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Exploring the Resilience of Public Transport Trips in the Face of Urban Violence from a Gender Perspective

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Abstract: Public transport systems that ensure safe and efficient mobility are essential to promote sustainability in cities. However, public transport is susceptible to violence. Additionally, men and women have distinct perceptions of security, which can lead to different reactions in the face of danger. Therefore, considering this situation from a gender perspective, the goal of this study is to assess the levels of resilience in trips made by public transport users when exposed to violence. Data were collected from 763 individuals (women: 60.8%; men: 39.2%) within the academic community of a university campus in Rio de Janeiro, Brazil, through an online questionnaire. The information obtained included the participants' socioeconomic details, security perceptions, and changes in travel patterns due to security concerns. The results of the Cronbach's alpha test (0.842) indicated a good internal consistency within the data. Chi-squared tests of independence were applied, and calculations for effect size measures were conducted to evaluate the possible association between gender and other variables. Regarding the level of resilience of the trips made, evidence was found that the perception of safety and the behavior of public transport users are influenced by their gender. Regarding the gender of the respondents, an association was found with the resilience levels of trips. Furthermore, it was found that women are more vulnerable to violence in public transport than men, with risks of feeling unsafe during walks to or from stations and on buses being 1.1 and 1.5 times higher, respectively. Additionally, it was observed that the behavior of public transport users is significantly influenced by past victimization experiences, prompting measures for greater protection to be sought. The results of this study allow for a better understanding of how men and women feel exposed to violence when using public transport and can contribute to the creation of public policies to promote safety. Additionally, they can assist security authorities in directing and concentrating police efforts more effectively.

Keywords: transport system; Brazil; resilience; violence; gender-based violence

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1. Introduction

In 2015, the United Nations established its 2030 Agenda, which comprises 17 Sustainable Development Goals. The agenda emerged as a global appeal for a fairer world, environmental protection, and the assurance of resources for future generations. The Sustainable Development Goal 11 (SDG 11) focuses on building sustainable, inclusive, safe, and resilient cities and communities [1]. A guideline of SDG 11 is to provide safe transport systems by expanding public transport, with particular attention to the needs of vulnerable groups of the population, such as women, children, people with disabilities, and the elderly [1].

A sustainable city must address people's daily mobility needs through a safe environment and an efficient public transport system [2]. However, representative segments of the population, managers, and urban planners remain concerned about public safety [3], especially in Latin American countries [4]. Research has identified various factors influencing the fear of crime in public spaces. Nevertheless, despite the growing interest in the literature on the perception of safety and its relationship with transport usage [5,6], and the alignment of this theme with the UN's 2030 Agenda Convention, little attention has been paid to the gender perspective [7]. Concerns about safety play a pivotal role in shaping women's mobility. Among various safety considerations, including the risk of physical harm or theft, safeguarding against gender-based violence emerges as a crucial determinant. This factor significantly influences women's decisions to either refrain from fully realizing their mobility potential or to adapt it within the framework of prevailing social conditions and internalized norms [8]. In the pursuit of a better understanding of this social issue, a study conducted in Brazil in 2019 indicated that 71% of women know at least another woman who has experienced harassment in public spaces, and 97% claim to have been victims of harassment in transportation [9]. However, in Rio de Janeiro, which is the focus of this study, there is little representative data pointing to the interrelation of public security, urban mobility, and gender [10].

Violence is a complex and multi-causal phenomenon [11], and the perception of safety is a subjective measure, influenced by direct and indirect experiences of violence [12]. Despite its relevance in urban planning, it is rarely incorporated into policy development [4]. Research aimed at enhancing the resilience of transport systems has been prompted by the need for a more robust and reliable transport infrastructure. An in-depth understanding of the relationships that generate vulnerabilities can contribute to reducing the consequences of potential shocks and disruptions [13]. Understanding the needs and perceptions of the population helps to create an inclusive transport policy at all levels of government [14]. Furthermore, studies on transport justice in a broader context, and particularly the research focused on gendered mobilities, need to transition toward a more comprehensive understanding of the range of gendered experiences that influence both mobility and accessibility [15].

A campus of the Federal University of Rio de Janeiro (UFRJ), which was the first official higher education institution established in Brazil, is located in the Cidade Universitária neighborhood in Rio de Janeiro. This campus houses the majority of the university's administrative and academic units, which provide services to 30,000 students [16]. According to the UFRJ master plan, 65.14% of the academic community uses buses for commuting to and from campus. A study carried out in 2022 by the National Transport Confederation [17], in Brazil, pointed out that the effects of social distancing measures motivated by the COVID-19 pandemic, associated with economic issues, contributed to the fact that 28.7% of pre-pandemic users did not return to public transport. From 2020 onwards, along with the drop in demand seen in public transport systems in Rio de Janeiro, criminal incidents also suffered a significant reduction. However, according to the Public Security Institute of Rio de Janeiro, in 2019, during the period before the pandemic and restriction measures, and only on buses operating in the city, 23,278 criminal incidents were recorded. In this recorded criminal pattern by law enforcement authorities, there is a significant gender disparity, as 67% of the victims were women and 33% were men. Whereas women's fear of crime in public spaces has been widely studied, safety in public transport has received little statistical attention [18].

This study examines the resilience of trips made by members of the academic community to and from a university campus from a gender perspective, considering the different perceptions of exposure to violence when using public transport. The concept of resilience is employed to explore the hypothesis that men and women take distinct actions in relation to public transport use, influenced by their perceptions of exposure to violence and crime. Consequently, the resilience levels of their trips, considering public safety conditions, also differ. Based on data collected through a questionnaire, descriptive and quantitative

analyses are conducted. The Cronbach's alpha test is also conducted to assess the validity of the survey. It provides a confidence interval for the reliability of indicators based on their internal correlation [19]. The chi-squared test of independence (χ^2) is applied to examine the potential associations between the selected variables. The relative risk and odds ratio are also calculated to understand the magnitude of any differences found in safety perceptions, the attributes that promote safety at different stages of trips, and actions adopted by men and women on public transport.

This research contributes to identifying key actions and strategies adopted by public transport users to protect themselves when exposed to urban violence or, at least, to mitigate the risk of victimization during their journeys. It also allows for distinguishing, according to users' perspectives, which attributes are considered crucial in making public transport safer against violence. Furthermore, the proposed approach can be replicated in other regions.

2. Bibliographic Review

Mobility significantly influences individuals' quality of life by shaping access to various places and opportunities [20]. Transport systems and their quality influence each individual's choices and the way they organize numerous activities, such as work, leisure, social events, shopping, education, and health [21]. Policies and practices that promote sustainable mobility are priorities for the future transformation of urban areas [22]. One of the challenges currently faced by developing countries is encouraging their citizens to opt for sustainable modes of transport in their regular journeys [23]. Many cities around the world have striven to meet urban sustainability standards through investments and improvements in public transport [24]. By connecting people to activities such as work, healthcare, leisure, and shopping, public transport plays a crucial role also in reducing social exclusion [25].

Transportation policies play a crucial role in shaping the distribution of resources within urban areas. Consequently, it is pertinent to examine the effects of transit interventions, particularly in developing nations [26]. Related research on the reliability and accessibility of public transport networks indicates that fear of crime and criteria related to personal safety are significantly inhibiting factors in the use of the system [27]. Among different sustainability criteria, security is known as one of the main components of a sustainability framework [28]. Therefore, despite the environmental and social benefits resulting from an efficient public transport network, a significant barrier to its use and the achievement of more sustainable cities is crime [29]. This happens because the feeling of insecurity not only determines the level of use of public transport [30], but it also serves as sufficient motivation for people to avoid making trips [31], especially women [32].

The occurrence of crime events has been shown not to be random [33] and most crimes occur in accessible locations that are easy to move through and provide opportunities for escaping [34], such as public transport systems. The routine activities theory (Cohen and Felson, 1979) emphasizes how the juxtaposition of offenders, suitable targets, and lack of guardianship are likely to result in the occurrence of a crime event [35]. The transportation networks and land use patterns of the urban context determine the opportunity structure of places by directing offenders, targets, and guardians to specific locations at particular times [36]. When addressing violence in public bus transport, the issue of crime corresponds to the realm of public security, alongside other problems, like theft, harassment, and social and political violence [37]. The crime pattern theory proposed by Brantingham and Brantingham [38] suggests that criminal activities will cluster around nodes (the locations from and to which individuals travel), along routes (the routes individuals take to reach several nodes), and at the boundaries of both nodes and routes (edges). Therefore, the exposure to violence to which public transport users are subjected should be considered not only inside the vehicles but also during the journeys made on foot to or from the stations, and even when users are waiting for the vehicles to arrive at the stations [25].

