northern Colombia, by examining the incidence and frequency of sexual and non-sexual violence experienced by public-transport users, with particular attention to the experiences of women. By employing Binomial and Poisson regression models, this research seeks to provide empirical evidence that can inform targeted interventions and policy recommendations to improve safety and equity in public transport systems in small urban contexts of the Global South.

One aspect that has increasingly affected public transport users' quality of service perceptions over the last few years is the violence occurring within these systems, affecting both developed and developing countries. Gender-Based Violence (GBV), defined as the harm, intent to harm or threats to harm, through physical, sexual, emotional, psychological, and financial abuse, a person based on actual or perceived sex, gender, sexual orientation, gender identity or expression or other such sex/gender related characteristics suffer (Office for the Prevention of Domestic Violence, 2024), has increasingly affected public transport users over the last few years (Ceccato et al., 2022). GBV is widely reported in the literature, with women identified as the most vulnerable group (Neupane and Chesney-Lind, 2014; Gardner et al., 2017). Understanding the determinants of violence on public transport is crucial for developing public policies to ensure the safety and security of passengers, which will help improve residents' quality of life and help those who cannot afford private transportation with opportunities that may have otherwise been difficult.

Understanding the dynamics of violence during public transportation trips in small cities of the Global South, where the mere existence of formal public transportation systems may be at risk as informal transportation is increasingly replacing buses to cover the demand gap left by these systems, is relevant (see, for example, Heinrichs et al., 2017). For example, Colombia's lower demand for bus systems than expected has affected the financial and operational aspects of public-transport systems, undermined the system's sustainability, and resulted in a gradual decline in service quality (Jiménez Vargas, 2018). Therefore, we devised a comprehensive instrument to gather insights from travelers to understand the factors that determine the incidence of violence on public transportation and propose practical solutions to reduce violence. Our survey asked about 13 situations related to violence on public transport that were disaggregated by mode (i.e., bus, pool taxi, motorcycle taxi) and by trip stage (i.e., walk from origin, waiting, in-vehicle trip, walk to destination). We focused on six models to explain how respondents' socioeconomic characteristics, residential location, and travel trip patterns define the frequency of violence reported on public transportation. Our analysis can guide leaders and city planners in making public transportation safer and more reliable. We aim to widen the discussion and highlight our position regarding the analysis of violence determinants on public transport in a small city, where aspects such as the violence in the public-transport systems arise and affect individuals' travel, showing the significant challenges that small cities in the Global South deal with.

The structure of this paper is as follows: after this introduction, we present a theoretical background on the determinants of violence on public transport, with a focus on small cities in the Global South. The methodological section describes the violence situations considered, the survey design, descriptive statistics, and the model used. The fourth section presents the model results and discusses the study's possible implications for public policy. The fifth section presents the study limitations. Finally, the last section presents the main conclusions of this study and proposes further research based on the findings.

2. Violence in public transport background

Public transportation has become a hotspot for violence due to several explaining factors, such as overcrowding (Gautam et al., 2019;

Quinones, 2020), lack of security conditions (Tripathi et al., 2017; Lubitow et al., 2020), deficiencies in the environment, such as lack of signaling and lighting (Soto et al., 2022), impunity (Useche et al., 2024), and lack of respect for others (Neupane and Chesney-Lind, 2014; Tiznado-Aitken et al., 2024). Public transportation may have a positive impact on both economic activities (Weisbrod and Reno, 2009; Chatman and Noland, 2011) and social interactions in a city (Currie and Stanley, 2008). However, public transportation users are also often exposed to environments of vulnerability and risks, including personal security concerns, during in-vehicle travel and in the access and wait stages, affecting users' well-being (Tiznado-Aitken et al., 2024). The variables that affect such crimes can vary significantly in different geographic, social, and economic contexts.

For many years, public transport planners and operators have recognized personal security as a relevant challenge to be resolved, since it affects fundamental elections such as schedule, mode, and route of travel (Atkins, 1990). Smith and Clarke (2000) distinguish three types of violence depending on its recipients: (i) the transit system itself, which includes fare evasion and vandalism; (ii) violence against drivers or other employees; and (iii) violence against passengers. This last type of violence directly affects users, so it has a higher potential risk of modifying their travel decisions.

Some studies have focused on crimes, such as robbery (see, for example, Hart and Miethe, 2014; Liu et al., 2020); however, most of the relevant academic production focuses on the presence of sexual, psychological, and physical violence, particularly GBV, in public transport (Neupane and Chesney-Lind, 2014; Gekoski et al., 2016; Tripathi et al., 2017; Hoor-Ul-Ain, 2020; Quinones, 2020; Owiti, 2021; Useche et al., 2024). In addition, the barriers women encounter when accessing public transportation and their exposure to GBV are evident. Recent research by the World Bank (2020) highlights that up to 60 % of women in several Latin American cities report having experienced harassment while using public transport and that these experiences significantly constrain their mobility and access to opportunities. Similarly, the "Ella se mueve segura / She Moves Safely" initiative, which analyzed data from several Latin American cities, found that more than half of the women surveyed had experienced some form of harassment or violence while using public transport, underscoring the widespread nature of the problem in the region (FIA Foundation, 2018). Undoubtedly, unsafe public spaces highlight women's adverse circumstances affecting their access to public transport, which generates social exclusion by limiting their mobility and restraining their full participation in accessing opportunities (Martens, 2017; Luz and Portugal, 2022).

GBV against women in transport and how it changes their travel patterns (e.g. changes in destinations, routes, and transport modes) is a widely reported fact in the scientific literature (Loukaitou-Sideris, 2008; Duncel-Graglia, 2013; Stark and Meschik, 2018; Rodas-Zuleta et al., 2022). Knowing that a good public-transport service must be efficient, accessible, and attractive to users, the fear of crime is one of the most important reasons women choose not to use it (Osmond and Woodcock, 2015). However, avoidance intention is not only associated with public-transport characteristics; variables related to the areas in which there is public-transport coverage, that is, socioeconomically depressed areas also affect travel behavior (Loukaitou-Sideris, 2008), as well as mobilization at night hours, which limits their options to move freely and without fear (Gardner et al., 2017). This violence is not only harmful to victims in the short term but also leads to mental fatigue and trauma for commuters who have suffered such violence, affecting their long-term mental health and well-being (Hoor-Ul-Ain, 2020).

Violence on public transportation has been reported around the world. For example, Gekoski et al. (2016) reviewed the magnitude of "unwanted sexual behavior" suffered by women on public transportation systems (i.e., vehicles and stations). The results show that for diverse Global South countries with differences in cultures, religions, and incomes (i.e., India, Bangladesh, Nepal, Indonesia, Mexico, Colombia, Kenya, Egypt, Azerbaijan, and France), a large or significant

percentage of women (40 % to 95 %) experienced violence. On the contrary, the prevalence of violence on public transportation appears to be higher in low-income and developing countries than in developed and high-income countries. Gekoski et al. (2016) also reported that studies in the United Kingdom have a much lower prevalence (approximately 15 %), indicating that sexual harassment in public transportation is widespread in the Global South. Similarly, research conducted in Australia shows contradictory findings compared with those from other countries, as it has been reported that the perception of safety and its relationship to the use of public transport is not affected by gender (Gardner et al., 2017).

In addition, some countries and cities do not have laws that punish GBV. This is the case in Karachi (Pakistan), where the government and law enforcement agencies remain ineffective in providing any relief to women commuters on public transport despite receiving thousands of complaints against sexual offences (Hasan, 2015). Similarly, Neupane and Chesney-Lind (2014) investigated sexual harassment on public transportation in Kathmandu, Nepal, revealing that unmarried women tend to experience more sexual and verbal harassment and feel more distressed than married women do. Furthermore, Owiti (2021) stated that specific cultural aspects, such as stereotypes held by public transportation service operators about women's dress and gender roles, significantly shape this violence in Nakuru County, Kenya. Most operators have traditional beliefs about how women should dress and their social roles, which motivates GBV against women using public transportation services. Similarly, Tripathi et al. (2017) demonstrated that sexual harassment in public-transport systems in certain parts of India is widespread and often neglected by local governments and transport providers. The aforementioned study also indicated that women experience a high degree of sexual harassment daily, resulting in distress and anxiety.

