



Women's perceived risk of sexual harassment in a Bus Rapid Transit (BRT) system: The case of Barranquilla, Colombia[☆]

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ABSTRACT

Background: Sexual harassment in public transportation is a growing concern, particularly among women. Over the years, there have been several programs and policies to mitigate sexual harassment while using public transport. However, there is little evidence of the effectiveness of these strategies, especially in Latin America.

Objective: This investigation aims to determine the factors that influence women's perceived risk of sexual harassment while using public transport in Colombia.

Methods: In this study, we designed an image-based stated preferences survey based on the current bus rapid transit (BRT) system in Barranquilla, Colombia. Several variables were considered in this experiment including the time of the day, surveillance, and crowding, among others. For each scenario, participants reported whether they felt safe or not. Then, a logistic regression analysis was conducted to identify the factors that influence women's perceived risk of sexual harassment while using the BRT system.

Results: The results show that more than 60% of respondents have been a victim of sexual harassment while using the BRT system. Also, overcrowded buses proved to have the most negative effect on the perceived risk of sexual harassment. Travelling at night, lighting and being alone were all significant variables as well.

Conclusion: Sexual harassment could potentially influence use of the BRT. The findings of this research can be used to develop countermeasures and increase public transport ridership.

1. Introduction

Sexual harassment (SH) is a form of sexual violence which includes practices such as leering, whistling, kissing, touching,

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brushing, and sexual gestures, among others (Australian Human Rights Commission, 2008). On-street SH is one of the most frequent gender violence issues given its briefness, anonymity, and deficient legal frameworks or penalties (Ceccato et al., 2018; Corazon, 2016). Women are more vulnerable to SH because of employment and differences in trip patterns. SH is highly prevalent in low- and middle-income countries, where there is a lack of social sanctions (Medina and Zapana, 2016). Research conducted by Mellgren et al. (2018) confirms that a great portion of the population is habituated to SH, which favors its invisibility and places it low on the political agenda.

Internationally there is a consensus that SH is a ubiquitous issue. For example, in London, a 2012 study showed that 43% of young women reported experiencing sexual harassment in public places. In Port Moresby, Papua New Guinea, a study revealed that more than 90% of women had experienced some kind of sexual violence when using public transport. In Kigali, Rwanda, a study revealed that 55% of respondents worry about going to school or college when it is dark (Mutesi and Abbot, 2013). In New Delhi, India, 92% of women have suffered from some kind of sexual violence in public places throughout their life (Madan and Nalla, 2016). In Latin America, this is not an unfamiliar problem. In cities such as Mexico City (Mexico), Lima (Peru), Santiago (Chile) and Bogota (Colombia), 60–90% of women reported being victims of SH (UN women, 2017).

In Colombia, although there is an increasing awareness of the issue, there is no evidence that SH is decreasing. A poll conducted by the Thomson Reuters Foundation (2014) ranked Bogotá as the capital city with the most dangerous transport system in the world. This study evaluated safety using indicators such as verbal harassment, physical harassment, public response to abuse, and confidence in authorities. In Bogota, only 38% of the public transport users feel safe and 62% feel that there will not be any public response if they are victims of abuse (OMEG, 2014). Surprisingly, in Barranquilla, Colombia, located on the northern coast of the country, there are no official reports of SH. This does not mean there are no SH situations, rather it is more likely that women are not filing police reports, mainly because it has largely been normalized and only rape is legally considered a crime (Contreras, 2018). Despite this, there is emergent research about SH on public transport in Colombia which focus only on prevalence but not the facilitating factors of SH.

Research shows that SH influences commuter decision-making and behaviors. Some of these changes include selecting alternative routes, schedules, modes of transport, clothing, and in the worst cases, avoiding travel altogether (Allen et al., 2018; Mellgren et al., 2018; Quiñonez, 2018; Willness et al., 2007). Particularly, women seem to use less public transport or forms of active travel such as walking and cycling (Guliani et al., 2015; Hatamzadeh et al., 2017) and prefer to use private cars (Mackett, 2014), motorcycles or even stay at home (Ceccato and Paz, 2017). This confirms that SH is not only a social problem but also a transportation and economic one that might be undermining the efforts to promote the use of public or active transport. Not addressing SH could have negative effects on congestion, road safety, economy and pollution (Menon and Khan, 2015).