The association between violence and public transport and changes in individual behavior has been explored in various global contexts. In the Czech Republic and Slovakia, Kubalova and Loveček [39] delved into this topic by conducting 200 opinion surveys at railway stations in the cities of Prague, Žilina, Čadca, and Zlín. Their study focused on the concept of Crime Prevention Through Environmental Design (CPTED), aiming to understand its real impact in terms of crime prevention, as perceived by users of the railway system.

In a New York City exploratory study involving 140 female university students and exploring their potential experiences of sexual victimization during their commutes to university, Natarajan et al. [40] identified different patterns of exposure to violence through a comprehensive analysis of their journeys. The study, which examined the perception of safety during walks to public transport stations, while waiting for vehicles at the stations, and inside the vehicles, revealed a non-uniform experience and distinct victimization patterns at different stages of the journeys. Yavuz and Welch [7], using data from a Satisfaction Survey conducted in 2003 by the Chicago Transit Authority Customer, sought to understand whether the perception of safety and other attributes associated with crime in the local railway system affected men and women differently. As a result, the authors found that the experience of security-related issues significantly impacts women more than men.

By administering a questionnaire to individuals at five local health centers in the Kathmandu Valley, Nepal, and employing multivariate logistic regression models, Gautam et al. [41] found that sexual harassment on public transport is significantly higher among female students who live alone and travel more frequently at night. Busco et al. [42], using qualitative and quantitative approaches, evaluated gender differences in the perception of safety on public transport in the city of Santiago, Chile. In general, it was observed that the perception of insecurity on buses and subways and while waiting for vehicles at public transport stations during the night is higher among women, the elderly, and national citizens.

In Spain, based on a case study conducted with students from the University of Granada, Lizárraga et al. [43] identified that the most relevant factors in terms of choosing walking as a mode of transport are location, perception of safety, and gender. In Brazil, using the results of an online survey and decision tree algorithms, Capasso da Silva and Rodrigues da Silva [4] identified how violence-related factors influence modal choice for trips to a university campus and the impact of these aspects on the users of sustainable modes of transport. They found that women felt less secure compared to men and that crimes are more frequent at night and on weekdays for both genders.

The factors contributing to an elevated perception of risk in public transport are similar to those associated with fear outside the system [44]. The dynamics of vulnerability are influenced by attributes such as ethnicity, age, usage level, and gender [7]. As sustainability becomes a standard practice in planning transport systems and mobility services, the identification and management of gender-related issues are crucial [19]. Traveling has been shown to have negative consequences, like violence on travelers, particularly for women and girls [45]. Unable to choose safe transport modes, women attempted to mitigate risks by changing their travel patterns and behavior and by restricting their travel frequency [46].

Beyond sociodemographic characteristics, the perception of insecurity and fear of crime in public transport is contingent upon users' past experiences [21]. In the literature addressing violence and public transport from a gender-focused perspective, the most extensively studied countries are those in the global south, including India [47], Mexico [48], Brazil [49], Argentina [50], and Colombia [27]. These studies consistently find that the most vulnerable users to violence and those most susceptible to criminal incidents in public transport are females and residents of peripheral areas characterized by higher levels of socioeconomic inequality.

The research has shown that women tend to experience more fear of crime than men [6] and exhibit a greater sensitivity to risk in their environments due to their increased physical

and social vulnerability [51]. Overall, women from diverse age groups and backgrounds exhibit heightened concerns regarding safety and personal security, driven by elevated levels of violence experienced as passengers within the transport system. These concerns influence their choice of transport mode [21]. In fact, women report levels of fear of crime that are two to three times higher than men's [52]. Furthermore, women's susceptibility to sexual assault and frequent experiences of various forms of harassment make them feel more vulnerable and, consequently, perceive risk more frequently than men [53]. As a result, they often employ strategies to assess and avoid potential threats [6,54]. Sexual harassment and various forms of sexual violence hinder women's capacity to engage freely in the educational, professional, and public spheres on a global scale [55]. In the university context and considering access by public transport, the situation is no different. The sexual victimization of female students during their commute to the university is a serious and quite common issue [40].

Several examples of violent incidents worldwide highlight the urgent need to continuously address issues related to the safety of people in shared spaces, with a particular focus on protecting the most vulnerable to violence, such as women [39]. The ability of governments to manage internal tensions and dynamics is commonly considered of great importance for city resilience [56].

Resilience is considered as the ability of a system to deal with, recover from, and absorb the impacts of threats, based on its capacity to persist, adapt, and transform [57]. Based on the literature on this topic and within the context of urban mobility [58,59], persistence is considered as the ability of an individual or group to maintain their mobility patterns without compromising their quality of life. Adaptability is associated to the potential to adopt different alternatives to usual mobility patterns, also without compromising the quality of life, carrying out daily activities in crisis situations through opportunity, creativity, or extra effort. Lastly, transformability focuses on the potential to create mobility patterns with an impact on the quality of life and socioeconomic aspects [20]. When establishing strategies for classifying resilient trips, the research has included the "exceptional" category [60,61]. An exceptional trip occurs in certain situations where, even if users do not want to use any mode of transport or route, they are forced to do so because they have no other option for their travels [62]. In this study, exceptional trips are those made by public transport users who, regardless of their perception of exposure to violence and crime, do not change their route or mode of transport due to a lack of alternatives. Trips classified as exceptional are undertaken by users more vulnerable, which undermines mobility, a fundamental right of any citizen [37,60,63].

In recent years, the awareness about conditions affecting safety in public transport has increased [44]. However, the literature still lacks an analysis of the resilience of this system in the face of the threat of urban violence, especially with a focus on gender disparities. Additionally, personal safety is an aspect that must be considered in transport planning [64]. Investigating significant disparities in the travel behavior of male and female users of public transport when exposed to violence can support the development of public policies aimed at reducing the exposure to risk. Therefore, the aim of this study is to classify trips made by public transport within the different levels of resilience as presented in the literature in the context of a Brazilian university campus. It also seeks to understand if there are significant disparities in user behavior when exposed to violence, considering their gender. This differentiation, if clear, can support the development of public policies aimed at reducing exposure to violence, as personal safety is an aspect that should be considered in transport planning [65]. With this in mind, the phenomenon of violence in public transport is analyzed, and through the classification of the resilience of journeys made by an academic community, the relationship between changes in travel patterns and the gender of the users is assessed.

3. Materials and Methods

In this section, the proposed approach for analyzing the perception of exposure to violence in transit (from a gender perspective) and assessing the resilience of bus trips in the face of public security vulnerability is presented. Initially, a description of the general procedure adopted is provided, outlining the essential steps involved in this process. Subsequently, the stages of the study, including characterization, data collection (design and application of a questionnaire), employed analyses, classification of trips according to resilience levels, and other relevant procedures, are described.

3.1. General Procedure for Determining the Resilience Levels of Trips

The adopted procedure starts with the characterization of the study (steps 1–3). Step 1 involves the selection of the study area and population. Since urban areas are complex systems exposed to various shocks impacting their diverse components [60], in step 2, the system to be examined should be defined. Given that resilience can be understood as the system's capacity to cope with and adapt to different threats, it is also necessary to define which threat will be assessed (step 3). Once the threat is defined, and the ways it interferes with the functioning of the evaluated transport system are assessed, the research moves onto step 4. In this phase, the analysis focuses on evaluating the behavior of different user groups in the face of the threat. In other words, in this step, the aim is to identify any disparities in individual actions during the use of the system when exposed to a similar type of threat. In step 5, it is examined how the behavior of different user groups, driven by the threat to the system's operation, affects their travel patterns. Finally, in the last step (6), the classification of different resilience levels of trips is carried out, along with the evaluation of the possible association between specific individual characteristics and the identified level of resilience.