Public transportation in India is perceived as unsafe and tends to increase the phenomenon by providing more opportunities for misconduct (Smith and Clarke, 2000). Incidents of verbal sexual harassment (e.g., making sexual comments, demanding sexual favors) are more common than physical harassment such as groping. Similarly, in countries such as Colombia and Chile, overcrowded buses on urban routes face high rates of physical harassment. It was found that stations, stops, and streets can be associated with more aggressive forms of harassment (e.g., following a potential victim) or extreme forms of GBV, including sexual assault.

According to recent statistics (Cavalari et al., 2025), Colombia has one of the highest homicide death rates in Latin America, despite a slight decrease in recent years. Data compiled by the United Nations Office on Drugs and Crime (2025) further indicate that serious assault offences in Colombia remain one of the region's most violent countries. Statistics from the Colombian Observatory of Women (Observatorio Colombiano de las Mujeres, 2024) show that the rate of forensic medical examinations for alleged sexual violence crimes in 2021 (which considers all crimes, not just those suffered during travel) was more than 100 times higher for women under 18 years than for men. According to the aforementioned studies, men are, to a greater extent, victims of physical violence for non-sexual motives, while women are, to a greater extent, victims of sexual-related offences.

Although there are no specific statistics related to rates of violence in public transport in Colombia, several studies in the country show that sexual harassment and the threat of GBV deeply affect women's lives and everyday choices (Jaramillo, 2014; Quinones, 2020; Tiznado-Aitken et al., 2024). In particular, some women report changes in their travel and mobility patterns (e.g., changes to private modes of transport such as cars, taxis, and motorcycles) due to experiencing GBV episodes (Rodas-Zuleta et al., 2022).

This study explores the elements of violence associated with the use of public transportation, with a specific focus on identifying socio-demographic and travel characteristics that influence the incidence and frequency of violence in Ocaña, Colombia. As explained below, the

intent of this research is to shed light on how local dynamics influence the prevalence and nature of sexual and non-sexual offences in public transportation trips in a small Colombian city.

2.1. Literature gaps and study contribution

Although various recent studies have addressed violence in transportation in the Global South, particularly in Colombia, very few have provided indications about the factors that determine the number of episodes of sexual and non-sexual violence suffered by victims and propose mitigation measures based on the analysis of quantitative results. In addition, most studies have focused on Mobility as a service (MaaS) public transportation in large and intermediate cities. Focusing on smaller urban settings, the study seeks to identify nuances that may be overlooked in broader analyses of larger metropolitan areas. Our modeling approach, applied to a small city (100,000 inhabitants) in northern Colombia, provides a reference framework to be applied in other locations. Likewise, the models distinguish situations by mode, time, frequency, and location, so "good practice" can be derived to reduce victims' exposure to these violent situations.

In metropolitan areas (or urban centers) and rural towns (or non-metropolitan areas), women face distinct safety issues when they are out and about, and these problems do not always receive the attention they deserve in research mainly focused on big cities. Ceccato and Adams (2025) and Ceccato et al. (2024) highlighted that small towns and rural areas often lack proper transportation, regular services, or adequate security. For example, in Ocaña, the mix of official minibusses and the more relaxed motorcycle taxis and shared taxi options increases risks because these are less strictly regulated and often operate in poorly lit or less busy areas. In general, small Latin American cities tend to have a very conservative and therefore sexist culture compared to larger cities, which adds additional elements of interest to our results compared to studies conducted in metropolitan areas (Bejarano et al., 2011). Our study extends this research by providing real-world evidence from a small city in the Global South, where actual violence and the fear of being targeted limit women's mobility. These findings reinforce the need to tailor policy measures to smaller urban areas, which are more difficult for women due to less crowded spaces and fewer transport options.

2.2. Research hypotheses

Our research proposes three hypotheses based on the literature review and identified research gaps. They allow us to define what we seek to test and how the results will be analyzed.

H1. Relationship between Gender and Violence

Women are more likely to experience violence on public transportation, particularly sexual violence, than men. This fact is consistent with the international literature, which has identified that women are more vulnerable to harassment and assault in transit environments (Neupane and Chesney-Lind, 2014; Ceccato et al., 2022).

H2. Travel Time and Exposure to Violence

Times experimented on the way to access the mode, on board the vehicle, and on the way out after leaving public transportation are associated with an increased likelihood of experiencing violence. Literature studies indicate that prolonged exposure to unsafe environments increases the probability of victimization (Gardner et al., 2017; Ceccato and Loukaitou-Sideris, 2020).

H3. Violence by transport mode and travel stage

Different transport modes imply different exposure levels to diverse types of violence due to variation in travel times (which include walking, waiting, and in-vehicle travel) and crowding levels. Moreover, it has been reported that poor regulation and security measures increase

the probability of violence (Heinrichs et al., 2017; Rodas-Zuleta et al., 2022).

These assumptions are relevant to both the survey design and model specification.

3. Methodology

The remainder of this chapter is divided into five subsections. First, the characteristics of the designed and applied survey are presented. Then, the situations of violence considered in the models are described. In the third subsection, the sample descriptive statistics are presented and descriptively discussed. Finally, the equations of the estimated models are then explained.

3.1. Survey design and application

The survey was conducted through a LimeSurvey (Limesurvey GmbH, 2003) link. The survey was applied in Ocaña, a small city in Colombia located 400 km northeast of Bogota and was supported by the local branch of the University Francisco de Paula Santander (UFPSO). According to the Land Use Plan of Ocaña (2023), the urban perimeter of Ocaña is divided into six districts or “comunas”, as shown in Appendix A. Sectors with high levels of commerce, distribution, and jobs characterize districts 1 (city center) and 6 (north).

The survey was applied in August and September 2022, with intercepts taking place at various public locations within the city, such as parks, formal and informal public transportation stops, universities, restaurants, and workplaces. Individuals were asked for their authorization to receive the survey via email or an instant messaging application and then completed the survey themselves. People were intercepted between 8 a.m. and 12 p.m. and between 2 p.m. and 6 p.m. on business days. A typical survey diagram is presented in Appendix B.

After discarding the respondents whose most frequent mode of commuting was not public transportation, socioeconomic information was requested, including gender, age, and educational level of the respondents. Later, we asked about the characteristics of the most common trip, such as the purpose, frequency, origin, destination neighbourhood, usual commuting time slots (i.e., morning, afternoon, night), and cost (see Table 1). The respondents were then consulted about how many times (i.e., frequency) they were victims of or experienced violent situations during the last year, separated by trip stage (on the way to access to mode, on board the vehicle, and on the way out after leaving public transport). Next, we asked about the perception of insecurity when traveling on the usual trip and about suffering the situations

Table 1
Survey variables and categorization.

Sociodemographic	Gender (women, men)
	Age
	Strata (*)
	Income
	Disabilities
Travel and hour location	District / “Comuna”
	External zone
	Time of the day (i.e., <i>afternoon, night</i>)
	Commuting mode (i.e., <i>minibus, shared taxi, motorcycle taxi</i>)
Other trip characteristics	Walking time to the public transportation stop per commuting mode
	Waiting time per commuting mode
	In-vehicle travel time per commuting mode
	Type of trip (i.e., <i>work, study, shopping, leisure, university</i>)
	Travel characteristics (i.e., <i>with company or packages</i>)

(*) Strata is a Colombian official classification of households, differentiating people based on their income from 1, the poorest, to 6, the richest (Vallejo-Borda et al., 2020; Rodríguez-Valencia et al., 2022).

of violence mentioned. In the case of having suffered episodes of violence, the participants were asked if they made the corresponding complaint and the reasons for not having complained, if applicable. Finally, monthly income was asked.

In total, 2210 surveys were conducted. After excluding incomplete surveys (97), persons whose commuting mode was not public transport (579), surveys conducted with minors under 18¹ (429) and those in which the number of reported episodes of violence was not credible² (140), 965 valid surveys were obtained for modeling purposes.

