

Uncovering gender-based violence and harassment in public transport: Lessons for spatial and transport justice

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ABSTRACT

When suitably organized, public transport plays an important role in social inclusion and equity by providing crucial access to social, political, and economic opportunities. Notwithstanding, a growing body of evidence points to gender-based harassment and violence associated with public transport journeys as significant barriers to women's travel. This raises important issues regarding spatial and transport justice.

Using a survey in Santiago, Chile, this study explores gender-based violence and harassment experienced while accessing, egressing, and using public transport. We use zero-inflated and logistic regression models to explore individual, behavioral and spatial factors associated with gender violence, particularly sexual harassment, defined as unwanted touching, filming or photography, stalking or masturbation, and rape. We examine these factors differentiating by trip segment (access to and egress from the system versus in-vehicle experience) and public transport mode (bus and Metro).

Our results show that 17.5% experienced four or more harassment situations. Public masturbation or rape primarily occurred on the journey to and from public transport (8.6%) and on board a bus (7.4%). Our models indicate a spatial component of harassment which intersects with behavioral and individual factors as trip frequency, trip purpose, gender, age, and income, reducing public transit's ability to serve women, particularly those in low-income living in more peripheral areas. This article contributes to knowledge regarding how these factors interact in a major city in the Global South, which has been under-explored to date. Our findings join other studies challenging theories of spatial and transport justice, which to date pay little attention to violence in general and gender-based violence in particular. We make suggestions for reinforcing theory in order to develop stronger solutions to ensure transport systems improve equity rather than locking in current discrimination and exclusions.

1. Introduction

The disparities in workforce participation and wages are widely recognized. According to the [International Labor Organization \(2022\)](#), only 47% of women are engaged in paid work, while 72% of men are. The gender pay gap is evident, with women earning 37% less than their male counterparts ([World Economic Forum, 2021](#)). As a result, the United Nations has established gender equality as a crucial global objective to achieve by 2030 ([United Nations, 2023a](#)). In particular, their Gender Equality Strategy (2022–2025) will focus on intensifying efforts in 80 countries to promote gender equality and mobilizing more than US\$100 billion to support gender equality through taxation

systems and public spending, among other initiatives ([United Nations, 2023b](#)).

Beyond the work dimension, women experience multiple mobility barriers at the urban scale, ranging from economic to psychological factors, with security and safety being among their main concerns. While the UK shows that only 15% of women experience sexual harassment ([Gekoski et al., 2015](#); [TfL, 2013](#)), other countries show prevalence rates over 60%, especially in emerging economies ([Gekoski et al., 2017](#)). Cities like Sao Paulo, Mexico City, or Lagos shows significantly higher numbers compared to more developed countries ([Ceccato and Loukaitou-Sideris, 2022](#)). In Chile, a recent survey found that 84% of those surveyed had experienced harassment in public spaces and on

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public or private transport, and 94% were women (Arenas and Madrid, 2021).

Public transport is essential to ensure women's full participation in society, when it fulfills its mission of providing convenient access to key social and economic opportunities. Its role is especially relevant in the Latin American context, where low-income and vulnerable communities live in the peripheries (see, for example, Hidalgo and Huizenga, 2013; Hernandez and Dávila, 2016; Pereira et al., 2019). However, it is also the site of violence and harassment, which limits women's development, well-being, and choices (ITF, 2018; del Mar Rodas-Zuleta et al., 2022; Dunckel-Graglia, 2013 and 2016; Gekoski et al., 2017; Jirón and Gómez, 2018).

Global studies show that these concerns are a key barrier to women's mobility (Loukaitou-Sideris, 2016). Specifically, insecure spaces pose a notable obstacle, particularly for individuals who face both transportation and social disadvantages. This issue can result in individuals not fully participating in society, a phenomenon known as social exclusion (Luz and Portugal, 2022). While social exclusion is a broader concept, it can be directly associated with transport issues, forming what is termed transport-related social exclusion (Lucas, 2012; Martens, 2017). Consequently, ensuring safe environments, convenient transportation choices, and affordable mobility for all emerges as a critical challenge.

A growing literature has examined gender-based violence¹ in transit environments (Gekoski et al., 2017; Ceccato et al., 2022). This is usually defined in terms of harassment and rape, that is, verbal or physical aggression toward passengers and/or employees or property, and is typically studied within five key domains: (i) transit environments and crime, (ii) users' perceptions of safety and security, (iii) temporal and seasonal aspects of crime and security, (iv) technology's potential benefits for improving security, and (v) interventions to reduce perceptions of crime and insecurity (Ceccato et al., 2022). Our study aims to explore gender-based harassment and violence in Santiago, Chile, examining the intersection between categories (i) transit environments and crime, and (ii) users' perceptions of safety and security.

Our work uses data from a survey in Santiago's low-, middle- and middle-high-income areas to explore the intersections among gender-based violence on public transport, socio-economic characteristics, travel behavior, and spatial factors. More specifically, our paper deploys zero-inflated and logistic regression models to explore which individual characteristics are associated with a higher propensity to experience various harassment situations (unwanted touching, photography, stalking, masturbating), sexual abuse or rape, differentiating by trip segment (access to and egress from the system versus in-vehicle experience) and public transport mode (bus and Metro). We compare our results with a broad literature on the topic, aiming to discuss policy implications and draw lessons for spatial and transport justice.

Four main contributions can be highlighted from this work. First, within quantitative evidence, descriptive analyses predominate (Ceccato et al., 2022). We go beyond by deploying multiple disaggregated and aggregated models to understand the factors behind each harassment situation for different public transport modes and trip segments. Second, we create a novel methodology for data collection, ensuring a diversity of transport and urban environments to study sexual harassment. Third, we extend the current evidence in the Global South and Latin America, particularly in Santiago, Chile, where these issues have gained space in the discussion with scarce robust evidence. Fourth, we

consider the implications from a transport and spatial justice perspective (Martens, 2020; Soja, 2010), where gender and violence are seldom considered in any depth.

The article is structured as follows. Section 2 offers a literature review grounded in gender, mobility, sexual harassment, and justice. Section 3 outlines the case study, including data collection and the methodological approach. Section 4 shows the main findings of the study, while Section 5 examines these findings in the context of prior international research on the topic and offers policy and justice implications. Section 6 concludes by summarizing the key contributions of the study and suggesting directions for future research.

2. Literature review

2.1. Gender and mobility examined through women's mobility

Gender² and mobility are inextricably linked, profoundly influencing each other in significant ways (Hanson, 2010). In her early work on urban planning for Canada's Status of Women, Wekerle (1979) noted that women were "transport disadvantaged", with far-reaching impacts. Monk and Hanson (1982) analyzed sexist bias in geography, noting how transportation systems limit women's participation in every aspect of society, while Grieco et al. (1989) focused mainly on work. Similarly, Valentine (1989) mapped women's "geographies of fear", relating these to the uneven distribution of male violence, while Pain (1991) examined interactions among space, sexual violence, and systems of social control, crucial links to which we will return in our discussion. Overall, however, researchers and planners alike have continued to treat transport as if it were gender neutral (Lindkvist Scholten and Joelsson, 2019).

More recent studies have underlined that social values and specific characteristics of transport systems produce differences in women's and men's mobilities. Indeed, women's travel patterns show similarities in different contexts worldwide, reflecting their ubiquitous role as primary caregivers, constituents of a "mobility of care" (Sánchez de Madariaga, 2013). In both the Global North (see examples from Canada: Ravensbergen et al., 2022, or UK: Root et al., 2000) and the Global South (see examples from Latin America: Jirón and Gómez, 2018; Sagaris and Tiznado-Aitken, 2020; Montoya-Robledo et al., 2020, or India: Mahadevia and Advani, 2016), research has revealed that rather than following the predominant male travel pattern of moving directly between home and work, women "trip chain", that is, they string destinations together as they move through the city, accompanying children to school, going to work, caring for themselves and others (Smith, 2008).