Figure 1 illustrates the proposed approach considering all the previously described steps. Using this framework, it is possible to replicate the strategy used to analyze other regions with different socioeconomic contexts.

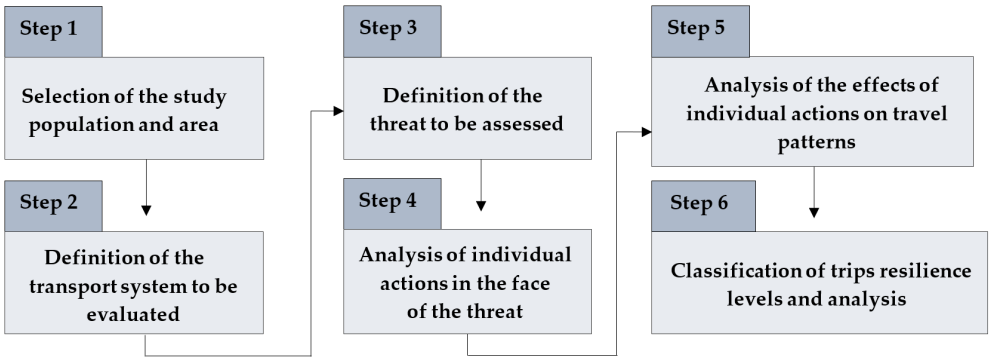

Figure 1. Flowchart showing the steps of the methodology employed.

3.2. Steps 1, 2, and 3—Characterization of the Study

The study area (step 1) was the Cidade Universitária neighborhood, located in the northern zone of Rio de Janeiro city, Brazil, and the study population consisted of the academic community of the Federal University of Rio de Janeiro (UFRJ) situated there. As the second-largest metropolis in Brazil, Rio de Janeiro has a population of just over 6.2 million inhabitants [66] living in 164 neighborhoods. Despite the actions of the security forces, 25.5% of these neighborhoods are controlled by militias, and 34.2% are controlled by drug trafficking [67]. According to the UFRJ master plan, the Cidade Universitária neighborhood, also known as 'Ilha do Fundão', is situated on an island on the western shore of Guanabara Bay, covering a total area of 4,266,095 square meters (Figure 2).

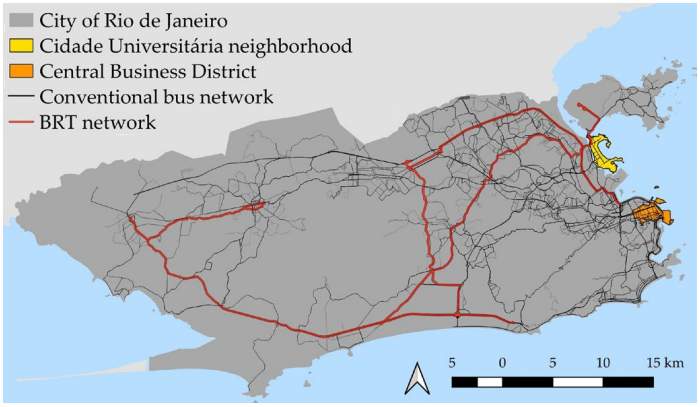

Figure 2. City of Rio de Janeiro, conventional bus and BRT network, and Cidade Universitária neighborhood.

Although the city of Rio de Janeiro has various modes of public transport, including rail and waterborne systems, in Ilha do Fundão, only road-based transport is available. Therefore, the academic community under scrutiny can only commute by bus, whether conventional or BRT (Bus Rapid Transit). Hence, the system under analysis in this study was the bus system (step 2). While certain areas of the city are served by a significant number of public transportation bus lines, there are also regions where this service is less frequent. In many of these regions, bus users find themselves with limited mobility options, both in terms of infrastructure and the operating hours of public transport services. Regarding the assessed threat (step 3), urban violence was considered. The concentration of violence and criminal activities in specific neighborhoods, whether due to organized crime actions or militia activities, exacerbates this situation. In this context, even if users consider altering their travel patterns due to violence, they must endure unfavorable conditions to avoid missing their trips.

Based on data released by the Public Security Institute of Rio de Janeiro, it is possible to verify that, both throughout the city and in the Cidade Universitária neighborhood, over the last 10 years, the number of criminal incidents recorded by public transport users shows a clear differentiation before and after the COVID-19 pandemic. Figure 3 presents the historical series of crime rates involving bus users per 100 thousand inhabitants.

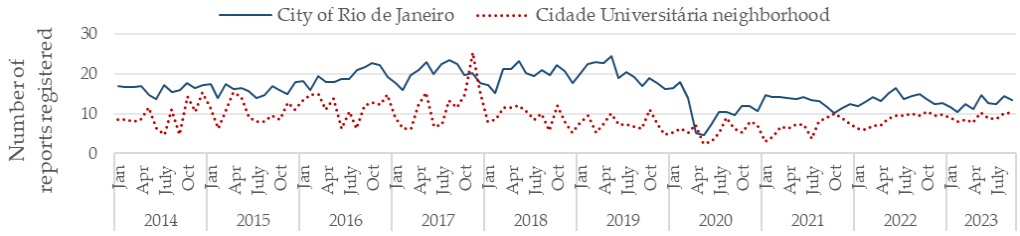

Figure 3. Historical series of criminal incidents recorded on public transport by bus (city of Rio de Janeiro and Cidade Universitária neighborhood).

Despite the drop in violence numbers seen in the first months of 2020, which, as already mentioned, accompanied the drop in demand for the system, due to restriction and isolation measures, it is possible to observe that, in the Cidade Universitária neighborhood, as well as throughout the city, criminal actions are on the rise. This demonstrates the importance of studies of this nature, since the majority of bus users who are part of the academic community under examination continue to use buses, which are the only mode of public transport that allows access to the campus.

3.3. Step 4—Assessment of Bus Users' Behavior in the Face of Urban Violence

A questionnaire was designed to understand the mobility patterns of the participants, as well as their perception of safety regarding the public transport systems they use. The

design process was based on the International Crime Victims Survey (ICVS), an important instrument developed in 1987 by a group of European criminologists to address gaps in crime rates compiled by law enforcement authorities, as highlighted by van Dijk et al. [68]. The questionnaire adhered to the ethical requirements outlined in Resolution 196/96 of the Brazilian National Health Council, which provides guidelines and regulations for research involving human subjects. Additionally, it received approval from the Research Ethics Committee of the Federal University of Rio de Janeiro (approval 5.554.155).

To collect a convenience sample, the questionnaire was administered online during the months of November and December 2022 in collaboration with the Federal University of Rio de Janeiro. The access link was distributed to the academic community through their institutional email. The questionnaire included the following sections:

1. Socioeconomic information: Age, gender, race, education level, household income, and vehicle ownership.
2. Perception of safety in transport modes and at public transport stations: Respondents were required to select a rating from 1 to 5, where 1 indicated "very unsafe" and 5 indicated "very safe."
3. Evaluation of the contribution of certain attributes to the safety of public transport stations: A scale of 1 to 5 was also employed, where 1 represented "not important" (little contribution) and 5 represented "very important" (significant contribution). Attributes such as high foot traffic, short waiting times, adequate lighting, presence of security cameras, presence of security personnel, functioning shops/businesses around the station, and cleanliness and organization of the station were assessed.
4. Revealed data about the trips to and from campus: Origin, destination, time, mode of transport, and travel time.

For public transport users, considering trips to and from campus, the questionnaire also included:

5. Evaluation of the level of service of the public transport system: Availability, frequency, punctuality, reliability, and waiting and travel time.
6. Evaluation of public transport stations and their surroundings: Sense of security, lighting, camera surveillance, cleanliness, policing, and presence of nearby commercial establishments, among other factors.
7. Evaluation of public transport vehicles: Safety, camera surveillance, seat availability, cleanliness, lighting, and policing, among other factors.
8. Changes in travel patterns due to a lack of security: Whether respondents modify their mode of transport, schedule, boarding and alighting locations, or transport of materials/personal things due to a lack of security.
9. Experience with violence in public transport: Questions related to experiences of violence (as a victim or observer), reporting to authorities, and other aspects related to Brazilian Law No. 13718, known as the "Sexual Harassment Law".