3.2. Violence situations considered

The study considered 13 different types of incidents. The types of incidents and their categorization, set out in Table 2, come from previous studies reported in the literature (e.g., Tiznado-Aitken et al., 2024; Rodas-Zuleta et al., 2022; Allen et al., 2019; Soto Villagrán, 2017). Furthermore, the categories were refined through exploratory qualitative research, ensuring that they reflect the real-life experiences of women transport users. The research also included the researchers’ knowledge (e.g., radio news, local newspapers, verbal interviews) of the study area regarding the phenomenon being addressed but also based on experiences reported in local studies such as the one conducted by Carrascal Gómez and Jaime Jaime (2020). Ocaña is part of an area greatly burdened by the armed conflict in Colombia, facilitating the spread of violent acts to different social levels (Centro Nacional de Memoria Histórica, 2018), including transport. The types of incidents were analyzed based on transportation modes (i.e., minibús, shared taxi, motorcycle taxi) and trip stages (i.e., walking from origin, waiting, in-vehicle trip, and walking to destination). These incidents can be divided into two categories: sexual violence, defined as “unwanted sexual attention from strangers in public” (Wesselmann and Kelly, 2010), and non-sexual violence.

Table 2
Categorization of considered violence situations.

Sexual	Non-sexual
Groping / physical harassment	Theft
Verbal harassment	Physical violence
Public masturbation	Verbal violence
Sexual abuse / rape	Racial discrimination
Attempted sexual abuse / rape	Being chased by someone (*)
Intimidation by suggestive looks	
Being photographed without consent (*)	
Sexual orientation discrimination (*)	

(*) For these situations, no defined categorization in the literature was found thus own criteria were adopted. “Being chased by someone” was associated with non-sexual violence given that many episodes of chasing were associated with attempted robbery or other types of violence without sexual connotations. “Discrimination based on sexual orientation”, although verbal in nature, stems from the victims’ perception of their gender and is therefore sexual in nature, while “taking photographs without the victim’s consent” is often associated with sexual motivation on the part of the perpetrators even if there is no physical sexual violence involved.

¹ Regarding minors under 18, the Ethics Committee of the sponsoring institution (Francisco de Paula Santander University) requires parental consent for surveys. Given the survey methodology—intercepting participants on the street—it was not possible to obtain such consent, and therefore these responses could not be used for the models.

² We assumed a maximum of 3 rapes, 5 attempted rapes, and 100 total episodes (the sum of the 13 events) reported during the previous year. Thus, 140 records were discarded due to the excessive number of reported episodes.

3.3. Descriptive statistics

Fig. 1 presents the main descriptive statistics from the valid surveys. Most respondents were young women with high school or university education.

The number of surveys by main commuting mode is presented in Fig. 2, for both the survey sample (left) and the expanded sample for modeling (right).

As shown in Fig. 3, most respondents, according to the expanded sample, live in Comunas 2, 3, and 4. No official data are available to compare this information with the current population.

Most trips were made in the morning and afternoon (Fig. 4). Note

that the question was asked about the periods of the most significant frequency of commuting trips; thus, the sum of the answers was greater than 1.

Fig. 5 shows the proportions of women and men who had experienced any of the presented violence, at least once.

A significantly higher proportion of women in the survey sample suffered at least one situation of verbal harassment, public masturbation, attempted sexual abuse or rape, intimidation by suggestive looks, and being chased by someone. Note that all these situations, except for the last one, correspond to sexual violence. For the rest of the events, no significant difference exists between genders. Grouping the situations into “sexual violence” and “non-sexual violence” yields the results

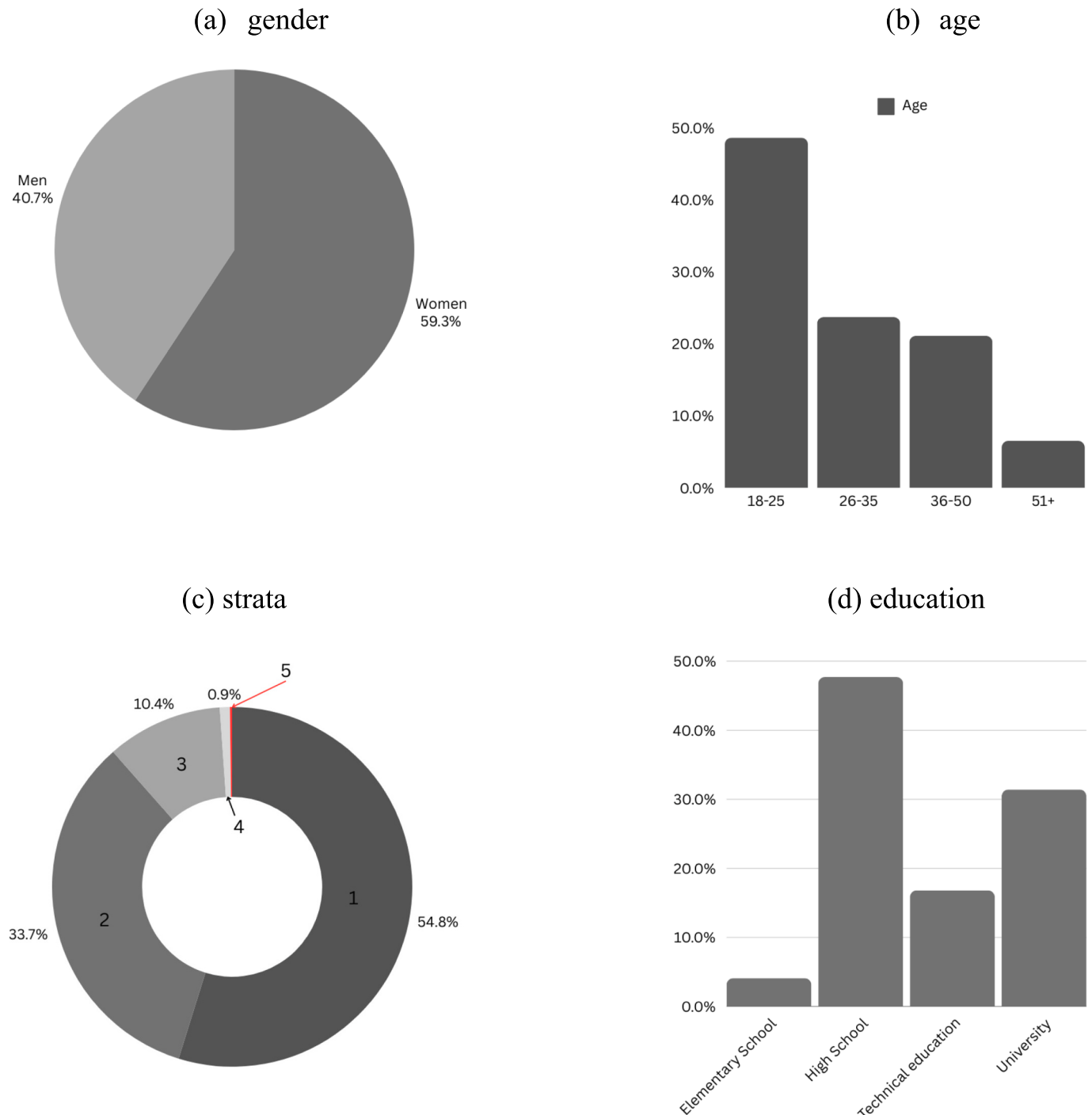


Fig. 1. Socio-demographic descriptive statistics.

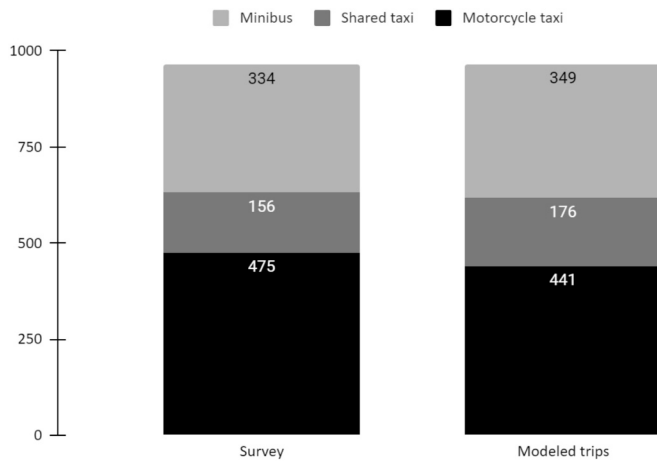


Fig. 2. Trips per mode.