As they travel, women experience cultural, economic, physical, and psychological mobility barriers differently from men (Loukaitou-Sideris, 2016). Security and safety concerns are significant barriers to women's travel (see examples from Santiago: Martínez and Santibáñez, 2015, and Mexico DF: Villagrán, 2017). Among these concerns, sexual harassment stands out as a primary issue, damaging mental health, generating anxiety, low self-esteem, and post-traumatic stress disorder (Fielding et al., 2021).

Women, unlike men, change their behavior by altering places visited, routes, and time in response to harassment in the US (Loukaitou-Sideris and Fink, 2009) and in Latin America (Allen et al., 2019; del Mar Rodas-Zuleta et al., 2022; Montoya-Robledo et al., 2020). Women's autonomy

¹ For the purposes of this study, we use the UN definition of gender violence, particularly Article 1, "any act of gender-based violence that results in, or is likely to result in, physical, sexual or psychological harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life", Article 2, which defines community as a relevant site for violence, and Article 3, which specifies specific rights relevant to the elimination of gender violence (UN, 1993).

² For this article we use "sex" to refer to biological aspects of human physiology and gender to refer to the cultural roles and attributes assigned to men and women, as per journal policy on Reporting on sex- and gender-based phenomena (<https://www.elsevier.com/journals/journal-of-transport-geography/0966-6923/guide-for-authors>). In this sense, we recognize the ambivalence of these identities and the many different roles emerging through the struggles of social movements advocating for Lesbian, Bi-sexual, Homosexual, Two-spirited, Trans-gender and other groups' rights. For the purposes of this article, however, only two respondents identified as non-CIS gender, so we were unable to include this aspect in our analysis.

is undermined by improper sexual behavior (Junger, 1987; O'Donohue et al., 1998), with public transport as a recurrent site, whether in vehicles, while entering or leaving the system, or waiting to board (Cecato et al., 2022). The built environment (sidewalks, parks, and streets) also matters (Madan and Nalla, 2016; Cecato and Paz, 2017), making a “whole journey” approach that considers all travel stages essential (Smith, 2008; Natarajan et al., 2017).

Therefore, access to safe, convenient, attractive mobility options is essential to ensure access to important social benefits and rights. These efforts, including specific policies to face sexual harassment, have the potential to generate sustainable, socially just, and inclusive transport systems and policies, as noted by del Mar Rodas-Zuleta et al. (2022).

2.2. Justice conceptualizations and their (dis)connection with gender issues

The literature shows diverse conceptualizations of what is understood and what is implied by a just society in urban and transportation terms. These theories may or may not have a direct link to gender and violence issues, and their conceptions may or may not have a direct link to the difficulties and barriers faced by different marginalized or vulnerable populations, whether by gender, age, race, ability, income, or another dimension.

Agyeman et al. (2003) and Agyeman (2013) have introduced the concept of “just sustainabilities”, which refers to the importance of balancing human needs and environmental limits to achieve true sustainability. Here, sustainability isn't just about protecting the environment but ensuring everyone can enjoy a good quality of life equitably. Martens (2017, 2020), meanwhile, has explored the concept of “transport justice”, applying Walzer's “spheres of justice” theory to transportation, along with Rawls's theory of distributive justice. He argues that the main goal of transport systems is to provide sufficient accessibility regardless of income, ethnicity, gender, abilities, and other characteristics (Martens, 2017). Similarly, van Wee and Mouter (2021) have explored ways to operationalize the concept of transport equity, considering horizontal, vertical, and territorial equity among eight equity types and principles, noting gender as one crucial factor to consider. However, like transport planning itself, the application of all these relevant theories and concepts often tends to mention gender but falls short of examining the mechanisms of discrimination that mediate how different population groups use and experience the same transport systems.

Soja's foundational work on spatial justice mentions that “geographically uneven development, whatever its particular source, is a contributing factor to the creation and maintenance of individual and social inequalities” (p. 72, Soja, 2010). That phrase, “whatever the source”, comes back to haunt us as we look at the growing body of evidence on the effect of gender and other forms of violence in controlling, and often severely limiting, movement through urban space of whole groups of people, particularly, and almost universally, women. Schwanen (2020) urges us to investigate how individuals shape their own identities, the identities of others, and their overall life experiences through their daily movements. Moreover, Grieco et al. (1989) insists that transport and gender issues had to be considered for individuals but also for collectives and particularly neighborhoods.

Recent work tends to operationalize distributive justice in terms of the uneven distribution of infrastructure and services, which in turn limit the accessibility of social groups concentrating in specific locations, underserved or not served at all by these arrangements. For example, Pereira et al. (2019) raised the issue of how transport policies generate an unequal distribution of transportation infrastructure and services in Rio de Janeiro and limit the accessibility of some population groups to the benefits of city and social life. Similarly, Oviedo (2021) applies the concept of splintering urbanism in Latin America, which relates directly to how different the infrastructure provision is if we consider power, wealth, and influence factors. While these are very

convincing approaches to understanding, analyzing, and responding to transport justice challenges, in this article we aim to reflect on whether these approaches are sufficient to address the underlying factors behind sexual harassment and gender issues identified in our analysis.

Hence, our goal is to delve into the issue of gender violence, specifically focusing on the dynamic interplay between physical spaces and the experiences of individuals, particularly women, as they move and navigate through public transport spaces. While it is beyond the scope of this article to engage in a full reconsideration of key theories about spatial and transport justice, we frame our findings to consider the spatial reality of gender discrimination as it plays out in implicit and explicit forms of harassment and gender violence to exclude women (some, more than others) from the full exercise of their rights.

3. Data and methods

3.1. Case study: Santiago, Chile

Chile is an independent nation situated at the southernmost point of South America (Fig. 1, left side). Chile grapples with acute economic inequality, as indicated by the second-highest Gini coefficient and one of the highest levels of perceived income disparity among OECD nations (OECD, 2021). Within Chile's 16 administrative regions, the Metropolitan Region has the country's capital, Santiago. Greater Santiago encompasses 640 km², housing 6.12 million inhabitants across 34 municipalities (INE, 2017).

This concentrated urban development in Santiago gives rise to significant socio-spatial segregation. Affluent households predominantly reside in the eastern sectors, while poverty is more dispersed across the southern, northern, and western regions (Fig. 1, right side). This unplanned urban growth spanning four decades has fostered severe urban segregation, inequality, and poverty. As explained and summarized before in Tiznado-Aitken et al. (2020, 2021, 2022), these challenges are rooted in several factors: economic activities clustering within high-income municipalities, governmental housing policies leading to the displacement of vulnerable communities, limited access to urban opportunities, unaffordable housing and transportation, and disparities in the quality of urban infrastructure and mobility systems, among other factors.

The location of low- and middle-income groups in pericentral and peripheral areas with fewer services and activities make cycling and walking often impractical due to lengthy commute distances. Notably, about 60% of households in Santiago lack private vehicles (SECTRA, 2015), compelling many low-income residents to depend on public transport for their fundamental needs.

Regarding coverage, operation, integration, and fleet characteristics, Santiago has one of Latin America's best public transport systems. In 2007, Santiago introduced a contemporary, integrated-fare public transportation system (Transantiago) encompassing both buses and Metro (Santiago's subway system). Rebranded in 2019 as RED, which carries a dual meaning of “network” in Spanish and aligns with the red color of the new buses, the system has continuously aimed to improve its service to users. However, several challenges remain in the system, such as unsatisfactory user evaluation, high fare evasion, and sexual harassment issues.