After data collection, data cleaning was conducted with the aim of eliminating observations with missing data and inconsistencies. Subsequently, preliminary descriptive analyses were performed to identify the general characteristics of the respondents, potential patterns, and gender disparities in the perceptions of safety and attitudes toward the use of public transport in the face of security concerns.

3.4. Step 5—Influence of Urban Violence on the Travel Patterns of Men and Women

To statistically assess the potential associations among the variables obtained in Step 4, independent chi-squared (χ^2) tests and measures of effect were conducted. The chi-squared test is widely used in the literature of health and social studies [3,69]. One of its main objectives is to verify if there is an association between two categorical variables by comparing the observed frequencies in the sample with the expected frequencies under the hypothesis of independence. Furthermore, to assess the effect of associations, the relative risk and odds ratio were calculated. According to Schmidt and Kohlmann [70], although both denote

effect measures, the odds ratio lacks an intuitive interpretation and is often interpreted as if it was equivalent to relative risks while ignoring its meaning as a ratio of odds. In this study, both measures were presented along with their respective 95% confidence intervals for each association test. Therefore, these tests enabled the examination of the potential association between gender and aspects related to changes in travel patterns and the sense of security in the face of the threat of violence in public transport.

3.5. Step 6—Resilience Level of Trips in the Face of Violence in Public Transport

A strategy was established to classify the resilience level of trips in the face of public transport violence, considering aspects related to individual actions and the influence of the threat on travel patterns. Figure 4 presents a flowchart illustrating the strategy applied in step 6.

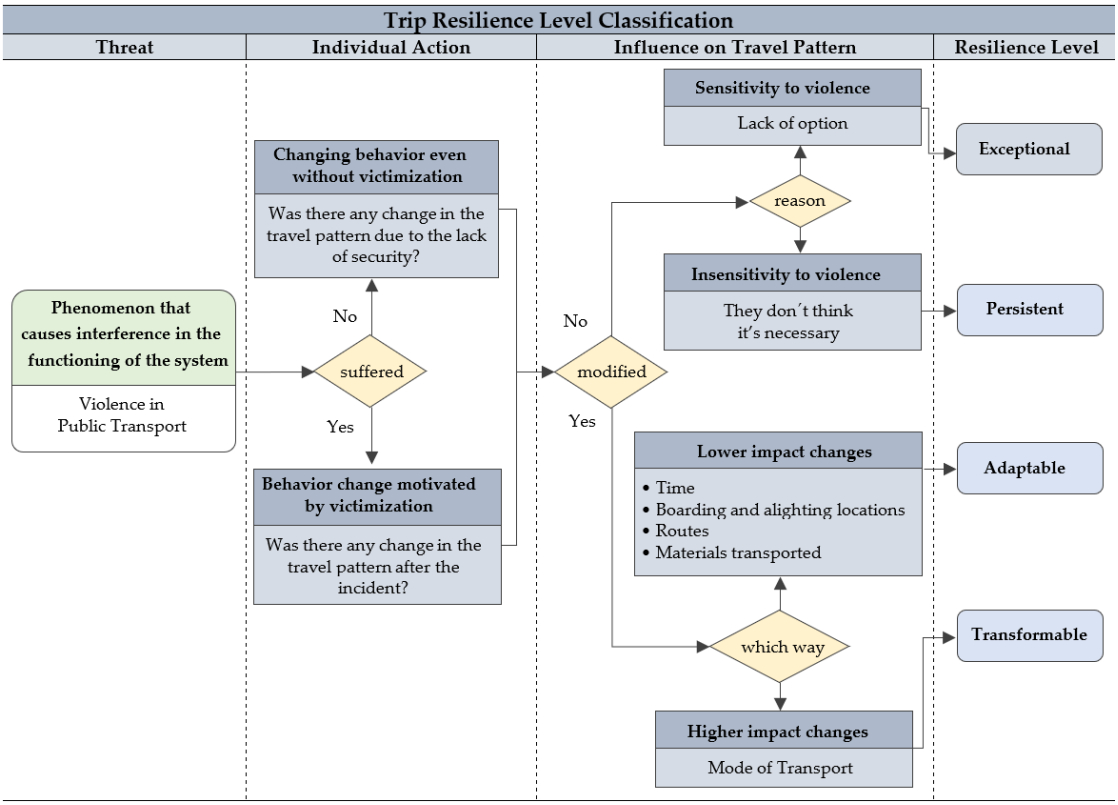

Figure 4. Proposed procedure for classifying the level of resilience of trips.

For users who experienced any type of criminal incident, an assessment was conducted to determine if there were any changes in travel patterns after the incident. In the case of those who did not have this experience, it was evaluated whether users make changes to travel patterns due to a sense of insecurity. For both user groups, when no changes occurred, and the maintenance of patterns was by the choice of the individuals (as alterations were not perceived as necessary), the trips were classified as "Persistent". In cases where this maintenance occurred due to a lack of choice, the trips were considered as "Exceptional". When changes in travel patterns were reported by the respondents, an evaluation was conducted to determine which aspect of the trip was modified. The trips were classified as "Adaptable" when the mode of transport was retained, but there were changes in the schedule, boarding or alighting locations, routes, or changes in the transport of materials/personal items. Finally, the trips were considered as "Transformable" when the mode of transport was changed. The sum of Persistent, Exceptional, Adaptable, and Transformative trips corresponds to the total number of evaluated trips. After the classifica-

tion of trips, chi-squared tests were also conducted to assess the association between the resilience categories and other variables.

Figure 5 presents a scheme that summarizes the procedure adopted in the present study. In other words, it shows the implementation of the steps described in Figure 4, considering the context, population, transport system, and threat chosen to conduct the study.