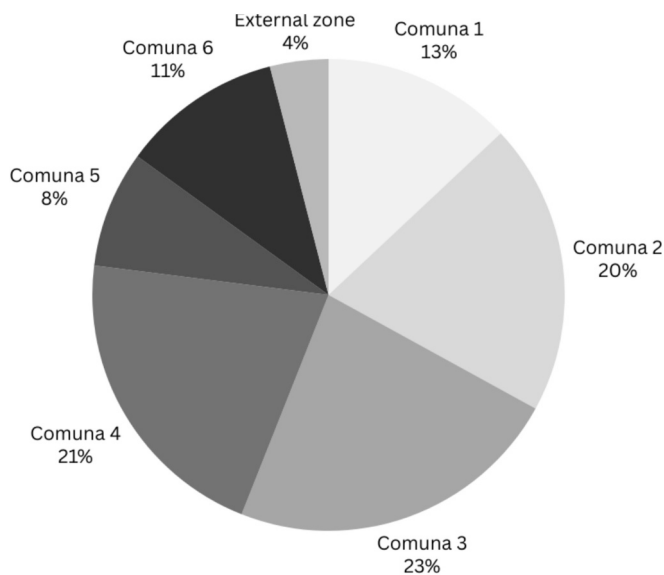


Fig. 3. Trips per district (comuna).

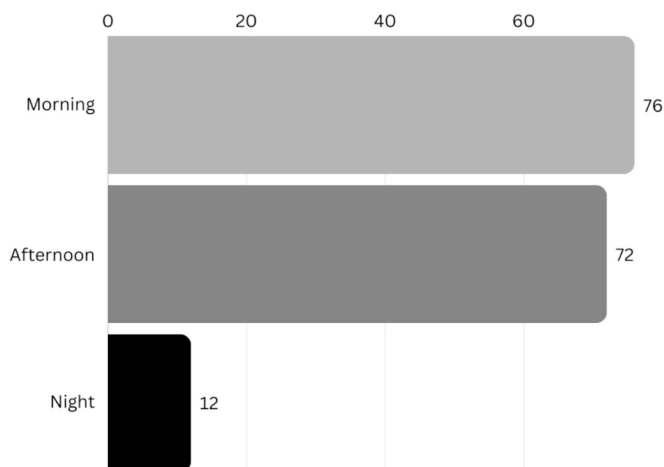


Fig. 4. Percentage of commuting trips per hour.

shown in Table 3.

Women were victims more than twice as frequently as men and suffered more sexual violence (more than triple) than men. The differences in both cases were statistically significant. In the case of non-sexual violence, there were no statistically significant differences by gender.

A specific focus of the survey was the reporting of harassment incidents. Among respondents who indicated that they had experienced harassment while using public transportation in Ocaña, only 68 % reported the incident to any authority or organization, while the remaining 32 % chose not to report it. Other studies, such as [Transport for London \(2013\)](#) and [Quinones \(2020\)](#), have also found a similar trend, which implies that underreporting violence on public transportation may be a global phenomenon. Although this percentage is higher for women than for men (69 % vs. 66 %), the difference is not statistically significant. However, there are relevant differences regarding the reasons that explain not reporting, as shown in Fig. 6. It is relevant to note that these figures refer exclusively to direct victims of harassment, as the survey questions on reporting were addressed only to those who had personally experienced such incidents and not to witnesses.

The most common reasons for not reporting for both women and men included not knowing where to report the situation and a lack of trust in the judicial system. Women did not report to a greater extent because they had insufficient information about the aggressor. The proportion of women who felt embarrassed by the situation was also higher than that of men, although the difference was not statistically significant. These findings highlight the significant underreporting of harassment incidents within the public-transport system.

According to [Transport for London \(2013\)](#), victims have to deal with four types of barriers to fill complaints over violent situations: normalization, i.e. victims see the behavior as a 'social nuisance' to be tolerated; internalization: i.e. victims want to escape and forget the incident as soon as possible, or find someone who cares (e.g. friends or family); lack of awareness: i.e. victims do not know which behaviors to report, who to report to, or how; and system credibility: i.e. victims have little faith that reporting will result in the offender being caught or sanctioned. Meanwhile, [Quinones \(2020\)](#) found that the main reasons for not reporting sexual harassment episodes in Bogota were: lack of support from the authorities, that reporting is perceived as useless, normalization, problems with the procedure, and fear or retaliation.

The low rate of reporting harassment incidents observed in this study is consistent with findings from other contexts and represents a major challenge for policymakers and local authorities. Underreporting not only limits institutions' ability to respond effectively but also perpetuates a culture of impunity and discourages future victims from coming forward. In the context of Ocaña, the main institutions involved in the reporting process were the local police, the municipal government, and public transportation service operators. Strengthening the coordination among these actors, improving the accessibility and confidentiality of reporting mechanisms, and increasing public awareness about available support services are essential steps to address the issue of harassment in public transportation. The data collected in this study underscore the urgent need for targeted interventions that encourage reporting and ensure victims receive appropriate support.

3.4. Model: "Zero Inflated Poisson"

Given that almost half of the respondents were not victims of any of the violence situations asked, a Zero Inflated Poisson (ZIP) model structure was used. The ZIP model is used to model events with excessive zero counts in the dependent variable; for this reason, it is preferred over the Poisson model to predict (see [Lambert, 1992](#)).

This model has two components: first one is the binomial model, representing the probability of having suffered at least one event (1) or no events (0). The second component is the Poisson regression model, which represents the probability of having suffered "N" events during

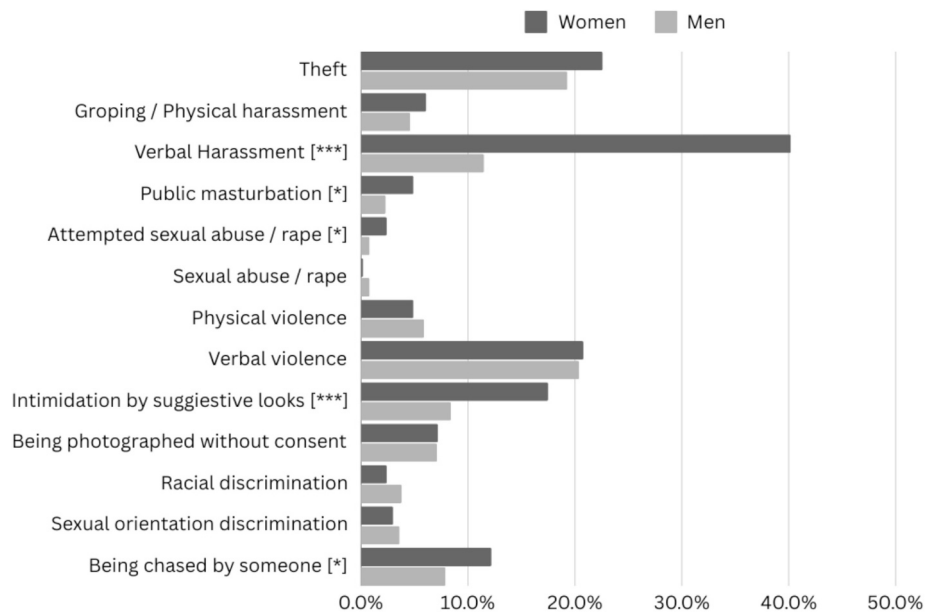


Fig. 5. Proportion of women and men that reported violence situations in public transportation.

Table 3

Proportion of respondents having suffered violence and average violence episodes per gender.

	sexual violence		non-sexual violence	
	victim [***]	average episodes [***]	victim [o]	average episodes [o]
Women	44.9 %	5.47	38.5 %	1.98
Men	21.4 %	1.41	33.8 %	1.79

Confidence level (two-tail t-test): [***] > 99.9 %, [o] < 95 %.

the analysis period. The ZIP probability function is presented in eq. 1.

$$P(Y = y) = \begin{cases} p + (1 - p)e^{-\lambda}, & \text{if } y = 0 \\ (1 - p)\frac{e^{-\lambda}\lambda^y}{y!}, & \text{if } y > 0 \end{cases} \quad (1)$$

where p is the probability of excess zeros, and λ is the Poisson rate.

Weighting was applied according to gender and age using census

information so that the weight of each survey in the model corresponded to the demographic composition of the population of Norte de Santander, the region in which Ocaña is located (Departamento Administrativo Nacional de Estadística (DANE), 2023). The weighting factors are listed in Table 4.

4. Results and discussion

Five of the situations that occurred more frequently (i.e., theft, groping/sexual harassment, verbal harassment, verbal abuse, and intimidation by suggestive looks) were modeled separately. For the rest of the situations, no significant relationships with the leading independent variables were found; thus, they were only included in the modeling of the sum of all the situations and were not represented separately. Table 5 presents the degrees of freedom, log-likelihood, and median Pearson residual for all regressions.