In order to address SH, several policies and interventions have been implemented, the majority of them focused on segregating passengers by gender. Some examples include pink wagons in Mexico, ladies' wagons in India, Japan, Brazil, Egypt, and Colombia, or ladies' seats in Indonesia and the UAE. However, the effectiveness of these interventions is debatable (Soto, 2017), with successful (Japan, India) and unsuccessful cases (Brazil, Indonesia, Colombia). One of the challenges is that groups of men now target these wagons and wait for female passengers to exit the vehicle to harass them. Nevertheless, this intervention is still praised by several communities (Dunckel-Graglia, 2013). Additionally, Gekoski et al. (2015) analyzed several policies and interventions, concluding that segregated wagons or vehicles are not recommended. Instead they proposed that public transport users should be informed that they are being monitored, which will increase the perceived risk of being apprehended.

SH on public transport is largely underreported. Consequently, it is hard to estimate the prevalence of SH based on available data or official reports. In a survey by the Manhattan Borough President's Office, only 4% of public transport SH victims reported the incident. In Bogota, Quiñones (2018) found that the majority of victims do not even try to report the incidents. This highlights the need to investigate SH on public transport using data collection methods that do not rely on police records. Some alternative methodologies and approaches can be transferred from previous work in SH in public spaces. For example, Tandongan and Ilhan (2016) and Páramo and Burbano (2011) applied surveys and descriptive statistics to illustrate the victimization rates and types of risks reported. Gaytan-Sánchez (2007) used grounded theory to assess the different types of harassment towards women in public places, while Ceccato and Tcacencu (2018) used both surveys and official reports to map the safety perception in shopping centers. Another study combined GIS and crime records into a set of regression models (Ceccato and Paz, 2017). In conclusion, the majority of previous research in this topic used descriptive statistics as an analysis technique (Madan and Nalla, 2016; Mellgren et al., 2018) whereas only Ceccato et al. (2017) used regression models.

The aim of this investigation is to identify the factors influencing the perceived risk of SH among female users of the bus rapid transit (BRT) system, using discrete choice models, thus making this one of the first studies to apply this type of modelling technique to assess SH on public transport. In this study, a binary stated preferences survey was developed and applied in Barranquilla, Colombia. The survey included image-based choice scenarios considering variables such as bus interiors, bus stops and BRT stations.

2. Methods

This study was conducted in the city of Barranquilla, located on the northern coast of Colombia, with a population of over 2 million people and a citizen security index of 0.58 (in a scale from 0 to 1, which locates it in the 5th place between the main six cities of the country) (Cabello et al., 2017). The city has had a BRT system since 2010, which operates from 5:00am to 10:30pm and moves around 150,000 passengers per day. The BRT system has a total of 13.3 km of exclusive corridors and several feeder lines across the city (Transmetro, 2017). There are different types of bus stops, varying from big stations in BRT's bus only corridors to sheltered and unsheltered stops for the feeder lines (Figs. 1 and 2).



Fig. 1. BRT's station Source: Google Maps.

2.1. Experimental design

We conducted a stated preferences survey during May to June 2018, these type of surveys are widely used for transport analysis (Cantillo et al., 2015, 2010; Hensher and Mulley, 2015; Orozco-Fontalvo et al., 2018; Rossetti et al., 2017). The interviews were face-to-face using trained staff, and the target population was public transportation users. The decision to employ a face-to-face methodology was made in order to capture the behavior on site, expecting more truthful answers. With stated choice experiments like this, the context is important and we wanted to avoid biased responses and reduce the attrition, both likely to be an issue when using internet-based surveys. The sample size was 500 participants. The first section of the survey contained questions about the service provided by the BRT and perceptions regarding SH.