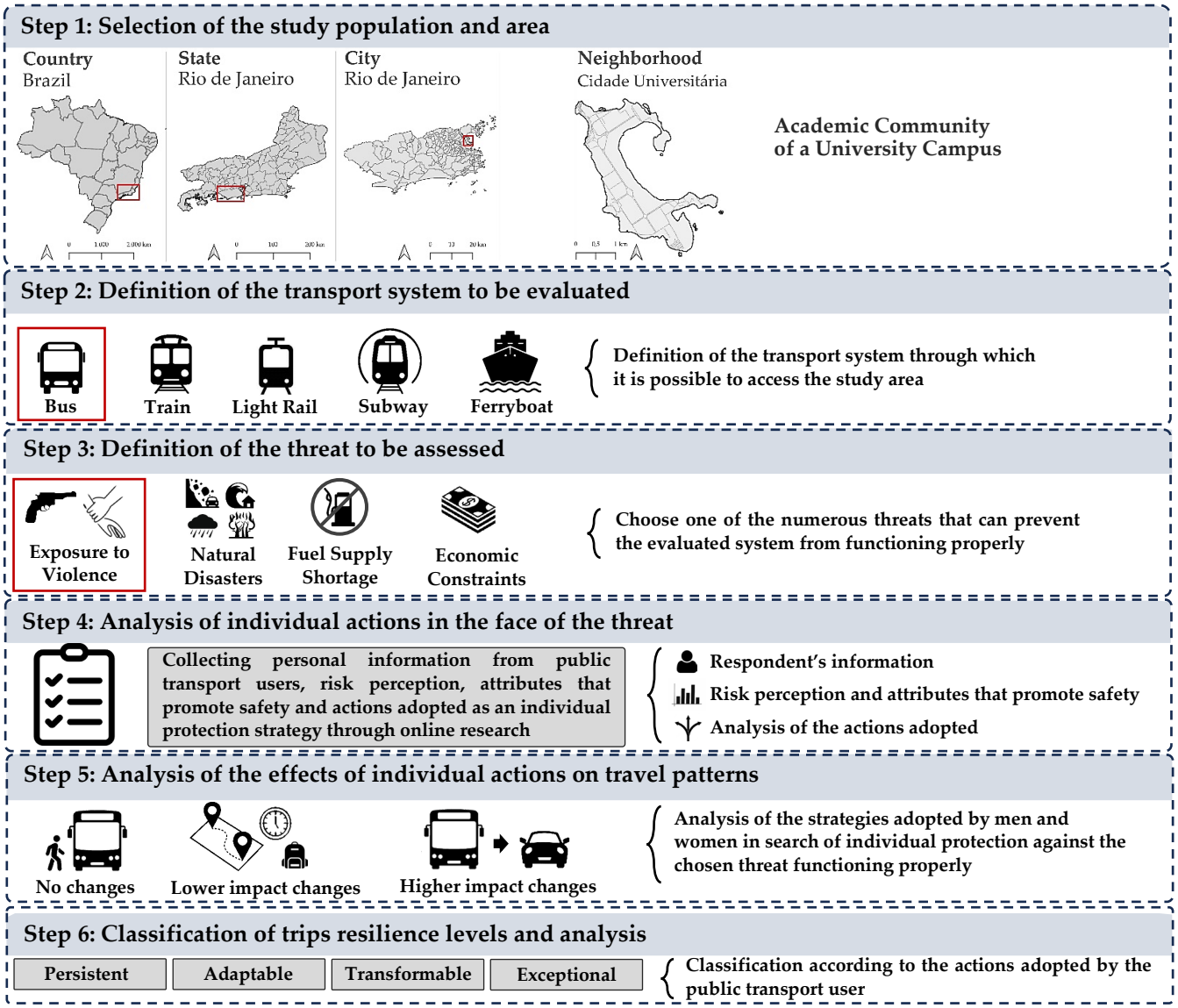

Figure 5. Flowchart showing the steps of the methodology employed in the area and with the selected population. The red boxes in steps 1, 2, and 3 indicate, respectively, the population and area, public transport system, and threat assessed in the study.

4. Results and Discussion

4.1. Collected Data and Evaluation of Bus Users' Behavior in the Face of Urban Violence

Information was collected from 978 respondents, and observations with missing data, inconsistencies, and data from users residing outside the city of Rio de Janeiro were discarded. The final database consisted of 763 valid responses, representing approximately 2.5% of the entire academic community on campus. In the Cronbach's alpha test, a coefficient of 0.842 was obtained, indicating a good internal consistency in the collected data. Among the respondents, 60.8% were women, 41.5% experienced sexual harassment in public transport, and 31.5% experienced some other type of violence.

Analyzing these same exposure characteristics to violence according to the gender of the respondents, it was found that significantly more incidents were reported by women compared to men. Figure 6 shows that, while 26.4% of male respondents reported some sexual harassment in public transport, 51.3% of women mentioned experiencing this type of violence. In the case of other crimes, women also reported experiencing more compared to men (34.1% and 27.4%, respectively).

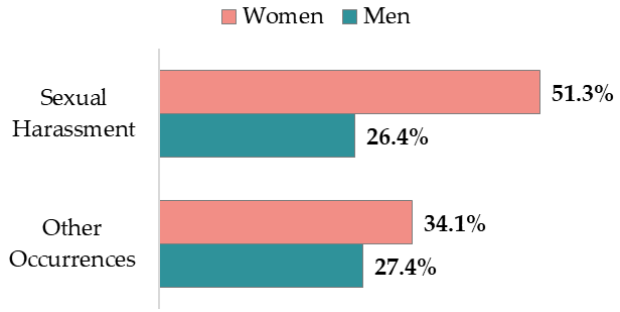

Figure 6. Violence reported by public transport users.

Table 1 presents the results obtained from the chi-squared test, examining the association between violence of a sexual nature or not during trips made by public transport and the users' gender. The results indicate a dependent relationship between sexual harassment and the gender of the users. Furthermore, the adjusted Pearson's standardized residuals indicated that the observed values deviated significantly from the expected values (at a 95% confidence level), contributing to a high final chi-squared (χ^2) value. Although a higher proportion of women (34.1%) was found to have experienced other types of violence compared to men (27.4%), no significant association was found between gender and other occurrences.

Table 1. Chi-squared test between violence and gender.

Violence	Female	Male	χ^2	*p*-Value
Sexual Harassment				
Victimized	238 (192.8) **[6.80]**	79 (124.2) **[−6.80]**	45.297	0.000 *
Not Victimized	226 (271.2) **[−6.80]**	220 (174.8) **[6.80]**		
Other Occurrences				
Victimized	158 (145.9) **[1.92]**	82 (94.0) **[−1.92]**	3.402	0.065
Not Victimized	306 (318.0) **[−1.92]**	217 (204.9) **[1.92]**		

Note: Observed frequencies—outside parentheses and brackets; Expected frequencies—within parentheses; Standardized adjusted residuals—within bold brackets; *—significant at a 95% level of confidence; χ^2—chi-squared test results.

The relative risk and odds ratio were also calculated considering the victimization of women compared to men on public transport (Table 2). When the 95% confidence interval includes a value of 1.0, it indicates no significant relationship between the risk and the outcome. In such cases, there is insufficient evidence to conclude that the true relative risk and odds ratio of the population are greater than 1.0. Despite the statistically significant value in the relative risk of experiencing criminal incidents other than sexual violence on public transport and the gender of users, an examination of the confidence interval in the odds ratio prevents the conclusive establishment of any relationship between these variables. However, it was found that women have a 1.9 times higher risk of experiencing sexual violence in public transport compared to men. Regarding the odds ratio, the results indicate that the odds of experiencing sexual harassment are 2.9 times higher for women than for men. These results suggest a greater vulnerability of women in public transport.

Table 2. Measures of effect of women being victimized compared to men.

Category of Violence	Relative Risk	CI (95%)		Odds Ratio	CI (95%)	
		Lower	Upper		Lower	Upper
Sexual Harassment						
Male	1.000 *	1.575	2.392	1.000 *	2.140	4.019
Female	1.941 *			2.933 *		
Other Occurrences						
Male	1.000 *	1.001	1.264	1.000	0.993	1.8788
Female	1.125 *			1.370		

Note: *—significant at a 95% level of confidence; CI—confidence interval.

Regarding the factors related to public transport travel, high levels of insecurity were observed among the respondents. A total of 61.4% of the interviewees felt partially insecure or completely insecure during the journey to or from public transport stations. While waiting for vehicles at the stations, 37.9% of respondents felt the same way. Inside the vehicles, only 47.1% of respondents claimed to feel partially secure or secure.

4.2. Differences in Security Perceptions between Men and Women

As discussed in the literature review, public transport users are susceptible to experiencing the impacts of violence and crime primarily at three different moments: when walking to or from the stations, while waiting for vehicles at the stations, and during their journeys (inside the vehicles). Table 3 presents the results obtained from the chi-squared test, examining the association between gender and the perception of safety in these three circumstances. The majority of public transport users, whether men or women, feel unsafe during the walks to or from the stations or while waiting for the vehicles to arrive. However, inside the transit vehicles, the sense of security for both genders is higher than in other stages of public transport journeys. The chi-squared test did not reveal a significant association between the sense of security at public transport stations and the gender of the interviewees. Nevertheless, within the subset of respondents who expressed feeling unsafe in this setting, women (40.5%) surpassed men (33.9%) in relation to the total number of participants. Regarding the remaining stages comprising the journey on public transport, associations were found between gender and the perception of safety during walking to stations and on buses.

Table 3. Chi-squared test between safety perceptions and the respondents' gender.

Perception of Safety	Female	Male	χ^2	*p*-Value
Traveling on foot				
Unsafe	300 (283.6) **[2.5]**	167 (183.4) **[−2.5]**		
Neutral	122 (128.2) **[−1.0]**	89 (82.8) **[1.0]**	8.539	0.014 *
Safe	39 (49.2) **[−2.5]**	42 (31.8) **[2.5]**		
Traveling by bus				
Unsafe	107 (92.6) **[2.7]**	45 (59.4) **[−2.7]**		
Neutral	151 (150.5) **[0.1]**	96 (96.5) **[−0.1]**	8.347	0.015 *
Safe	202 (216.9) **[−2.2]**	154 (139.1) **[2.2]**		
At bus stations				
Unsafe	186 (174.1) **[1.8]**	100 (111.9) **[−1.8]**		
Neutral	151 (163.8) **[−2.0]**	118 (105.2) **[2.0]**	4.632	0.099
Safe	122 (121.1) **[0.1]**	77 (77.9) **[−0.1]**		

Note: Observed frequencies—outside parentheses and brackets; Expected frequencies—within parentheses; Standardized adjusted residuals—within bold brackets; *—significant at a 95% level of confidence; χ^2—chi-squared test results.