Table 6 below shows the variables included in models and their sign. “+” represents a higher incidence of violence, corresponding to a higher probability of having suffered at least one episode, a higher number of

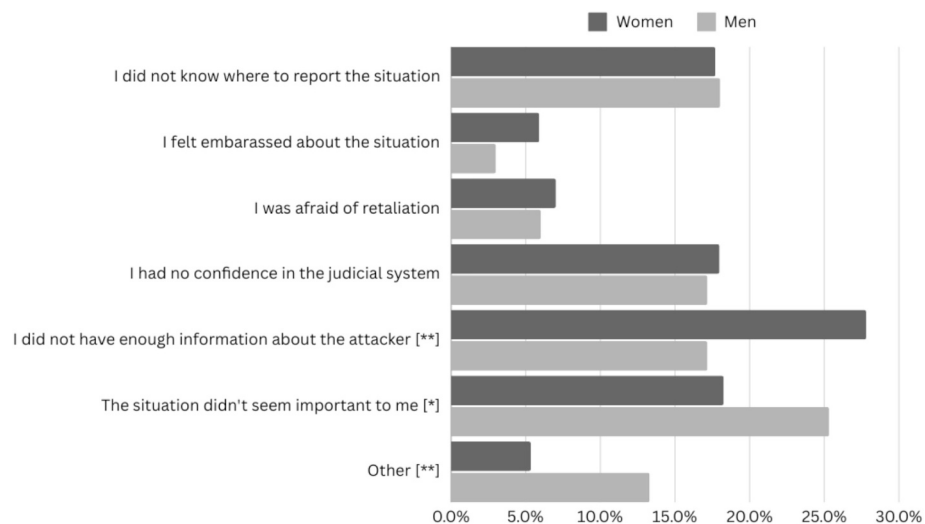


Fig. 6. Reasons for not reporting violent situations [**] > 99 % CI, [*], > 95 % CI.

Table 4
Sample weighting for modeling.

	Sample proportion [A]	Population proportion [B]	Weight [B/A]
Women - 18 to 25	27.7 %	9.3 %	0.338
Women - 26 to 35	15.0 %	11.4 %	0.758
Women - 36 to 50	12.5 %	13.8 %	1.097
Women - 51 +	4.0 %	20.9 %	5.172
Men - 18 to 25	20.9 %	9.7 %	0.462
Men - 26 to 35	8.7 %	11.5 %	1.323
Men - 36 to 50	8.6 %	13.0 %	1.509
Men - 51 +	2.5 %	13.9 %	5.592

episodes or both, and “-” represents the opposite. Finally, “±” represents opposite effects in the count and binomial models. The coefficient values, *t*-test results, and confidence level for the count model are presented in Appendix C and D.

4.1. Variables explaining the prevalence and number of violent episodes

Significant variables can be divided into three groups: **sociodemographic variables**, **travel period and location**, and **other trip characteristics**.

4.1.1. Socio-demographics

The model results show that women were more likely to experience violent events when using public transport, which highlights a gender disparity in the context of an urban trip, thereby giving rise to social and security problems. Regarding event-specific models, women were more likely to experience verbal harassment, which is consistent with the

Table 5
General characteristics of models.

Situation	all situations	theft	groping / sexual harassment	verbal harassment	verbal abuse	intimidation
Degrees of freedom	25	17	8	23	10	14
Log Likelihood	-3305.73	-756.25	-232.65	-1167.19	-1013.66	-640.37
Median Pearson residual	-0.533	-0.290	-0.146	-0.290	-0.314	-0.182

Table 6
Impact on violence incidence per variable.

Model variable	all situations	theft	groping / sexual harassment	verbal harassment	verbal abuse	intimidation
Woman	+			+		
Age	-	+	-	-		-
Teenager		+				
Strata	+	+		+		
Income	-	-	-		-	-
Disabilities	-			±	-	
Comuna 1				+		+
Comuna 2				+	-	+
Comuna 3		+		+		
Comuna 4		+				
Comuna 5	+					
Comuna 6	+	+				
External zone	+			-		
Morning			+			
Afternoon				+		-
Night						+
Shared taxi		+				
Motorcycle taxi	-				-	
Minibus	+	+				+
Total travel time	+	+			+	
Walking time to transit stop				+		
Walking time - minibus	+					
Walking time - shared taxi	+					
Walking time - motorcycle taxi	+					
Waiting time				+		
Waiting time - minibus	+			+		
Waiting time - motorcycle taxi	+			+		
Waiting time - shared taxi	+					
In-vehicle travel time			+			+
In-vehicle travel time - minibus	+					+
In-vehicle travel time - motorcycle taxi				+		
In-vehicle travel time - shared taxi	+			+		+
Walking time to destination				+		
Work trip		+	+			-
Study trip	+					
Shopping trip		-		+		
Leisure trip	+					
Personal business trip			+			
Travel with company				-	-	+
Trip to University	-					
Travel with packages	+	+				

higher prevalence of reported sexual violence. This disparity highlights the urgent need to address this problem as a priority and develop comprehensive prevention and awareness strategies in society. Therefore, our findings show that the historically common practice of treating transportation planning as gender-neutral excludes relevant factors from theoretical development and planning practice. These results align with Tiznado-Aitken et al. (2024).

There is a decrease in the probability of having suffered a violent event as age increases. Older people reported having suffered fewer episodes of “verbal harassment” and “intimidation”, which could be related to higher respect for older adults. Evidence reported by Verma et al. (2020) states that older people are more likely to perceive buses as safer than younger ones. On the other hand, Valan (2020) found that one-third of all young women traveling in Chennai city (India) reported having faced some form of sexual harassment in the last six months, with the majority (81 %) falling into the age group of 18–22. Therefore, there are higher odds that younger women aged below 25 will suffer sexual harassment than those aged above 25. It seems, teenagers were more likely to be victims of robbery: a higher proportion of young people made night trips (see, for example, Roberts and Eldridge, 2007) may explain this trend.

Furthermore, according to the model results, individuals with disabilities are less likely to experience violent events. However, the literature highlights that people with disabilities may face additional challenges in their mobility, which may limit the amount of travel they make and force them to travel with companions (see, for example, Kett et al., 2020), which could influence the lower incidence of violent events. In Ocaña particularly, buses and shared taxis are not equipped with ramps or specific spaces for passengers with physical disabilities, and motorcycle taxis are not suitable for use by people with reduced mobility. Hence, people with disabilities have solid barriers to mobility. This finding invites future studies to better understand the reasons for the lower violence suffered by people with disabilities on local public transportation without losing sight of the fundamental premise of equal access and safety for all individuals.

Regarding users' economic conditions, it is observed that as their income increases, the probability of having suffered a violent event decrease. High-income individuals report fewer instances of robbery and sexual harassment, which may be related to traveling in safer environments and time periods. People with higher incomes have more transport mode options available (Tiznado-Aitken et al., 2024) and jobs that allow them greater flexibility in their travel schedules (see, for example, McCrate, 2012); hence, they can choose safer times and routes. On the contrary, lower-income residents usually take longer trips to get to their jobs (Stacy et al., 2021) and are therefore exposed to more violent situations. It is also observed that as the socioeconomic stratum increases, the probability of facing violent events increases, which could be associated with the geospatial and socioeconomic distribution of the strata in the urban area, the security dynamics of each area, and the mobility patterns of the group of individuals. Although there seems to be a contradiction between the results of the general model regarding income and the stratum of people, it is common for people with higher incomes in Ocaña to live in rural areas, which correspond to low stratum ratings because they are located outside the city perimeter.

4.1.2. Travel period and location

Models demonstrate that people are more likely to experience bullying when traveling at night. This may be associated with greater insecurity related to the lack of lighting and fear of crime, which issuing restrictions on the choice of the transport mode for their trips (Fenster, 2005; Bastomski and Smith, 2016; Gardner et al., 2017). On the contrary, groping is more frequent for trips made in the morning, which may be explained by the higher crowding on public transport vehicles where strangers take advantage of environmental conditions to harass, in addition to encouraging the greater anonymity perceived by the perpetrators (Smith and Cornish, 2006; Gekoski et al., 2017). This

violent method is listed as one that causes greater fear on public transportation because it is confrontational (Gardner et al., 2017).