Previous research in Chile has shown that “women face a triple burden of gender-, road- and crime-related violence, exacerbated by poverty, age, and/or belonging to a sexual or visible minority, migrant or other groups” (Sagaris and Tiznado-Aitken, 2023, p. 9). In Santiago, women experience a strong sense of insecurity from crime and related activities at public transport stops, particularly in downtrodden urban settings, especially at night, which may lead them to suppress travel or rely on cars (Tiznado-Aitken et al., 2020). Evidence shows that people perceive cars (59%) to be the safest transport mode, while they consider public transport (34%), walking (20%), and cycling (14%) the least safe (Arenas and Madrid, 2021). Similarly, opinion polls identify that 63%

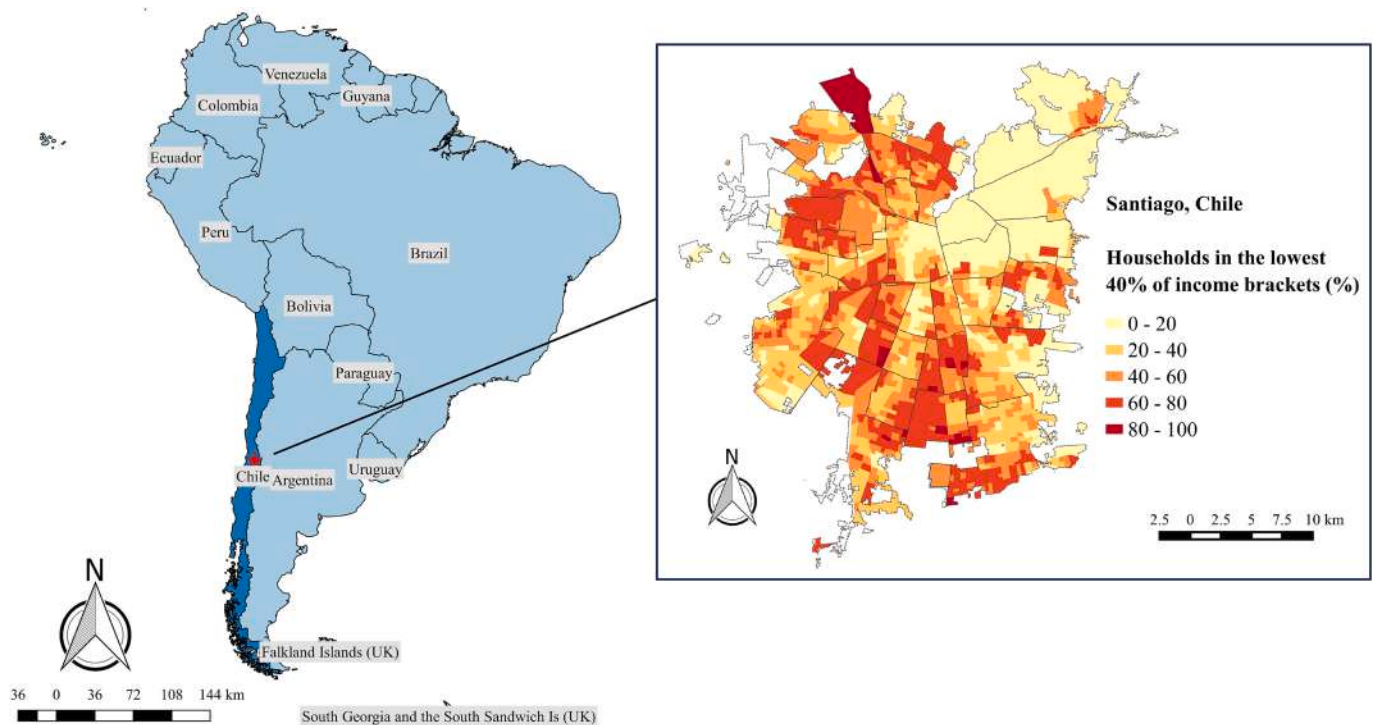


Fig. 1. Chile's location and socioeconomic segregation in Santiago, Chile (Source: Own elaboration based on OCUC (2018) and Porto Tapiquén (2020)).

consider public transport the most unsafe place (MTT, 2023).

This body of evidence highlights how critical it is to address safety concerns, especially for women. A study of gender violence linked to public transport in four Latin American cities (Bogotá, Mexico City, Lima, and Santiago) revealed that Santiago was the furthest behind in recognizing and dealing with this issue, reflecting institutional and public policy challenges (Rozas and Salazar Arredondo, 2015). Legally, harassment in public transport was not addressed until 2019, when it was incorporated into an existing law concerning sexual violence (Riviera et al., 2020). Currently, sexual harassment is a criminal offense with penalties ranging from 61 days to five years in prison and fines up to USD 1000. This law seeks to eradicate all types of violence against women, especially in public places (Ministry of Women and Gender Equality, n.d.).

Considering these trends, The Ministry of Transport and Telecommunications (MTT), in collaboration with the Ministry of Women, has recently launched the “La Familia Miranda” campaign to combat harassment on public transport. This nationwide initiative uses videos, posters, and radio messages to raise awareness and prevent harassment. The campaign targets all individuals who may witness such behavior and can help identify it, underscoring that we all have a role to play in eliminating violence against women (MTT, 2023).

3.2. The survey

The survey used in our research is part of a broader initiative known as “Ella se mueve segura” (ESMS, Allen et al., 2019). ESMS was a global safety and wellness study that examined women’s safety and experiences with public transport in three Latin American cities: Buenos Aires, Quito, and Santiago. In 2018, we specifically conducted a survey and reflective workshops as part of the Santiago case study to gain insights into the intersection of these issues. The dataset derived from this survey was employed for various analyses, including the estimation of logistic regression and zero-inflated models for Santiago, as presented in this paper.

The survey comprised 30 questions regarding socio-economic characteristics, travel habits, and travel perception/experience. In this work,

we focused our attention on harassment in Santiago’s public transport system. The *Observatorio Contra el Acoso Chile* (OCAC), an NGO that studies harassment in Chile, defines four categories of harassment:

- **Verbal and non-verbal:** Suggestive looks, noises, and inappropriate comments with implicit or explicit sexual connotations (“piropos”).
- **Physical:** Touching shoulders, hands, waist, etc., or intimate body parts (buttocks, genital area, breasts, etc.) and/or rubbing against a person’s body without their consent.
- **Audiovisual recording:** Taking photographs or recording a person or parts of their body without their consent.
- **Serious:** Stalking and intimidation, giving chase (on foot or using a car or other vehicle), exhibitionism, and public masturbation.

Our study focused on the three most severe categories of harassment (physical, audiovisual, and serious) considering situations where: (i) a passenger groped or pressed against another passenger in a sexual manner, (ii) a passenger photographed intimate body parts without consent, (iii) passengers witnessed public masturbation, (iv) felt that a person was following or stalking them, or (v) experienced assault or rape. For each situation, respondents answered for specific modes and trip segments, particularly (i) access to and egress from public transport, regardless of the mode, (ii) traveling by bus, and (iii) traveling by Metro.

Responses were collected using tablets at bus and subway stations, which immediately entered replies online using the SurveyGizmo platform. When passengers entered a bus or Metro carriage, surveyors accompanied them to complete the survey (10–15 min). Surveys were conducted in public transport stops from three municipalities in Greater Santiago: Nuñoa (mid- to high-income), Santiago (mixed-middle income), and El Bosque (low-income). They belong to three of Santiago’s six macrozones, used to collect transport data (Fig. 2). Wealth in Santiago is heavily concentrated in the eastern macrozone, as shown in Fig. 1, while poverty is present throughout most of the city, particularly in the north, south, and southeast, which also suffer from considerable isolation in transportation terms.