Corroborating what was described in the literature review, the results show that, when assessing the feeling of insecurity among public transport users, women experience a greater sense of fear. By calculating the relative risk (Table 4), it was found that women

have 1.1 and 1.5 times higher risks of feeling unsafe during their walks to or from stations and inside buses, respectively, compared to men. Regarding the odds ratio (Table 4), the results also demonstrate that the odds of women feeling unsafe while walking to or from stations are approximately 1.9 times higher compared to men. Similarly, the odds of women feeling unsafe inside vehicles are approximately 1.8 times higher compared to men. In both cases, the 95% confidence intervals do not encompass the value 1.0 for either the relative risk or the odds ratio. This enables us to conclude that there is robust statistical evidence of an association between the mentioned variables, suggesting that both the relative risk and the odds ratio are greater than 1.0 within the population.

Table 4. Measures of effect of women feeling insecure compared to men.

Perception of Safety	Relative Risk	CI (95%)		Odds Ratio	CI (95%)	
		Lower	Upper		Lower	Upper
Traveling on foot						
Male	1.000 *	1.024	1.197	1.000 *	1.203	3.111
Female	1.108 *			1.935 *		
Traveling by bus						
Male	1.000 *	1.135	2.065	1.000 *	1.207	2.723
Female	1.531 *			1.813 *		
At bus stations						
Male	1.000	0.913	1.252	1.000	0.807	1.708
Female	1.069			1.174		

Note: *—significant at a 95% level of confidence; CI—confidence interval.

The association between gender and attributes related to public transport stations that could enhance safety against violence, according to users' opinions, was also evaluated. The results indicate that the impacts of these attributes differ for users based on their gender.

Additionally, the proportion of respondents who stated that the evaluated attributes contribute to increased security was higher among women. While no significant associations were identified among adequate lighting, the presence of security agents, and the gender of the users, these attributes were the primary considerations for enhancing public safety (88.7% and 83.3%, respectively). According to public transport users' perspectives, increased security can be achieved not only through the reinforcement of law enforcement, but also through the relatively straightforward implementation of urban planning measures. The results (Table 5) reveal that the observed differences in the impact of the presence of security cameras and functioning shops/businesses between men and women are unlikely to have occurred by chance. In both cases, although the questions were formulated to elicit responses on a 5-point Likert scale, the answers were categorized into three levels. Therefore, the intermediate score (3) corresponds to the neutral category.

Table 5. Chi-squared test between the attributes promoting safety in public transport stations and the respondents' gender.

Attributes	Women	Men	χ^2	*p*-Value
High foot traffic				
It does not contribute	58 (57.7) **[0.1]**	37 (37.3) **[−0.1]**		
Neutral	99 (102.7) **[−0.7]**	70 (66.3) **[0.7]**	1.084	0.781
It contributes	306 (302.6) **[0.5]**	192 (195.4) **[−0.5]**		
Proper lighting				
It does not contribute	24 (23.7) **[0.1]**	15 (15.3) **[−0.1]**		
Neutral	26 (28.6) **[−0.8]**	21 (18.4) **[0.8]**	1.271	0.736
It contributes	413 (410.7) **[0.5]**	263 (265.3) **[−0.5]**		

Table 5. *Cont.*

Attributes	Women	Men	χ^2	*p*-Value
Presence of security cameras				
It does not contribute	43 (51.6) **[−2.0]**	42 (33.4) **[2.0]**		
Neutral	61 (68.6) **[−1.6]**	52 (44.4) **[1.6]**	9.049	0.029 *
It contributes	358 (341.8) **[2.7]**	205 (221.2) **[−2.7]**		
Presence of security personnel				
It does not contribute	35 (20.4) **[−1.0]**	17 (20.4) **[−1.0]**		
Neutral	43 (45.6) **[−0.6]**	32 (29.4) **[0.6]**	1.955	0.582
It contributes	385 (385.8) **[−0.2]**	250 (249.2) **[0.2]**		
Presence of functioning shops/businesses				
It does not contribute	36 (44.3) **[−2.1]**	37 (28.7) **[2.1]**		
Neutral	60 (72.2) **[−2.5]**	59 (46.8) **[2.5]**	13.674	0.003 *
It contributes	366 (345.4) **[3.5]**	203 (223.6) **[−3.5]**		

Note: Observed frequencies—outside parentheses and brackets; Expected frequencies—within parentheses; Standardized adjusted residuals—within bold brackets; *—significant at a 95% level of confidence; χ^2—chi-squared test results.

By calculating the relative risk and the odds ratio (Table 6), it was found that women have an approximately 1.1 times higher risk of feeling safer both with the presence of security cameras and functioning shops/businesses, compared to men. Regarding the odds ratio, the results also demonstrate that the odds of women perceiving the presence of security cameras and of functioning shops/businesses around public transport as factors that promote safety are 1.7 and 1.8 greater than those of men, respectively.

Table 6. Measures of the effect of women considering the attributes presented as promoting safety in comparison to men.

Attributes	Relative Risk	CI (95%)		Odds Ratio	CI (95%)	
		Lower	Upper		Lower	Upper
High foot traffic						
Male	1.000	0.933	1.078	1.000	0.648	1.595
Female	1.003			1.017		
Proper lighting						
Male	1.000	0.964	1.036	1.000	0.506	1.905
Female	0.999			0.981		
Presence of security cameras						
Male	1.000 *	1.007	1.149	1.000 *	1.078	2.698
Female	1.076 *			1.706 *		
Presence of security personnel						
Male	1.000	0.938	1.021	1.000	0.410	1.364
Female	0.979			0.748		
Presence of functioning shops/businesses						
Male	1.000 *	1.012	1.145	1.000 *	1.135	3.024
Female	1.076 *			1.853 *		

Note: *—significant at a 95% level of confidence; CI—confidence interval.

4.3. Resilience Level of Trips in the Face of Public Transport Violence and Associations with Gender

Figure 7 shows the distribution of the total and gender-specific trips according to the resilience level. The majority of trips (66.1%) were classified as Adaptable, signifying a situation in which the mode of transport was retained, but there were changes in the schedule, boarding or alighting locations, routes, or changes in the transport of materials/personal items. The same trend was observed when evaluating men (62.5% Adaptable) and women (68.3% Adaptable) separately.

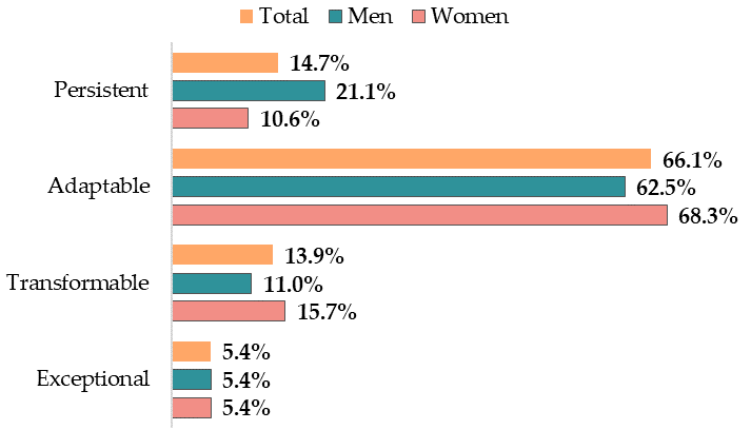

Figure 7. Distribution of the total and gender-specific trips according to the resilience level.

Transformable trips (changing the mode of transport) accounted for 13.9% of the total trips, 11.0% for trips made by men, and 15.7% for trips made by women. When considering trips where patterns were not altered due to violence or a lack of security, only 5.4% of the total cases (also 5.4% for both men and women) were attributed to a lack of choice (Exceptional trips). In 14.7% of the total cases (21.1% for men and 10.6% for women), the users deemed it unnecessary to make changes.

These findings suggest that public transport users found alternatives to feelings of insecurity, most often by adjusting aspects such as schedules, routes, and boarding and alighting locations. Additionally, a greater disparity in the proportion of men and women classified in the Persistent category was observed, indicating a possible association between this category and gender.