Data collection was conducted at various locations inside the BRT system (main stations, bus stops, and on buses). In the stated preference section of the survey, the respondents were faced with 8 choice situations. Three different surveys were designed depending on different locations relevant to respondents' use of the BRT, which are in-vehicle, BRT main stations, and on-street feeder line bus stops. A fractional factorial design was conducted using N-gene® (Choice metrics, 2012), obtaining nine blocks with four situations each. Each respondent answered two four-choice situation blocks, having always one in-vehicle block and one for bus stops or BRT stations, for a total of 2000 observations. Each survey required between 10 and 15 minutes to be completed. Following previous research, the variables included the time of day, lighting, crowding, if someone accompanies the participant, and surveillance (Allen et al., 2018; Ceccato et al., 2017; Quiñonez, 2018; Tandogan and Ilhan, 2016). Attributes and levels of the stated preferences survey are shown in Table 1 and an example is shown in Fig. 3.

Participants were shown images in order to easily evaluate all variables considered (Hensher and Mulley, 2015; Rossetti et al., 2017). The images (Table 2) were accompanied by some text to illustrate the whole situation. In each scenario, participants were asked "Do you feel safe in this situation?" (yes/no). For the variables 'time of day' and 'surveillance', we used drawings so it would be easy to identify them over the real photos that showed the location, crowding, and lighting. We did this because in the pilot survey we used photos of real cameras and police officers, but respondents missed the police officers and cameras in the majority of the cases. Additionally, participants reported some general security perceptions and experiences with SH in the BRT.



Fig. 2. Feeder line stop Source: Google Maps.

Table 1
Attributes and levels SP survey.

Variable	Levels
Time of the day	Day-night
Lighting	Good-poor
Crowding	Empty-few passengers-crowded-overcrowded (bus only)
Companionship	Alone-with a woman- with a man
Surveillance	None- camera- police/security staff

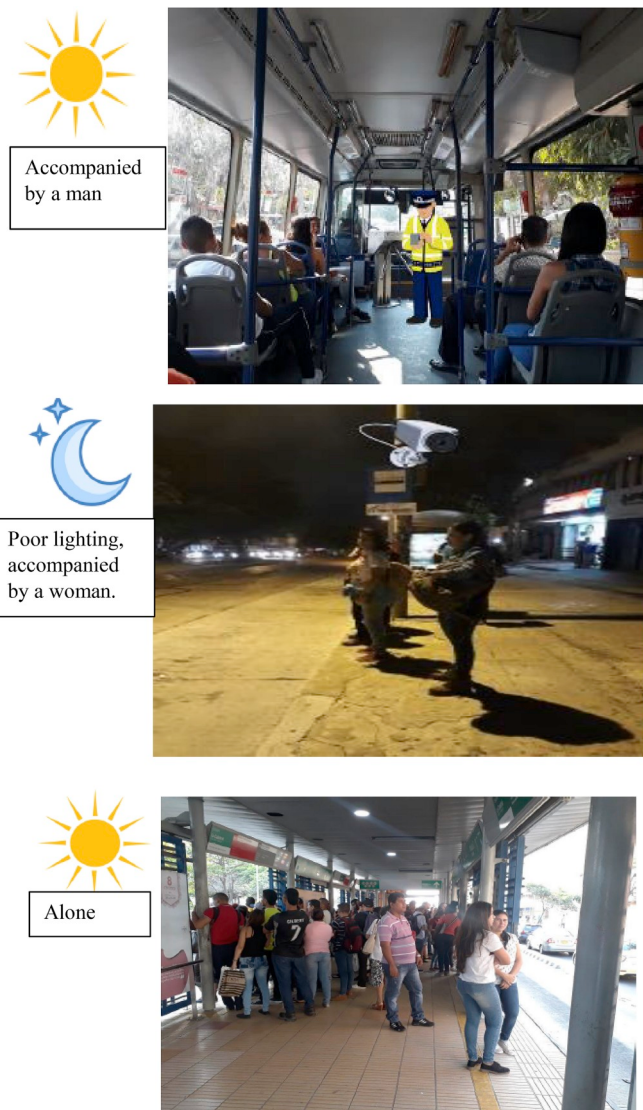


Fig. 3. Example of SP survey applied.

2.2. Model framework

Discrete choice models were used in this research based on the random utility theory (Ortuzar and Willumsen, 2011), according to which an individual chooses the alternative, providing always that the utility of such alternative is greater or at least equal to the utility of alternative, i.e.:

$$U_{ni} \geq U_{nj} \quad \forall j \neq i \quad (1)$$

Nevertheless, it is not possible for the modeler to observe the true value that the individual assigned to a particular alternative, or

Table 2
Drawings used for time and surveillance.