This location heterogeneity was necessary given how transport-related costs and benefits are unevenly distributed across the

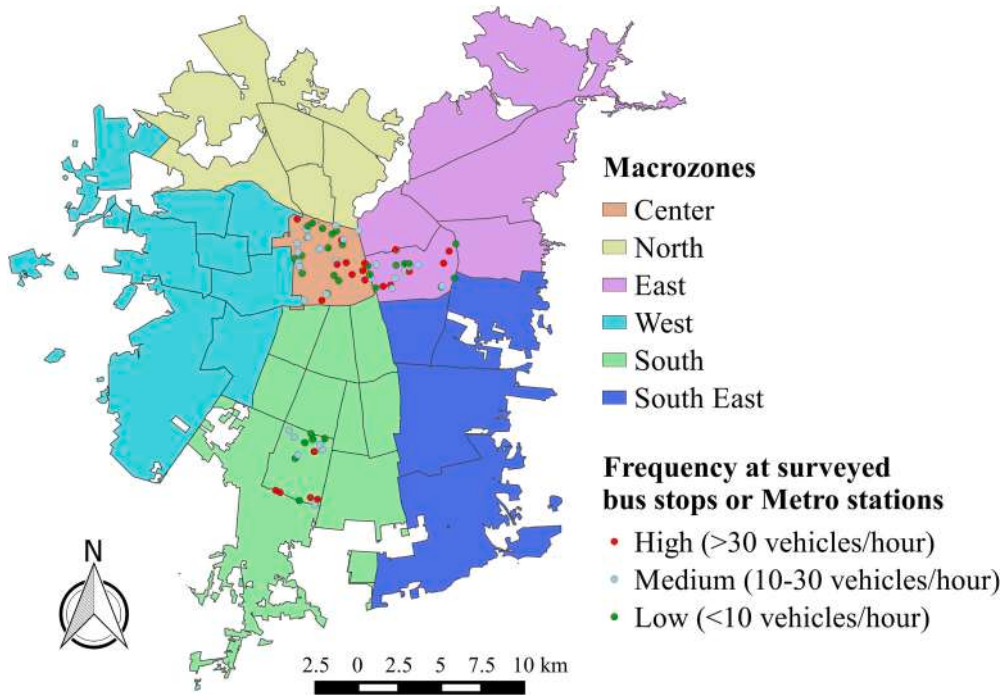


Fig. 2. Macrozones and public transport stops selected for survey collection (Source: Own elaboration).

population in Santiago (Iglesias et al., 2019). To capture this diversity, stops were categorized (see Table 1) and randomly selected based on service frequency (Fig. 2) and surrounding urban amenities (Fig. 3). We conducted the survey during peak and off-peak times, at high- and low-frequency stops in attractive and deteriorated urban locations (see Fig. 4 for some examples). In the latter scenario, we collected fewer surveys as a safety measure for our surveyors, especially in areas with high crime rates. Consequently, it's important to acknowledge that the results from these locations may be less representative.

After data cleaning, the survey consisted of 790 observations (404 men, 386 women; 348 in Santiago, 239 in Ñuñoa, and 203 in El Bosque), statistically representative of people using public transport in those three municipalities, at 95% confidence with a 10% sampling error, using the sample size formula to estimate the population parameters for random samples without replacement (de Dios Ortúzar and Willumsen, 2011).

Table 1
Dimensions used for selecting public transport stops in data collection.

Dimension	Category	Index value	Index explanation and sources
Public transport frequency	Low	< 10	Buses or subway trains per hour, with values ranging from 0 to 30. We use official information at the stop level, determining the average frequency at morning and afternoon peak hours (DTPM, 2018).
	Medium	10 to 30	
	High	> 30	
Urban environment	Low	1 to 10	Environment and Urban Quality Index with values ranging from 0 to 21 (theoretically) and 19 (in practice). We use georeferenced information to create an index considering security/safety, environment, cleanliness, and infrastructure (see more in Tiznado-Aitken et al., 2018)
	Medium	10 to 13	
	High	13 to 19	

3.3. Modeling approach

We examined socio-economic and spatial characteristics associated with a higher likelihood of experiencing harassment using two models from the Generalized Linear Model (GLM) family: zero-inflated and logistic regression.

A zero-inflated model (Cameron and Trivedi, 2005) is a statistical technique used to address data that exhibits excessive zeros, which cannot be explained by a standard distribution alone. This model is advantageous in cases where many observations are zero. Unlike negative binomial or Poisson models, zero-inflated models can deal with excess zeros and over-dispersion of the data (Sultana et al., 2018).

In a zero-inflated model shown in (1), two processes are combined to account for the excess zeros: a binary process determining the probability of a data point zero (p_i^*0) and a counting process, usually following a Poisson or Negative Binomial distribution that models the non-zero observations $(1-p_i^*)n_i$. The binary process represents the presence or absence of an event, while the counting process characterizes the occurrence count when the event is present.

$$E(y_i) = p_i^*0 + (1 - p_i^*)n_i \tag{1}$$

Logistic Regression is a statistical method for analyzing a dataset in which one or more independent variables determine an outcome. The outcome is measured with a dichotomous variable, a binary (1/0, Yes/No, True/False) outcome, given a set of independent variables. Logistic Regression aims to find the best fit for the relationship between independent variables and the binary outcome. The probability that the qualitative variable Y takes the value k (the reference level, coded as 1), given that predictor X has the value x, is as follows (2):

$$Pr(Y = k | X = x) = \frac{e^{\beta_0 + \beta_1 X}}{1 + e^{\beta_0 + \beta_1 X}} \tag{2}$$

For this study, we estimated 15 different logistic regression models (Y-values), considering five different types of harassment and the three possible trip stages where it occurred (access/egress, traveling by bus, and traveling by metro). Each one was codified as 1 when the type of harassment was experienced by the individual, 0 otherwise. Moreover, we used zero-inflated regression to model the number of situations

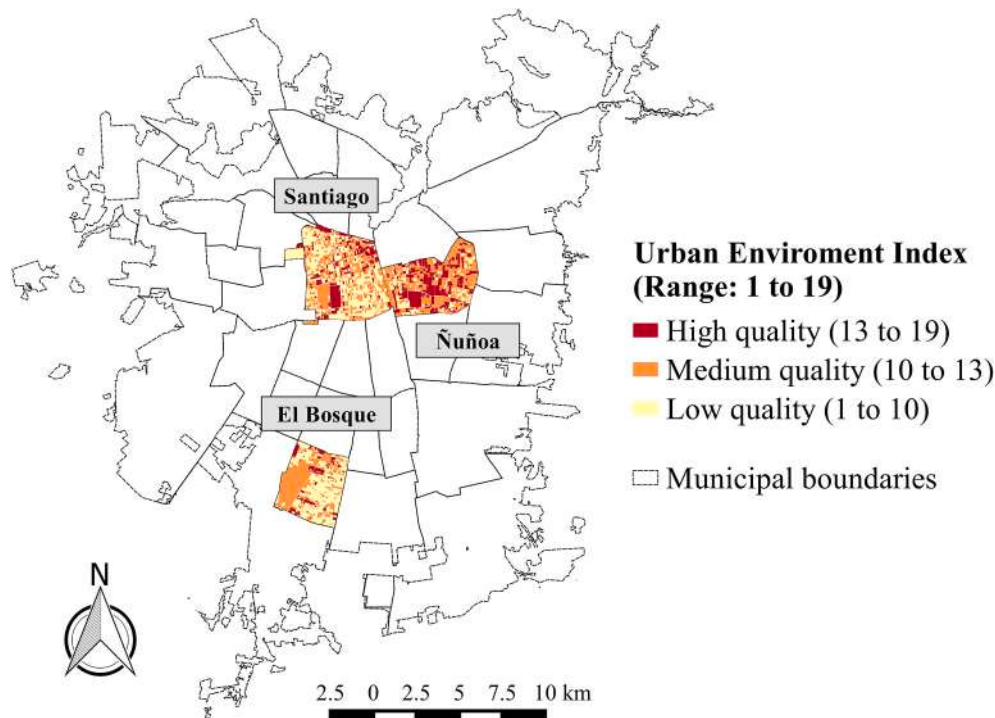


Fig. 3. Urban Environment Index in Santiago, Ñuñoa, and El Bosque (Source: Own elaboration).

encountered by an individual from 0 (none) to 15 (all 15 cases previously mentioned). We consider two explanatory variables (X-values): travel behavior (mode use, trip purpose, and trip frequency) and individual characteristics (age, gender, educational level, occupation, income). Moreover, we consider the spatial dimension of harassment by considering where these occur and including the respondent's location in the city. How these variables were codified and then introduced into the model can be found in the following section (Table 2).