Regarding geographic location, people living in the northern and outer areas of Ocaña city (i.e., comunas 5 and 6 and external zone) tend to experience a more significant number of violent events, which could be associated with the time of exposure during the trip and the security conditions of those areas (Carrascal Gómez and Jaime Jaime, 2020). The urban dynamics and social conditions experienced in these areas can explain the previously mentioned patterns. Individuals who live in this city sector usually travel long distances from their homes to the city center, thereby increasing their exposure to potential threats. Several studies (e.g., Armstead et al., 2021; Pearl, 2019) have shown that neighborhoods that often lack street lighting and surveillance systems (e.g., cameras, CCTV), consistent police presence, basic services, and limited economic opportunities increase social tensions and criminal activities. In addition, their residents tend to be at higher risk of becoming victims of violence.

4.1.3. Other trip characteristics

Using a minibus is associated with a higher proportion of users who have experienced at least one episode of violence in general and with a higher probability of having suffered robbery and intimidation, compared with shared taxis and motorcycle taxis. Sharing a trip with more people represents, on the one hand, greater exposure to episodes of verbal and physical violence. On the other hand, sharing the same space can also deter potential aggressors (Gekoski et al., 2017). Additionally, aspects such as lack of proper surveillance, inadequate vehicle design, poorly lit minibuses, undefined passenger boarding protocols, and the absence of enforced safety policies are often risk factors that increase the violence, especially for women and other marginalized groups in public transport (Loukaitou-Sideris and Fink, 2009).

The behavior of variables such as travel time was consistent with the expected. Namely, longer travel times imply higher exposure to episodes of violence, which is reflected in the models in the following aspects: as travel time increases, the proportion of people who experienced at least one instance of groping, verbal harassment, verbal abuse, and intimidation is higher. These facts are well documented in public transportation research on violence (Sant'Anna Cardoso et al., 2021; Ceccato and Loukaitou-Sideris, 2020).

The survey divided the trip time into four stages: walking to the public transportation stop (1), waiting (2), in-vehicle travel (3), and walking to the destination (4). Stages 1 and 3 were associated with a higher number of total episodes of violence. In addition, stages 1 and 2 are associated with more episodes of verbal harassment. There is greater vulnerability when walking to a public transportation stop and waiting because potential victims are more likely to be alone than when traveling in the vehicle. In this sense, just as expected, traveling with a companion reduced the number of episodes of verbal harassment. This could be linked to a lower probability of having experienced at least one episode of verbal harassment and abuse.

Trips for study and recreation are associated with a higher probability of violent events. In these cases, it is relevant to consider that some trips take place outside normal hours (such as late evenings or weekends). This could be due to decreased public presence and increased security risks (Smith and Clarke, 2000), which could increase travelers' vulnerability. Our findings indicate that traveling more frequently implies higher exposure. Likewise, this highlights the need for targeted interventions by decision-makers, planners, and government authorities. In this sense, the results show that measures such as increasing security during off-peak hours, better lighting, and increased patrolling in high-risk areas mitigate frequent and vulnerable travelers' risks. In contrast, trips to the university showed an inverse association with the probability of experiencing violent events, which could be related to a higher density of people on these routes and in the areas surrounding university campuses. This situation can act as an intrinsic deterrent for potential aggressors because the probability of being subjected to

scrutiny and detection increases significantly. In addition, private security forces usually protect the surroundings of university campuses, thus increasing the perception of security in these areas.

4.2. Deriving “good practice” for public policy

Violence in public transport, in particular sexual harassment and assault, has been typically overlooked by planners in many cities, as there has been a common perception that such incidents are minor crimes (Clark et al., 2016; Ball and Wesson, 2017). As such, the first step in devising public policies to prevent such incidents is to convince local authorities of the relevance of public transportation users' safety at all stages of their journeys. The results of our models may provide insights for planners and officers in small cities in the Global South regarding different types of measures that may be useful to reduce violence on public transportation.

4.2.1. Level of service and public transportation regulation

Improving the level of service offered for public transport, for example, by reducing access and travel times, would directly impact the enhanced route planning. This can be achieved by building bus-only lanes or bus stops with raised platforms that will not only benefit users in terms of the duration of their trips but also through increased safety by reducing exposure to potential aggressors. This would particularly benefit low-income women, who walk and use public transportation the most (Levy, 2015) and are therefore at greater risk of exposure to unsafe conditions. Women in these circumstances face compounded challenges, such as limited access to private transportation, increased vulnerability to harassment and violence, and an increased burden of caregiving-related travel. These factors restrict mobility and affect access to education, employment and essential services, worsening existing inequalities. Addressing these risks is critical for fostering safer, more equitable urban mobility systems.

One of the critical challenges in improving Ocaña's public transportation services is the lack of regulations for most transportation modes, except for minibusses. This regulatory gap prevents the integration of shared and motorcycle taxis into the urban transportation system. Investment in road infrastructure to support these modes may increase their utility but may also make car use more attractive. Such induced demand can increase congestion, leading to degraded travel times and reduced public-transport efficiency. Mitigating this will require careful management of alternatives without creating unintended impacts, a very challenging issue that is well-known across several cities worldwide (Rodrigue et al., 2020).

4.2.2. Relevance of participation and long-term solutions

The active participation of drivers and passengers in preventing violence in public transportation systems is also required. Drivers should be trained to recognize and act in inappropriate situations, as seen in the “Safe Taxi” program in Manizales (Rodas-Zuleta et al., 2022). Also, including female staff in transportation services could further increase safety. However, passengers should be encouraged to travel in groups, avoid high-risk hours and be alert, especially regarding shared modes of transportation. Examples include the “5D Family Miranda” campaign by Metro de Santiago (Ministerio de Transportes y Telecomunicaciones, MTT, 2023), the Active Bystander Campaign by Transport for London (Transport for London, 2023), and the “Against the aggressors, let's raise our eyes” campaign in France (Gouvernement de France, 2023). These campaigns promote collective action against violence in public spaces, with local public awareness aimed at creating a safe environment for all users.

Short-term solutions, such as women-only sections and special seating, can provide concrete steps toward curbing harassment. However, their effectiveness is questionable, with studies showing that these solutions reinforce gender stereotypes (Kondylis et al., 2019). Long-term solutions will require holistic urban policies that improve the security of

women across all spectrums of urban life. For instance, the use of crime mapping technologies for governmental agencies and reporting applications, as illustrated in São Paulo and Quito (CEPAL, 2019; Ceccato and Paz, 2017; Carvajal, 2017), can provide data-driven insights to improve urban safety. Policies should go beyond addressing symptoms and should challenge fundamental gender gaps. According to Quinones (2020), many initiatives lack an examination of social power structures in society, which limits their potential to create lasting transformation.

The findings of this study are broadly consistent with international research on violence in public transport, particularly regarding the higher prevalence of victimization among women and the widespread issue of underreporting, as documented in studies from both the Global North and South (e.g., Tiznado-Aitken et al., 2024; Gekoski et al., 2016; Quinones, 2020). However, the case of Ocaña also presents specific features that distinguish it from larger urban centers. The city's small size, semi-rural character, and the coexistence of formal and informal transport modes create unique exposure and vulnerability patterns. For example, the reliance on shared taxi services and motorcycle taxis, as well as the limited presence of regulatory frameworks, may influence both the types and frequency of violent incidents. These contextual factors highlight the need for tailored policy responses that consider the realities of smaller cities in the Global South. At the same time, the results from Ocaña contribute to the international literature by providing evidence from a setting often underrepresented in research, offering insights that may be relevant for other small or rural cities facing similar challenges.

5. Study limitations

The methodology applied is suitable for modeling relatively low-frequency phenomena, as described in the previous section. The same methodology has been applied in other recent studies, allowing for useful comparisons between cities. One of the main limitations of this study is the difficulty in determining the exact response rate, considering that we did not record the number of individuals who declined to participate. This makes it challenging to assess the potential for non-response bias. While we made efforts to intercept a diverse range of individuals and applied weighting to align the sample with the demographic composition of the population, it is possible that the sample may not perfectly represent the public transportation users of Ocaña. This limitation should be considered when interpreting the results of this study. However, the survey was sufficiently detailed to distinguish the impact of various situations of violence and to consider the different stages of public-transport trips.