As noted in the literature, past negative experiences influence the perception of exposure to violence. Therefore, the distribution of trips into resilience categories was assessed, separating men and women into two groups: those who have been victims of violence and those who have not (Figure 8). A total of 24.7% of non-victimized women had their public transport trips classified at the persistent level, while only 0.4% of those who have experienced some form of violence fell into this category. From the results, it is also noticeable that the prior victimization experience led to a higher number of women with trips classified as Transformable (change in the mode of transport) compared to men.

Table 7 contains the distribution of responses from men and women regarding changes in travel due to violence or the feeling of insecurity. Additionally, the table includes the distribution of responses regarding the found resilience levels and whether the individual has been a victim or not of any type of violence in public transport. From these results, it can be observed that the mode of transport is not changed by most respondents, both men and women. Among them, a significant proportion does not find it necessary to do so, while a minority refrains from altering due to the limited options for exceptional trips. However, when examining other modifications in travel patterns prompted by feelings of insecurity (e.g., changes in schedule, boarding and alighting locations, and routes), most respondents do make adjustments. Consequently, a substantial portion of trips to and from the campus were categorized as Adaptable.

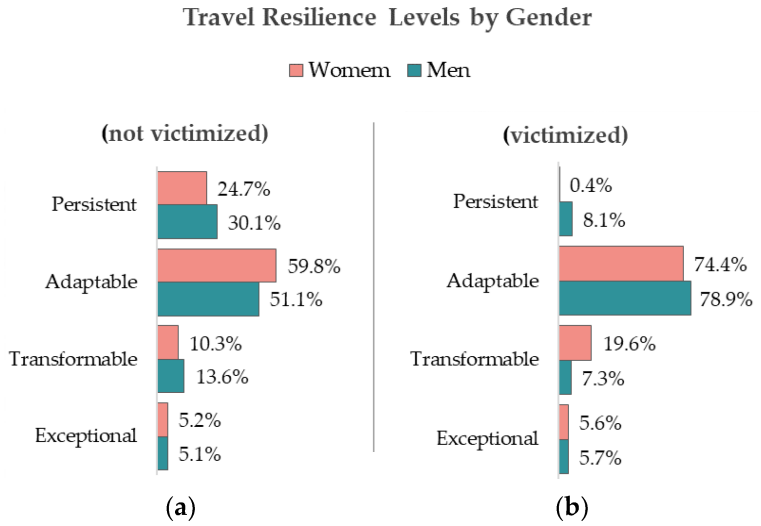

Figure 8. Distribution of gender-specific trips according to the resilience level. (**a**) Public transport users who have not suffered any type of violence on their trips; (**b**) public transport users who have suffered any type of violence on their trips.

Table 7. Travel resilience levels according to the adopted strategies.

		Travel Resilience Levels (RL)											
	Legend:	**Persistent**			**Adaptable**			**Transformable**			**Exceptional**		
		Female (464)						**Male (299)**					
		Non-Victimized			**Victimized**			**Non-Victimized**			**Victimized**		
Changes in Travel Patterns		**n**	**(%)**	**RL**	**n**	**(%)**	**RL**	**n**	**(%)**	**RL**	**n**	**(%)**	**RL**
Did you modify the schedule?	(A)	8	(4.1)		9	(3.3)		6	(3.4)		3	(2.4)	
	(B)	53	(27.3)		7	(2.6)		64	(36.4)		18	(14.6)	
	(C)	133	(68.6)		254	(94.1)		106	(60.2)		102	(82.9)	
Did you change the boarding and alighting locations?	(A)	8	(4.1)		12	(4.4)		5	(2.8)		5	(4.1)	
	(B)	55	(28.4)		21	(7.8)		64	(36.4)		20	(16.3)	
	(C)	131	(67.5)		237	(87.8)		107	(60.8)		98	(79.7)	
Did you modify the route to the public transport station?	(A)	8	(4.1)		12	(4.4)		5	(2.8)		5	(4.1)	
	(B)	51	(26.3)		7	(2.6)		64	(36.4)		15	(12.2)	
	(C)	135	(69.6)		251	(93.0)		107	(60.8)		103	(83.7)	
Did you fail to transport any material on public transport?	(A)	8	(4.1)		9	(3.3)		4	(2.3)		6	(4.9)	
	(B)	54	(27.8)		10	(3.7)		62	(35.2)		19	(15.4)	
	(C)	132	(68.0)		251	(93.0)		110	(62.5)		98	(79.7)	
Did you change the mode of transport?	(A)	10	(5.2)		15	(5.6)		9	(5.1)		7	(5.7)	
	(B)	164	(84.5)		202	(74.8)		143	(81.3)		107	(87.0)	
	(C)	20	(10.3)		53	(19.6)		24	(13.6)		9	(7.3)	

Note: RL—resilience level; (A) No, due to lack of option; (B) No, because I don't think it's necessary; (C) Yes.

Moreover, a higher percentage of women engage in these alterations compared to men, particularly those who have previously experienced violence as victims. In the case of men and women who have never experienced violence, the frequency of trips considered as Persistent is always lower compared to the victimized group. Analyzing public transport users who undertake Transformable trips, this resilience level is more frequent for women who have been victimized than for those who have not. However, in the case of men, the effect was the opposite. Men who have experienced violence in public transport undertake less Transformable trips compared to those who have not experienced violence.

It can also be observed that some aspect of their trip was altered by most respondents due to violence, except for changing the mode of transport, which was deemed unnecessary by most respondents.

The results regarding the chi-squared test of independence are presented in Tables 8 and 9, where the observed values, expected values (in parentheses), and the values of the adjusted Pearson's standardized residuals (in bold brackets) are displayed. In both tables, a statistical significance was found for all considered variables, suggesting an association between them and the resilience levels of the trips. The adjusted Pearson's standardized residuals values greater than 1.96 or lower than −1.96 denoted that the observed values deviated significantly from the expected values (at a 95% confidence level), contributing to a high final chi-squared (χ^2) value.

Table 8. Chi-squared test results among gender, prior victimization, and travel resilience levels.

User Characteristics	Persistent	Adaptable	Transformable	Exceptional	χ^2	*p*-Value
Gender						
Female	49 (68.1) **[−4.00]**	317 (306.5) **[1.64]**	73 (64.5) **[1.83]**	25 (24.9) **[0.02]**	17.488	0.001 *
Male	63 (43.9) **[4.00]**	187 (197.5) **[−1.64]**	33 (41.5) **[−1.83]**	16 (16.1) **[−0.02]**		
Victimized						
No	101 (54.3) **[9.56]**	206 (244.4) **[−5.87]**	44 (51.4) **[−1.55]**	19 (19.9) **[−0.28]**	91.781	0.000 *
Yes	11 (57.7) **[−9.56]**	298 (259.6) **[5.87]**	62 (54.6) **[1.55]**	22 (21.1) **[0.28]**		

Note: Observed frequencies—outside parentheses and brackets; Expected frequencies—within parentheses; Standardized adjusted residuals—within bold brackets; *—significant at a 95% level of confidence; χ^2—chi-squared test results.

Table 9. Chi-squared test between the adopted strategies and travel resilience levels.