We use odds ratios (OR) to measure the strength of the association between model variables and thereby interpret our results (Barri et al., 2021), estimated by the exponentiation of the coefficients from the logistic regression model. Its value lies between 0 and infinite. An OR of 1 indicates no association between variables, an OR >1 indicates a positive association, and an OR <1 indicates a negative association. The magnitude reflects the strength of this association.

4. Results

4.1. Descriptive analysis

A total of 790 valid surveys were obtained for model estimation. The response options for each variable and their distribution are summarized in Table 2. All sampled individuals were adults (at least 18 years old), 48.9% were women, and the rest were men. Most (53.6%) were formally employed, with 15.7% reporting independent employment. About 90% reported their education level as between high school and an undergraduate degree. For this sample, the most common reason for travel was work (62.3%), with 42.3% reporting a typical frequency of 3 to 5 days per week. Our survey is slightly biased toward higher incomes; 64% reported their collective household income was <900,000 CLP (about USD\$1100), compared to 75% of Santiago's population (MDS, 2020).

While surveys took place in three specific municipalities in the yellow (south), green (center) and purple (eastern) macro zones, people's homes were located throughout Greater Santiago, especially two of the poorest, the south and southeast macro zones (green and blue in Fig. 2). As seen in Table 2, macrozone 2 (north) has only a 1% sample share of individuals' households. Despite this low percentage, we maintained the

official transport ministry's zoning (SECTRA, 2015), considering the low-income nature of this macrozone and that a potential aggregation with other macrozones could induce biases in our modeling approach.

Over half of our survey respondents reported no personal experience with harassment, 11.0% having one experience, 17.3% having two to three experiences, and 17.5% having more than four. Table 3 shows how these experiences are disaggregated by gender. Women show a higher percentage in all categories, except for those with no experience. A more detailed look at the frequency and types of harassment experienced by gender is shown in Table 4. Metro was slightly safer, for all categories, than buses and traveling to or from public transport. As can be seen, it shows the lowest percentage of respondents experiencing different harassment situations at least once. Being groped and followed were the most common occurrences, with the latter experienced mainly when going to or from a Metro station or bus stop (36.9%). Severe forms of harassment, such as public masturbation or rape, primarily occurred on the journey to and from public transport (8.6%) and on board a bus (7.4%). In all cases, females are the most affected.

4.2. Logistic regression and zero-inflated models

Table 5 shows the odds ratios (OR) for the Logistic regression models and significance levels for the five most relevant models (results from all the other models are shown in Appendix A1). The choice of the best models obeyed two criteria: (i) the minimum value of the Akaike information criterion (AIC) (Akaike, 1974) and (ii) the significance levels of the model's explanatory variables. If the variable is shown in Table 5, it means that it was considered explanatory of the model at least once.

The models' results show that the gender parameter (β_{gender}) is significant for all estimates except for the case of Masturbation/Metro. Nevertheless, among those witnessing public masturbation on the Metro, women were the most affected, and the parameter sign shows consistency (OR <1). Sexual groping during trips to and from stops/stations and stalking on the bus disproportionately affected young individuals, specifically those aged 18–25 (27.6% of the total sample) and 26–40 (34.1% of the full sample). Work travel, the most frequent purpose (62.3%), revealed a greater probability of unwanted photos on the



Fig. 4. Examples of bus stops and quality of urban environment. Above, more deteriorated urban environments, with different public transport frequencies (highest on the left, lowest on the right). At the bottom, high-frequency public transport in medium and high-quality urban environments (Source: Own elaboration)

Metro. Similarly, more frequent travel (3–5 days/week; 42.3% of the total sample) increased the probability of experiencing all the situations considered in this study.

Income proved to be a significant factor in experiencing harassment, as shown by the value of the β_{inc1} : low-income people were more likely to experience groping (when going to or from the bus/Metro station), unwanted photographing (on Metro), public masturbation (on Metro) and sexual abuse/rape (when going to or from the bus/Metro station).

Regarding spatial factors, we tested both the respondent's home macro zone and the survey location as independent variables. The latter turned out to be non-significant. We believe this is a result of the diverse nature of public transport trips: we intercept people at a given stop, but that does not necessarily guarantee they often use that stop, spend a lot of time there, or move through those areas regularly. In that regard, the respondent's residence proved significant, serving as a better proxy probably because public transport users require access to bus or subway stops close to their residence.

We used the transport ministry's zoning (Fig. 2, SECTRA, 2015) to associate respondents' residences with macro zones. The model (Table 5) revealed that living in macrozone 3, Santiago's (and Chile's) wealthiest neighborhoods, reduced the probability of harassment, particularly stalking associated with travel by bus and being groped or pressed up sexually while accessing or egressing the system. Conversely, 41.7% of Santiago's low- and medium-income households live in macrozones 1 (center), 2 (north), and 6 (southeast), with a higher

probability of sexual abuse, rape, and public masturbation.

We used our zero-inflated model (Table 6) to determine the influence and significance of demographic and trip characteristics associated with the number of harassment events, given that 54.2% of individuals in our sample had not experienced harassment. Overall, the estimates show consistency with results from Logistic models. The count model shows that women and frequent users (3–5 days a week) tended to experience more harassment events. The model confirmed that living in macrozone 1 (the city center) is associated with more harassment situations, while macrozone 3 showed less probability of harassment situations. Similarly, younger people (18–25) and those making work, study, and shopping trips have a higher likelihood of experiencing more harassment situations studied in this research. Finally, those occasionally employed also increase the likelihood of experiencing public transport-related harassment.

The inflated model shows which variables are associated with no experience of harassment situations. As expected, being a man, aged 41–60, living in the high-income eastern zone has a higher probability of experiencing no harassment. Remarkably, people with elementary school education show a higher likelihood of experiencing no harassment, which may be counterintuitive as this may be related to lower income. However, this latter variable was not significant in our model.

Table 2
Characterization of sample variables.

Category	Variable	Categories	Percentage
Gender	gender	Male	51.1
		Female	48.9
Age	age1	18–25 years	27.6
	age2	26–40 years	34.1
	age3	41–60 years	29.5
	age4	≥ 61 years	8.8
Education level	est1	No education level	0.5
	est2	Elementary school	9.5
	est3	High school	43.0
	est4	Undergraduate	45.5
	est5	Postgraduate	1.5
Occupation	ocup1	Head of household	7.3
	ocup2	Independent employed	15.7
	ocup3	Dependent employed	53.6
	ocup4	Occasional employed	0.3
	ocup5	Volunteer	0.3
	ocup6	Retired	1.3
	ocup7	Student	16.7
	ocup8	Unemployed	4.4
	ocup9	Other	0.4
	purp1	Work	62.3
Purpose	purp2	Study	16.1
	purp3	Shopping	3.9
	purp4	Leisure	3.2
	purp5	Health	2.0
	purp6	Accompany someone	1.8
	purp7	Visit	2.3
	purp8	Carry out a personal activity	8.4
	freq1	Never	2.2
Frequency of journey	freq2	1–2 days/week	16.5
	freq3	3–5 days/week	42.3
	freq4	Everyday	39.0
	inc1	< 450,000 CLP	27.8
Household income	inc2	450,000 CLP – 900,000 CLP	36.3
	inc3	900,000 CLP – 1,800,000 CLP	16.2
	inc4	1,800,000 CLP – 4,500,000 CLP	5.4
	inc5	> 4,500,000 CLP	14.3
	macrozone1	Centre	13.5
Respondent's home macro zone	macrozone2	North	1.0
	macrozone3	East	7.0
	macrozone4	West	15.9
	macrozone5	South	15.9
	macrozone6	South-East	29.2
	macrozone7	External zones	17.5

Table 3
Number of different harassment situations experienced by gender (Note: each gender adds up to 100%).