Another notable limitation of the present study is the absence of data on the strategies that women and men employ to avoid harassment while using public transport. The literature consistently reports that women adapt their travel behavior in response to perceived risks of harassment. For example, Tiznado-Aitken et al. (2024) documented that women often avoid traveling at night, alter their routes, or change their mode of dress to reduce their exposure to potential harassment. Borker (2021) further highlighted how the risk of street harassment can influence major life decisions, such as educational choices, with women in Delhi sometimes opting for less prestigious institutions simply to avoid unsafe commutes. These avoidance strategies, while reasonable responses to unsafe environments, can significantly restrict women's mobility, limit their access to opportunities, and reinforce existing inequalities. Although our survey did not directly address this issue, future research in Ocaña should seek to explore the prevalence and impact of such adaptive behaviors among public-transport users.

In addition, the survey aimed to analyze the factors that influence episodes of violence when commuting, so those who use other modes, such as car, walking, or bicycle, were excluded from the sample. This makes it impossible to provide comparisons between modes, although walking to and from the bus stop and destination was included for users of minibusses, shared taxis, and motorcycle taxis. Furthermore, there is a

general limitation associated with surveys on violence, regardless of the instrument used.

Moreover, although the survey was conducted with the intention of modeling the causes of 13 violence situations, as described in [Section 3.2](#), only five situations that were separately modeled were found to have significant variables. Although the exact cause of the lack of significant variables for other situations is unknown, it may be associated with the sample size for rape or attempted rape events because very few respondents were victims. Furthermore, participants were not asked about their perceived sexual orientation and skin color, which may be relevant for modeling the occurrence of discrimination based on racial and sexual orientation.

Finally, some of the reasons for not reporting, such as internalization, fear and lack of confidence in the system, can also motivate a person not to want to reveal the situations of violence they suffered on public transport when asked in a survey. Consequently, care must be taken when interpreting the results of the models, given that values such as the number of events suffered are probably far from reality. However, analyzing which characteristics influence the probability of having suffered a given event is still a valid exercise. To do so, we assumed that there would be no significant differences in the probability of not reporting a given event, for example, according to area, time, or age.

6. Conclusion and future work

In summary, the estimated models showed that variables such as gender, age, income, geospatial location, reason for travel, walking time, waiting time, and travel time significantly influenced the probability of non-sexual violence during public transportation trips in Ocaña, a small city in Colombia. These results provide valuable information that can be instrumental in developing strategies aimed at safety and prevention in the field of public transport, such as improving public-transport service levels to reduce exposure to risks and encouraging drivers and other passengers to care for potential victims.

Beyond the applicability of the models, their main strengths are that their ZIP structure distinguishes the determinants of the probability of having suffered at least one event of violence during the last year from those factors that affect the number of violent events suffered. On the other hand, this is one of the first surveys regarding public transportation violence that was applied in a small city in the Global South, where there are formal and informal public-transport alternatives that allow differentiating the degree of vulnerability of users for both different alternatives and different travel stages.

Regarding the limitations of the models, the sensitive nature of some questions linked to the episodes of violence suffered, together with reasons why victims tend not to report such situations, such as fear of aggressors or distrust in institutions, can introduce bias in survey results. In contrast, although 13 specific situations of violence were asked, reasonable models were only obtained for 5 of the most frequent ones.

Appendix A. Ocañas map

Future work can extend this research by applying future surveys to estimate time-series models to analyze the impact of a given set of policies. Furthermore, applying a similar instrument to other small cities would help compare the incidence of violence across cities with diverse public transportation options, as well as extending the models to commuters using other modes such as walking, active, and private transport to compare the incidence of violence between diverse transport options. In addition, it could also be of interest to test these results at seasonal events to determine changes in the presence of public transportation violence affecting users during the non-common period.

CRediT authorship contribution statement

Paul Basnak: Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Thomas E. Guerrero B.:** Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization, Writing – review & editing, Writing – original draft. **Jose Agustin Vallejo-Borda:** Validation, Investigation, Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft. **María Fernanda López Fabra:** Validation, Investigation, Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft. **Thalia Turrén-Cruz:** Visualization, Validation, Investigation, Formal analysis, Conceptualization, Writing – review & editing, Writing – original draft.

Declaration of generative AI and AI-assisted technologies in the writing process

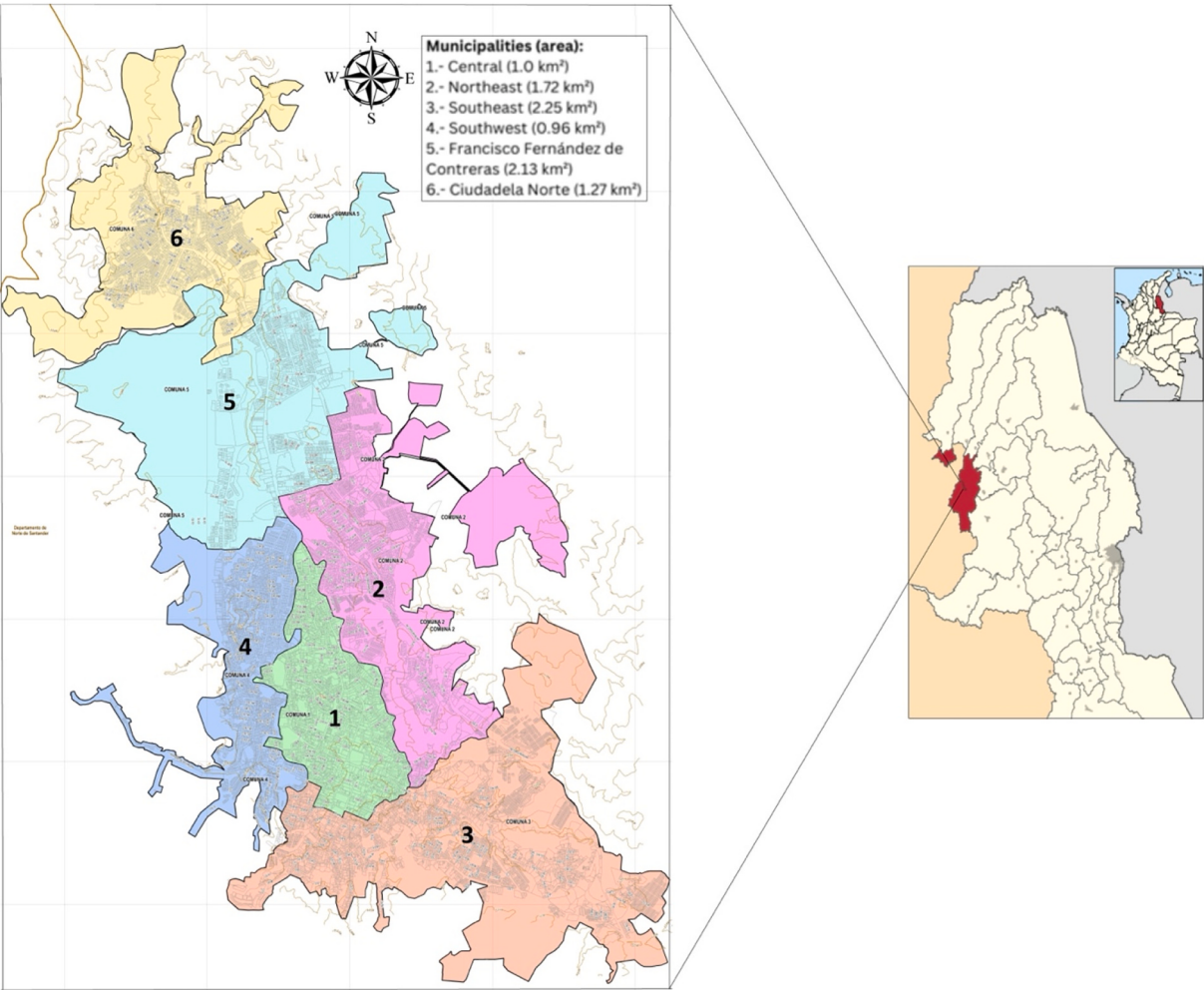
During the preparation of this work the authors used ChatGPT in order to improve language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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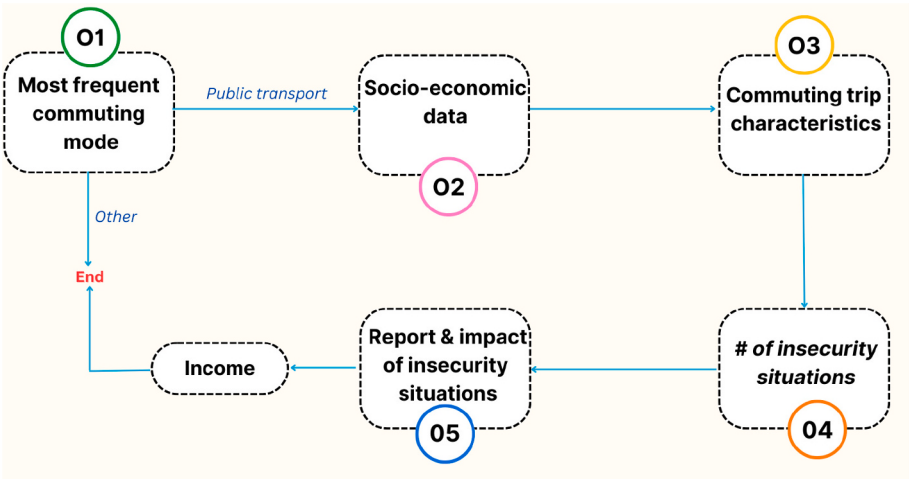
Declaration of competing interest