User Characteristics	Persistent	Adaptable	Transformable	Exceptional	χ^2	*p*-Value
Do you modify the schedule due to the lack of security?						
No	112 (24.7) **[21.56]**	24 (111.0) **[−16.05]**	6 (23.3) **[−4.38]**	26 (9.0) **[6.58]**	541.5	0.000 *
Yes	0 (87.3) **[−21.56]**	480 (393.0) **[16.05]**	100 (82.6) **[4.38]**	15 (32.0) **[−6.58]**		
Do you change the boarding and alighting locations due to the lack of security?						
No	112 (27.9) **[19.90]**	33 (125.5) **[−16.35]**	15 (26.4) **[−2.76]**	30 (10.2) **[7.35]**	486.2	0.000 *
Yes	0 (84.1) **[−19.90]**	471 (378.5) **[16.35]**	91 (79.6) **[2.76]**	11 (30.8) **[−7.35]**		
Do you modify the route to the public transport station due to the lack of security?						
No	112 (24.5) **[21.64]**	19 (110.3) **[−16.88]**	6 (23.2) **[−4.35]**	30 (9.0) **[8.16]**	575.9	0.000 *
Yes	0 (87.5) **[−21.64]**	485 (393.7) **[16.88]**	100 (82.8) **[4.35]**	11 (32.0) **[−8.16]**		
Do you fail to transport any material on public transport due to the lack of security?						
No	112 (96.4) **[21.24]**	21 (434.0) **[−16.94]**	12 (91.3) **[−2.98]**	27 (35.3) **[6.82]**	534.0	0.000 *
Yes	0 (15.6) **[−21.24]**	483 (70.0) **[16.94]**	94 (14.7) **[2.98]**	14 (5.7) **[−6.82]**		
Do you change the mode of transport due to the lack of security?						
No	112 (25.2) **[4.60]**	504 (113.6) **[15.48]**	0 (23.9) **[−27.62]**	41 (9.24) **[2.64]**	763.0	0.000 *
Yes	0 (86.7) **[−4.60]**	0 (390.4) **[−15.48]**	106 (82.1) **[27.62]**	0 (31.8) **[−2.64]**		

Note: The variables related to changes in the trips were dichotomized into the categories No and Yes. Observed frequencies—outside parentheses and brackets; Expected frequencies—within parentheses; Standardized adjusted residuals—within bold brackets; *—significant at a 95% level of confidence; χ^2—chi-squared test results.

Regarding the gender of the respondents, although an association was found with the resilience levels of trips, an adjusted residual value greater than 1.96 (in absolute value) was observed only for the association with the Persistent resilience level. This indicates that the association found between gender and resilience levels was mainly driven by the relationship with the Persistent category. As for previous victimization, i.e., whether the

user has or has not experienced past violence in public transport, the results demonstrate an association with the Persistent and Adaptive resilience levels. When calculating the relative risk (Table 10), it was found that trips classified as Persistent had a 1.9 times higher risk of being undertaken by men compared to women, and non-victimized people had a 9.2 times higher risk of taking trips in this same category compared to those who have already experienced violence on public transport. Regarding the odds ratio (Table 10), the results also demonstrate that the odds of a man undertaking trips classified as Persistent rather than Adaptive on public transport are approximately 2.2 times higher than those of women. Furthermore, the chances of a non-victimized person making Persistent and not Adaptive trips are 13.3 times higher compared to those who have already suffered some type of violence on their trips using public transport. Therefore, the results indicate a greater vulnerability of women in their trips and that past victimization experiences influence the behavior of public transport users, leading to a tendency to seek protection.

Table 10. Measures of effect of men to undertake Persistent trips compared to women and of non-victimized people compared to those who have already suffered violence.

User Characteristics	Relative Risk	CI (95%)		Odds Ratio	CI (95%)	
		Lower	Upper		Lower	Upper
Gender						
Female	1.000 *	1.344	2.636	1.000 *	1.440	3.300
Male	1.882 *			2.180 *		
Victimized						
Victimized	1.000 *	5.062	16.872	1.000 *	6.954	25.371
Not Victimized	9.242 *			13.282 *		

Note: *—significant at a 95% level of confidence; CI—Confidence Interval.

Table 9 shows the results of the analyses regarding changes in the use of public transport made by users in the face of violence or lack of security. A total of 64.5% of the interviewed users reported adopting some form of change in their travel patterns due to violence. Many respondents, who are predominantly university students, opt to arrive on campus much earlier than necessary. In some cases, they also choose to travel later, sometimes even missing certain classes in their pursuit of greater safety during their commutes. Only 13.9% claimed to change their mode of transportation. Since the only public transport available on campus is the bus, this change in mode was likely directed towards cars, whether private or shared. Additionally, 5.4% of respondents undertake their trips as they wish to do differently but are unable to do so due to the lack of alternatives. In all cases, adjusted Pearson's standardized residual values greater than 1.96 (in absolute value) were observed. These results reveal that the observed differences in the adopted strategies and travel resilience levels are unlikely to have occurred by chance.

5. Conclusions

Research focused on the accessibility promoted by urban transport networks has highlighted the significant impact of fear of violence on people's choices, especially regarding the decision to use or abstain from public transport. A resilient public transport system must be capable of providing mobility, even in situations that may restrict its availability. However, the feeling of insecurity in the areas surrounding stations and within the vehicles can lead users to limit their usage, impairing their mobility. Additionally, among public transport users, women can be more affected by violence compared to men. The criminal data provided by law enforcement agencies, regarding incidents documented on buses in Rio de Janeiro, Brazil, in 2019, along with the data collected and analyzed in this study, collectively affirm that women experience less favorable conditions when traveling on public transport compared to men.

Therefore, a strategy was proposed to assess the resilience level of public transport trips in the face of urban violence. Furthermore, the distinct perspectives of men and women

concerning the perception of safety and their attitudes toward using public transport in this scenario were analyzed. Data related to travel behavior and security perceptions were collected and analyzed from the academic community at a campus of the Federal University of Rio de Janeiro, Brazil. An approach to classify trips to and from the campus into resilience levels (Persistent, Exceptional, Adaptable, and Transformable) was established. Chi-squared tests of independence were conducted to evaluate the potential associations between gender and the resilience levels of trips and other variables related to individuals' security perceptions during different phases of their journeys.

The results demonstrate that the fragility of public security and the perception of exposure to risks influence the behavior of most public transport users. Most respondents, both men and women, did not alter their transport modes, with the predominant reason being a perceived lack of necessity. However, when examining other changes in trip patterns due to feelings of insecurity (e.g., changes in schedules, boarding and alighting locations, and routes), a significant portion of the respondents made modifications. As a result, most trips to and from the campus were classified as Adaptable, indicating a nuanced response to security concerns.

Moreover, this study underscored gender disparities in travel behavior. Women were more inclined to modify their travel patterns, especially those who have suffered violence. Significant associations were found between gender and the perception of safety during journeys, both on foot to or from the stations and within the vehicles, highlighting a heightened sense of insecurity among women. Additionally, significant associations were also identified between the resilience levels of trips and both gender and an individual's history as a victim of violence in public transport or sexual violence.

Recognition is given to the fact that the chosen area and target population posed limitations to the research. The analyses were confined to a specific academic community and the bus system, which represents the only available mode of public transport in the studied area. Focusing on a specific context in Rio de Janeiro may limit the applicability of the findings to other contexts. However, the proposed approach can be replicated in future studies, not only in different socioeconomic and cultural contexts but also by considering various transport systems and addressing threats beyond violence. The use of self-reported information through questionnaires can introduce biases, affecting the accuracy of the results. Future studies may offer a new approach by combining self-reported data with records of past incidents, aiming to uncover correlations between reported perceptions and recorded occurrences of violence in public transportation. Furthermore, future research endeavors may offer a further examination or verification of the selected resilience levels, ensuring their precision in capturing the varied responses to security concerns across various travel scenarios.

The methodology applied can also be further developed to add greater robustness to the analyses and provide more comprehensive insights into violence within the transportation system. Future research should consider adopting a longitudinal design to overcome the cross-sectional limitation, enabling the tracking of changes in safety perceptions and behaviors over time. To enhance the depth of the study, investigations should explore the interplay between gender, age, ethnicity, and economic status concerning public transport safety. Integrating qualitative research methods can provide a more comprehensive understanding by delving into personal experiences and perceptions associated with safety in public transport. Furthermore, when new specific interventions for enhancing the resilience of public transport against criminal activities are implemented, research can compare pre-and-post-scenarios to investigate their effectiveness.

The results of this study allow for a better understanding of how men and women feel exposed to violence when using public transport and can contribute to the creation of public policies to promote safety. By acknowledging the impact of violence perception on passengers' choices, particularly affecting women, policymakers can implement security measures within and around public transport stations. Gender-specific interventions should address the identified disparities in travel behavior and safety perceptions, considering the

heightened sense of insecurity among women. Additionally, this analysis can assist security authorities in directing and concentrating police efforts more effectively. The research findings have the potential to contribute to the development of preventive and intervention measures focused on enhancing the safety of urban public transport, fortifying its resilience against criminal activities, and fostering a safer and more reliable environment for users.

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