Number of different harassment situations experienced	Percentage of respondents (%)	
	Male	Female
0	65.6%	42.2%
1	10.4%	11.7%
2–3	14.1%	20.7%
4–5	4.2%	7.8%
>5	5.7%	17.6%

5. Discussion

5.1. Our results: What do they confirm, and what do they add to the discussion?

Our findings show significant factors already found in the literature elsewhere and other surprising or less explored dimensions worth discussing as contributions to the field. Both logistic and zero-inflated

Table 4

Percentage of respondents experiencing, at least once, different harassment situations for each mode/trip segment and gender (Note: the sum of percentages in the table add >100%, since respondents could report multiple harassment situations in different mode/trip segments).

Harassment type	When going to or coming back from the metro/ bus station		On board the bus		On board the metro	
	Male	Female	Male	Female	Male	Female
Being chased or stalked	7.6%	15.8%	5.1%	10.9%	2.0%	3.9%
Being groped or pressed up in a sexual way	4.1%	9.5%	4.9%	12.9%	2.9%	8.6%
Being photographed	2.7%	3.2%	2.0%	2.7%	1.5%	2.8%
Sexual abuse or rape	1.6%	3.2%	1.3%	3.7%	0.6%	2.0%
Public masturbation	0.4%	3.4%	0.5%	2.0%	0.5%	0.8%

models show that women experienced a higher risk of victimization than men, a clear sign of gender-based violence (Division of International Protection and UNHCR, 2021; Joshi et al., 2022). These results for Santiago reinforce the tendencies found by multiple contexts worldwide: Moreira and Ceccato (2021) for Sao Paulo (Brazil), Mohamed and Stanek (2020) for Cairo (Egypt), Ceccato and Nalla (2020) for Mexico City (Mexico), Tokyo/Kanagawa (Japan), Rio Claro (Brazil), and Lagos (Nigeria), Tripathi et al. (2017) for Lucknow, India, del Mar Rodas-Zuleta et al. (2022) for Manizales (Colombia), Quinones (2020) for Bogotá (Colombia), and Kash (2019) for Bogotá (Colombia) and El Alto (Bolivia), to name a few.

We found that young individuals are more affected by harassment situations, groups that have been found as usual users who depend heavily on public transport for daily commutes (Ceccato and Nalla, 2020). Similarly, our results show that more frequent travel increased the probability of experiencing all the situations considered in this study, consistent with international evidence showing more significant harassment as the frequency of use increases (see, for example, Tripathi et al., 2017 and Gautam et al., 2019).

Income was another key factor in our analysis. Low-income people were more likely to experience several harassment situations, including severe forms such as public masturbation, and in all trip segments. This result is tied to our spatial analysis, which revealed that low- and medium-income neighborhoods in macrozones 1 (center), 2 (north), and 6 (southeast) are more likely to experience severe harassment. The literature has found similar results, showing that the stops located in regions with low per capita income are more prone to violent situations (Moreira and Ceccato, 2021). Similarly, women in poor neighborhoods have been reported as being more afraid of assault than their wealthier equivalents, while women of color tend to perceive greater risk than white women (Ross, 2000).

Additionally, evidence reported by Ceccato and Nalla (2020) shows that people living in low-income neighborhoods — most of whom use public transport—are more likely to experience victimization and fear. Low-income women frequently find themselves as “captive users” of public transportation, relying on public transport for their daily mobility because there are no other feasible, convenient, or affordable alternatives available to them. This situation heightens the risk of harassment, as noted in the study by Gekoski et al., 2015. In the specific context of Santiago, our results might also be associated with higher use of public transport among low-income groups but also with the deteriorated urban environment (Tiznado-Aitken et al., 2018) and level of service conditions (higher waiting times and crowding conditions) experienced during these public transport trips (Tiznado-Aitken et al., 2021).

This is bad news for efforts to position sustainable transport as a real and feasible option, with public transit serving longer trips and trip purposes not suited to walking (0–2 km) or cycling (2–5 km). If public transit is not reliable or safe, women's mobility and freedom are significantly limited, reinforcing inequalities and exclusion. In the case

Table 5

OR values for the Logistic Regression model.

Variables	Being groped or pressed up in a sexual way	Sexual Abuse or Rape	Been photographed	Public Masturbation	Being chased or stalked
	Access/Egress		Metro		Bus
$\beta_{\text{intercept}}$	0.09 ***	0.05 ***	0.05 ***	0.0015 ***	0.15 ***
$\beta_{\text{gender (male)}}$	0.32 ***	0.48 **	0.44 **	0.25	0.34 ***
$\beta_{\text{age1 (18–25 years)}}$	2.38 ***	–	–	–	2.78 **
$\beta_{\text{age2 (26–40 years)}}$	2.32 ***	–	–	–	2.52 *
$\beta_{\text{age3 (41–60 years)}}$	–	–	–	–	2.31 *
$\beta_{\text{purp1 (Work)}}$	–	–	2.24 *	–	–
$\beta_{\text{freq3 (3–5 days/week)}}$	2.01 ***	–	–	12.73 **	–
$\beta_{\text{inc1 (< 450,000 CLP)}}$	1.69 **	2.02 **	3.80 ***	5.41 **	–
$\beta_{\text{inc4 (1,800,000 CLP – 4,500,000 CLP)}}$	–	–	–	–	0.36
$\beta_{\text{macrozone1 (Centre)}}$	–	2.56 **	–	–	–
$\beta_{\text{macrozone2 (North)}}$	–	–	–	6.31 *	–
$\beta_{\text{macrozone3 (East)}}$	0.42 **	–	–	–	0.31 ***
$\beta_{\text{macrozone6 (South-East)}}$	–	–	–	6.40 **	–
Sample size	756	756	382	382	754
AIC	550.37	283.1	198.21	68.27	627.39

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.**Table 6**

Parameter values for the zero-inflated model.

Model	Variable	Parameter value
Count	$\beta_{\text{intercept}}$	0.36 ***
	$\beta_{\text{gender (male)}}$	–0.47 ***
	$\beta_{\text{age1 (18–25 years)}}$	0.20 **
	$\beta_{\text{ocup4 (Occasional employed)}}$	1.06 ***
	$\beta_{\text{purp1 (Work)}}$	0.51 ***
	$\beta_{\text{purp2 (Study)}}$	0.48 ***
	$\beta_{\text{purp3 (Shopping)}}$	0.76 ***
	$\beta_{\text{freq3 (3–5 days/week)}}$	0.19 **
	$\beta_{\text{inc1 (< 450,000 CLP)}}$	0.23 ***
	$\beta_{\text{macrozone1 (Centre)}}$	0.19 **
Inflated	$\beta_{\text{macrozone3 (East)}}$	–0.40 ***
	$\beta_{\text{intercept}}$	–0.78 ***
	$\beta_{\text{gender (male)}}$	0.92 ***
	$\beta_{\text{age3 (41–60 years)}}$	0.54 ***
	$\beta_{\text{est2 (Elementary school)}}$	0.89 ***
	$\beta_{\text{freq3 (3–5 days/week)}}$	–0.33 *
	$\beta_{\text{macrozone3 (East)}}$	0.53 *
Sample size		759
LL		–1118

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

of this study in Santiago, gender violence, particularly when combined with low income, limits mobility and access, maintaining the subordination of low-income women. This is particularly serious given that walking is a “majority” mode in the poorest municipalities of Santiago, with women accounting for up to 80% of walking trips. Because walking trips are very short, up to 1.5 km, women’s sphere of action diminishes (Herrmann-Lunecke et al., 2020).