None.



Appendix A. Map of Ocaña (based on Ocaña City, 2023).

Appendix B. Survey diagram process



Appendix B. Survey diagram process.

Appendix C. Count model results

Appendix C presents the variable coefficients, z-test, and significance for the Poisson regression model. Given that this model represents the probability of having suffered “N” events during the last year, a positive coefficient can be understood as a higher probability of being a victim of more events.

Appendix C

Variable coefficients and significance per model (count model).

Model variable	all situations	theft	groping / sexual harassm't	verbal harassment	verbal abuse	intimidation
(Intercept)	1.60 [30.10, ***]	-3.44×10^{-1} [-1.38, o]	1.56 [3.96, ***]	3.90×10^{-1} [2.87, **]	1.58 [30.03, ***]	1.31 [11.87, ***]
Woman	2.00×10^{-1} [5.76, ***]			8.17×10^{-1} [7.90, ***]		
Age		1.43×10^{-2} [3.16, **]	-2.89×10^{-2} [-2.59, **]			
Age < 20		7.36×10^{-1} [3.69, ***]				
Strata	9.88×10^{-2} [4.84, ***]	2.39×10^{-1} [3.25, **]		1.29×10^{-1} [3.65, ***]		
Income		-4.23×10^{-4} [-5.37, ***]	-6.38×10^{-4} [-3.41, ***]			
Disabilities	-1.62×10^{-1} [-2.97, **]			-2.82×10^{-1} [-3.11, **]	-7.06×10^{-1} [-4.03, ***]	
Comuna 1				5.22×10^{-1} [6.80, ***]		3.04×10^{-1} [2.70, **]
Comuna 2				3.03×10^{-1} [3.66, ***]	-2.99×10^{-1} [-2.32, *]	3.08×10^{-1} [3.01, **]
Comuna 3		3.83×10^{-1} [2.57, *]		1.83×10^{-1} [2.31, *]		
Comuna 5	2.45×10^{-1} [4.27, ***]					
External zone	2.73×10^{-1} [3.52, ***]			-1.06 [-2.45, *]		
Afternoon				2.42×10^{-1} [3.81, ***]		
Night						4.21×10^{-1} [3.74, ***]
Shared taxi		3.61×10^{-1} [2.20, *]				
motorcycle taxi	-4.45×10^{-1} [-4.73, ***]				-3.20×10^{-1} [-4.00, ***]	
Total travel time		5.25×10^{-3} [5.27, ***]				
Walking time to transit stop				1.61×10^{-2} [4.93, ***]		
Walking time (minibus)	5.64×10^{-3} [2.04, *]					
Walking time (shared taxi)	3.30×10^{-2} [9.27, ***]					
Walking time (motorcycle taxi)	1.45×10^{-2} [4.31, ***]					
Waiting time (minibus)	5.40×10^{-3} [3.34, ***]			1.11×10^{-2} [6.55, ***]		
Waiting time (motorcycle taxis)	3.46×10^{-2} [6.50, ***]			3.37×10^{-2} [4.09, ***]		
Waiting time (shared taxi)	2.19×10^{-2} [3.67, ***]					
In-vehicle travel time (minibus)	2.37×10^{-2} [14.90, ***]					1.01×10^{-2} [2.71, **]
In-vehicle travel time (motorcycle taxi)				1.02×10^{-2} [1.80, o]		
In-vehicle travel time (shared taxi)	2.00×10^{-2} [4.97, ***]			2.38×10^{-2} [6.17, ***]		2.49×10^{-2} [3.71, ***]
Walking time to destination				1.07×10^{-2} [4.93, ***]		
Work trip			5.62×10^{-1} [2.03, *]			-3.64×10^{-1} [-3.93, ***]
Study trip	2.09×10^{-1} [4.93, ***]					
Shopping trip		-6.24×10^{-1} [-2.57, *]		6.12×10^{-1} [7.06, ***]		
Leisure trip	3.78×10^{-1} [3.13, **]					
Travel with company				-4.49×10^{-1} [-4.82, ***]		3.39×10^{-1} [3.23, **]

(continued on next page)

Appendix C (continued)

Model variable	all situations	theft	groping / sexual harassment	verbal harassment	verbal abuse	intimidation
<i>Travel with packages</i>		-6.62×10^{-1} [−4.31, ***]			1.62×10^{-1} [1.96, o]	
<i>Trip to University</i>	-1.70×10^{-1} [−3.05, **]					

Confidence level (two-tail T-test): (***) > 99.9 %, (**) > 99 %, (*) > 95 %, (o) < 95 %.

Appendix D. Binomial model results

Appendix D presents the variable coefficients, z-test, and significance for the binomial model. Given that this model represents the probability of not having suffered a violent situation, a negative coefficient can be understood as a higher probability of being a victim.

Appendix D

Variable coefficients and significance per model (binomial model).

Model variable	all situations	theft	groping / sexual harassment	verbal harassment	verbal abuse	intimidation
(Intercept)	-9.96×10^{-3} [−0.04, o]	1.30 [5.93, ***]	4.57 [7.98, ***]	0.97 [3.32, ***]	1.36 [6.96, ***]	2.32 [5.69, ***]
Woman	-7.24×10^{-1} [−5.05, ***]			−1.76 [−8.04, ***]		
Age	2.87×10^{-2} [5.42, ***]			5.43×10^{-2} [7.93, ***]		2.04×10^{-2} [2.04, *]
Income	2.20×10^{-4} [2.28, *]	6.16×10^{-4} [3.56, ***]			3.20×10^{-4} [3.16, **]	3.86×10^{-4} [3.41, ***]
Disabilities				-9.69×10^{-1} [−3.06, **]		
Morning			-9.42×10^{-1} [−1.82, o]			
Afternoon						5.76×10^{-1} [2.56, **]
Comuna 2					6.62×10^{-1} [2.72, **]	
Comuna 4		-5.64×10^{-1} [−2.52, *]				
Comuna 6	-4.41×10^{-1} [−2.05, *]	-5.46×10^{-1} [−1.99, *]				
Minibus	-4.96×10^{-1} [−3.27, **]	-5.57×10^{-1} [−3.03, **]				−1.49 [−6.16, ***]
Total travel time	-3.83×10^{-3} [−1.84, o]				-1.61×10^{-2} [−4.32, ***]	
Waiting time				-5.79×10^{-2} [−3.61, ***]		
In-vehicle travel time			-6.64×10^{-2} [−4.73, ***]			-6.07×10^{-2} [−5.83, ***]
Work trip		-6.12×10^{-1} [−3.10, **]				
Personal business trip			-8.42×10^{-1} [−2.33, *]			
Travel with company				7.77×10^{-1} [2.80, **]	4.30×10^{-1} [1.74, o]	
Travel with packages	-3.24×10^{-2} [−1.94, o]	-9.25×10^{-1} [−3.48, ***]				

Confidence level (two-tail T-test): (***) > 99.9 %, (**) > 99 %, (*) > 95 %, (o) < 95 %.

Data availability

Data will be made available on request.

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