Non-work travel purposes and occasional employment also correlated with higher indices of harassment, as shown in our zero-inflated model. This is something less explored in the literature. Still, in the case of Santiago, these are categories where women are two or three times more likely than men to realize travel in Santiago (Sagaris and Tiznado-Aitken, 2020), with the added complexities that they are often accompanying vulnerable, sick, disabled or older personas. This reflects the importance of these motives for using public transportation for individuals, especially women (Madan and Nalla, 2016).

As noted in our literature review, evidence suggests that women’s autonomy is frequently compromised by inappropriate sexual behavior. In the transport domain, this may happen within vehicles, at entry and exit points, during wait times, but also in the associated built environment, so sidewalks, parks, and streets also play a significant role (Cecato et al., 2022; Madan and Nalla, 2016; Ceccato and Paz, 2017). Our

findings in Santiago show that most harassment situations happen in the latter, while accessing or egressing public transport, and primarily for women. Therefore, our findings align with the idea of adopting a comprehensive “whole journey” approach that takes into account all stages of travel in order to address these concerns and ensure women’s safety and autonomy (Smith, 2008; Natarajan et al., 2017), especially when public transport planning and operation usually ignore what happen in these trip segments. As Valentine (1990) identified 30 years ago, two of the most problematic spaces are enclosed spaces with few exits, such as alleyways and multi-story parking lots, and open spaces like lonely transit stops.

Our results are important for decision makers and authorities studying harassment in public transport in Santiago, since vehicles might be less of a problem than accessing or egressing the system. In the US context, evidence has shown that women feel safer on the bus than while waiting for one: the presence of a bus driver is reassuring (Loukaitou-Sideris and Fink, 2009). Our results show that Metro is the safest place in terms of harassment, which might be explained by the presence of guards and illuminated spaces within stations. While peak hours can be dangerous considering overcrowding (Tiznado-Aitken et al., 2020), the overall experience says that buses and urban environments are more dangerous in Santiago’s case.

Finally, our work found relatively high rates of severe forms of harassment, such as public masturbation or sexual abuse, in both buses and urban environment for women (over 3%). Moreover, 17.5% of our sample express having experience more than four harassment situations. This fact indicates a significant risk that transport authorities seldom consider and is usually omitted from studies. Frequency and types of harassment are generally understudied, and one of the strengths of this study was to analyze these situations in different trip segments. These results might have profound implications for how women perceive and use public transport. As reported in Allen et al. (2019) study on Santiago, Buenos Aires, and Quito, women apply six strategies looking for safety: avoid travel, modify routes, change transport modes, change hours of travel, walk or travel with someone else, and increase awareness. These changes, the majority in travel behavior, could limit women’s activity participation and exclude them from urban spaces, or create unsustainable trends by massive shift to personal cars or modes perceived as safer.

5.2. What to do? Policy implications

We share the conviction that infrastructure design and service operations are relevant to improving transport justice, as discussed in our

literature review. Notwithstanding, we question whether this perspective provides sufficient insights to generate effective solutions for gender-based violence. In many cases, transport infrastructure, particularly the virtual highways and segregation caused by trains, Bus Rapid Transit infrastructure and related bridges, tunnels, and links, crowded vehicles and stations, and dark, deserted public transport stops, may worsen these conditions. Our research and findings reinforce this view. Downtown Santiago (macrozone 1) is the location best served by walking, cycling, and frequent services by bus and Metro. Waits at bus stops and subway stations, particularly during peak hours, are at most 5–7 min. Still, safety concerns and harassment situations remain high in these areas.

We face the existence of a complex and enduring cycle. The fear women feel is not isolated but rather a symptom of broader dynamics within these public spaces. Depending on the specific time and context, these dynamics are influenced by the diverse ways in which different groups engage with and exert authority over these areas (Valentine, 1989). Therefore, there is no single solution for a problem that requires addressing both situational and dynamic factors through a whole-journey approach (Ceccato et al., 2022). As Sagaris and Tiznado-Aitken (2023) note, wicked problems could be addressed more effectively by wicked solutions, that is, bundled solutions that address both transport and social systems together. A recent International Transport Forum underlines the usefulness of training programs, public awareness campaigns, stakeholder collaboration, and technologies (ITF, 2018) that might support the current efforts in designing and operating safe public transport systems.

Different regions globally, including Brazil and the United States, have experimented with diverse approaches. These include enhancing the design and facilities of public spaces, deploying security measures like cameras, introducing reporting tools like SMS, panic buttons, apps, or hotlines, and conducting educational and community-based campaigns. Some of these strategies have been previously tried in Santiago, and additional efforts have been implemented over the past five years. However, notable progress in addressing the issue has yet to be achieved. The reality is that the most effective measures will highly depend on context: the type of harassment, space, and time (Ceccato and Paz, 2017; Gekoski et al., 2015). Some strategies, however, need to be more consistent between women's needs and measures applied by transit agencies (Loukaitou-Sideris and Fink, 2009). For example, some cities in India and Mexico City have been experimenting with segregation (Dunckel-Graglia, 2013), a controversial measure, since women-only coaches on trains or buses tend to be less frequent and may reinforce negative gender norms (Dunckel Graglia, 2016). Evidence from India suggests that raising awareness among other users or confronting perpetrators may help (Lea et al., 2017).

Broader contexts and cultural factors must also be considered. Lucas (2011) points out in her study of the Tshwane Region of South Africa, asking how the concept of social exclusion might change in the Global South, where most of the population experiences transport and income poverty. When framed this way, the critical issue ceases to be a “deficit” in supply and becomes a systemic failure in the way transport planning addresses social barriers to access. This conclusion is important because this framing reveals low-cost, manageable, small-scale national and local policy interventions that could effectively address these challenges.

Cultural factors need to be addressed, which are highly embodied in our society. Discussions concerning road violence often mirror patterns observed in gender-related discussions. Cyclists are frequently blamed for not wearing helmets when involved in accidents. However, it's crucial to recognize that at speeds of 50 mph, 75% of individuals are unlikely to survive (NACTO, n.d.). In such cases, even protective gear cannot prevent severe, often fatal, injuries caused by a collision with a vehicle. Similarly, in cases of sexual assault against women, blame is usually placed on the victims themselves rather than those responsible, citing their choice of clothing or presence in the wrong place at the

wrong time. To move ahead on these issues, we must move beyond framing these issues in terms of women's fear and perceptions of insecurity and look more deeply into who and how both decision-makers and perpetrators reinforce violence and exclusion throughout transport systems to identify solutions that are both profoundly social and technically creative.

5.3. Lessons for transport and spatial justice

In his discussion of Lefebvre's right to the city, Soja (2010) calls for thinking more deeply about the “(social) spatiality of human life”. We should think about how space is connected to our lives: the places we live in (like our homes and neighborhoods), the time we spend there (our personal history), and our physical bodies. Thus, our relationship with the spaces we inhabit is more than just physical; it's also about our personal experiences and how we connect with the places around us. The way transportation plays out in both embodied (walking, cycling) and spatial (segregation, gender violence) dimensions suggests a crucial intersection for (re-) considering transport and spatial injustice as vital, dynamic, and pervasive phenomena. This perspective goes beyond quantitative measures for accessibility and distributive justice approaches, recognizing that how we build our social imaginary must also become an integral part of any effort to improve transport justice (Sagaris et al., 2020).

Moreover, our findings indicate that women's sexual harassment experiences differ from men's, which increases their fear of crime and reflects a level of social control that undermines efforts to guarantee their equality. While our approach and current transport justice and equity formulations focus mainly on the *physical areas* where women experience fear, these ignore the important symbolic connotations of space (p. 417, Pain, 1991) and the ongoing threat experienced by women who transgress social norms regarding how they should dress, where they should travel, and by which modes. Violence is often framed as “punishment” for girls or women who “should not have been there” or “should not be doing that” (using public transport, riding a bike). In Latin America, it is legitimized by social norms, although these are increasingly challenged, both socially and in new laws enacting strict punishment for domestic violence and femicide. As discussed in previous subsections, these elements are essential to move toward more effective solutions.

While design, infrastructure, and service provision are highly relevant to transport justice in theory and practice, these factors are insufficient to overcome the social exclusion generated by gender- or mode-based violence, particularly as they intersect. Pain (2016) notes the importance of understanding women's fear “as a spatial phenomenon”, requiring a realistic assessment to develop adequate theories. Based on our research, we find it helpful to expand current formulations of transport justice by moving beyond women's fear to consider male and vehicular violence that aims to maintain the subordination of women or other social groups. The risk of violence has been used to limit the participation of different socially excluded groups (Wilkerson, 2020), and even when transport services and infrastructure exist, women in Delhi, Mexico City, Santiago, and many other cities remain hesitant to use them for solid reasons.

Our results call for reconsidering critical theoretical gaps, particularly the social worlds that constitute mobile spaces, as they vary not only by location but by the social imaginaries and invisible rules of behavior controlling movement and excluding specific categories of people, in our case, by gender, age, and income. These elements should be part of future research efforts of our own team and beyond. Moreover, Sheller's notion of mobility justice broadens our understanding of movement dynamics, linking them with questions of power and inequality (Cook and Butz, 2019). Social and technical systems intersect and tend to constitute each other, particularly in the field of transport and mobilities. Reinforcing theories of spatial and transport justice requires that we think more deeply about gender and different types of

violence as they enforce — or reflect resistance to — unjust power structures and systems of decision-making.

6. Conclusions

As stated early in this paper, our work makes four primary contributions. Firstly, our analytical approach used multiple disaggregated and aggregated models to comprehensively comprehend the factors influencing each instance of harassment across different public transport modes and trip segments. This survey design and posterior analysis enable us to identify the spaces and individual characteristics most susceptible to harassment, both in terms of frequency and severity. Secondly, and connected to the first contribution, our work enriches the existing body of evidence in the Global South and Latin America, focusing on Santiago, Chile, where these issues have garnered attention in discussions but have lacked robust supporting evidence. Our study yields findings that align with those from other contexts, as well as novel insights that contribute nuanced perspectives. These results serve for policymakers to focus their attention on specific trip segments and modes, specifically when it refers to severe forms of harassment, such as public masturbation or sexual abuse.

Thirdly, a pivotal strength of our study lies in the methodology we employed for data collection. Our data collection process adopts a nuanced approach, accommodating a broad spectrum of urban and transport environments to ensure diversity is adequately represented. This approach, readily adaptable to other contexts, is facilitated by abundant open data on the built environment, quality of urban spaces, and GTFS data, allowing for exploring frequencies in different locations. Nonetheless, it's essential to acknowledge the challenges posed by survey collection in more hazardous areas and the logistical complexities associated with deploying multiple surveyors and conducting extended surveys that require additional time to accompany individuals on public transport vehicles. These elements might be costly for researchers but worth it if more disaggregated and representative results are needed.

Fourthly, we delve into the implications of our findings from the vantage point of transport and spatial justice (Martens, 2020; Soja, 2010), areas in which gender and violence are frequently underexplored. In both our literature review and section 5.3, we critically challenge the theoretical and practical aspects of spatial and transport justice conceptualizations, providing some key directions for further exploration. An exclusive focus on the design and operation of public transport systems might offer a partial picture, which falls short in capturing the intersection of social and technical systems through social imaginaries, gender and mode violence, and power structures.

From our study limitations, several promising avenues for future research emerge. Our survey did not directly link harassment situations with behavior and mode change. Delving deeper into exploring the short-term and long-term impacts of harassment on activity participation and travel behavior changes seems relevant, especially after initial results from Allen et al. (2019) in Latin American cities. This could be addressed through more comprehensive surveys combining traditional travel diaries with travel decisions, behavior changes, and reasons behind over time.

Similarly, our survey only captured the harassment situations in

space and their frequency but did not capture cultural factors often embedded in society. There's an opportunity to expand the scope of questions to explore social imaginary that usually remains invisible in sexual harassment research in transportation. Uncovering latent variables could prove invaluable, deploying more complex approaches such as structural equation modeling.

Finally, even when our survey included other non-binary gender alternatives, we could not capture the experiences and behavior of these groups. The evolving understanding of how gender violence influences the mobility of a broader spectrum of gender identities, including transgender, gender non-conforming, and LGBTIQ+ communities, presents an emerging study area. This exploration could shed light on current challenges and potential solutions (see, for example, Lubitow et al., 2020; del Mar Rodas-Zuleta et al., 2022). Finding out more requires using qualitative and quantitative methods directly with a specific audience.

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

During the preparation of this work the author(s) used ChatGPT and Grammarly exclusively for copyediting reasons, aiming to improve grammar, readability, and correct typos. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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CRediT authorship contribution statement

Ignacio Tiznado-Aitken: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Thomas E. Guerrero B.:** Data curation, Formal analysis, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Lake Sagaris:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

None.

Data availability

The data that has been used is confidential.

Appendix A

Table A1 shows the ten remaining logistic regression models used to complete all models, considering five different types of harassment and the three possible trip stages where it occurred (access/egress, traveling by bus, and traveling by metro)

Table A1

OR values for the Logistic Regression models.

Variables	Being groped or pressed up in a sexual way		Being photographed		Public masturbation	Being chased or stalked		Sexual abuse or rape	
	Bus	Metro	Access/Egress	Bus	Access/Egress	Access/Egress	Metro	Bus	Metro
$\beta_{\text{intercept}}$	0.26 ***	0.21 ***	0.03 ***	0.02 ***	0.11 ***	0.36 ***	0.03 ***	0.05 ***	0.07 ***
β_{gender} (male)	0.28 ***	0.22 ***			0.05 ***	0.33 ***	0.41 **	0.29 ***	0.28 **
β_{age1} (18–25 years)	1.95 ***	2.03 ***				1.56 **			
β_{age2} (26–40 years)	1.96 ***							2.77 ***	
β_{age3} (41–60 years)						0.55 ***			
β_{est2} (Elementary school)			0.14 **						
β_{ocup1} (Head of household)					0.15 ***				
β_{ocup2} (Independent employed)			2.23 **	1.99 *					
β_{ocup4} (Occasional employed)				33.73 **					
β_{purp1} (Work)				3.39 **	0.12 ***		2.22 *		
β_{purp2} (Study)					0.18 **				
β_{purp3} (Shopping)				7.1 **			6.13 **		
β_{frec2} (1–2 days/week)					0.34 *				
β_{frec3} (3–5 days/week)		1.98 ***	1.92 **			1.6 ***	1.86 *		
β_{inc1} (< 450,000 CLP)		1.92 **	2.76 ***		4.06 *	1.3	3.56 ***		2.18 *
β_{inc2} (450,000–900,000 CLP)					2.97	1.64 **	2.41 *		
β_{inc3} (900,000–1,800,000 CLP)					6.4 **				
β_{inc5} (> 4,500,000 CLP)				0.21					
$\beta_{\text{macrozone1}}$ (Centre)									2.41
$\beta_{\text{macrozone2}}$ (North)					5.24 ***				
$\beta_{\text{macrozone3}}$ (East)	0.46 **		0.36 *			0.38 ***			
$\beta_{\text{macrozone5}}$ (South)		1.77 **							
$\beta_{\text{macrozone6}}$ (South-East)								1.76	
$\beta_{\text{macrozone7}}$ (External)									
Sample size	754	382	756	754	756	756	382	754	382
AIC	660.45	366.14	321.52	268.63	205.26	764.74	247.99	292.81	158.48

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

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