Image	Convention
	Day
	Night
	Surveillance camera
	Police/security staff

all the variables that define its utility. So, the modelling approach specifies only one part of the utility, known as the systematic utility. This takes form as a linear equation of observable attributes and parameters to be estimated. The unexplained part of the utility is treated as an error term (McFadden, 2001), as follows:

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad (2)$$

As had been mentioned, the systematic utility can be specified as a linear function of observed attributes, multiplied by a total of k parameters to be estimated, which can be generic or specific to each alternative.

$$V_{nj} = \sum_{k=1}^K \beta_{nj k} \cdot x_{nj k} \quad (3)$$

The assumption made about the distribution of the error terms can lead to several models. The most common is to assume that error distributes identical and independent Gumbel, which leads immediately to the logit model whose functional form allows to obtain the probability that an individual chooses an alternative, as follows:

$$p_{ni} = \frac{e^{V_{ni}}}{\sum_{j=1}^J A_j \in A(n) e^{V_{nj}}} \quad (4)$$

Although multinomial logit models assume that preferences are identical for all individuals, it is possible to introduce into the model specification variations in preferences within the population, either randomly or systematically. In the estimated models, we use both taste variations, with the inclusion of systematic taste variation by including attributes interacting with socio-economic variables (gender in our case). Also, a random parameter was added in order to correlate observations made by the same respondent.

3. Data

Participants were 64% female and 36% male, aged 18 years and over. Minors (under 18 years) were excluded from this study due to the sensitivity of the topic. An overview of the sample characteristics is shown in Table 3. More women were approached to be participants in the survey due to women being the main victims of SH in public places (UN women, 2017).

Neighborhood socio-economic status in Colombia is divided into low (1-2), medium (3-4) and high (5-6). Among the respondents, 55% live in low strata zones, 42% in medium strata and only 3% in high strata. The sample is consistent with the population distribution. The low percentage of high strata in the sample is due to two facts, first is that only 6% of homes in the city belong to high strata, and the second is that they tend to use private transport to commute (BqCV, 2017). Regarding occupation, most

Table 3

Overview of the sample's characteristics.

Variable		Study sample	Percentage	Population percentage
Gender	Male	180	36%	49%
	Female	320	64%	51%
Age	18-25	195	39%	17%
	26-35	150	30%	29%
	36-50	110	22%	27%
	more than 50	45	9%	4%
Neighborhood socioeconomic status ^a	1-2	275	55%	51%
	3-4	210	42%	43%
	5-6	15	3%	6%
Occupation	Employee	205	41%	-
	Retired	10	2%	-
	Student	155	31%	-
	Unemployed	30	6%	-
	Independent	70	14%	-
	Other	30	6%	-

^a <https://www.dane.gov.co/index.php/69-espanol/geoestadistica/estratificacion/468-estratificacion-socioeconomica>.

respondents are employees (41%) and students (31%). This has an effect on the results of trip purpose, as work-related trips are the most frequent (24%), followed by errands (23%). See Table 3 for more details of the participant characteristics.

4. Results and Discussion

4.1. Self-reports of security and sexual harassment

Regarding respondents' experiences of SH, the majority stated the system was "poorly secure" (37%) and the most common SH type witnessed was verbal harassment (20%). Only 18% had not witnessed any kind of SH inside the BRT system (Table 4). On the other hand, we found that 26% of men have been victims of SH, while 48% of women reported some kind of SH experience. Fig. 4 shows the situations experienced by respondents.

Verbal harassment is the most common type of SH experienced by female participants, however, it is still not considered as abuse by a large portion of the population. Regarding SH severity, 18% of women surveyed reported previous experience with physical harassment (the most severe type in the survey). This is a worrying number taking into account that a high proportion of victims prefer not to share this experience, so we would expect this percentage to be even higher than reported.

Respondents were also asked about the place or scenario inside the system where they witnessed or were victims of SH, with 40% of situations occurring inside the vehicle, 22% at bus stops and 18% inside stations. The other answer provided was "while boarding/getting off the vehicle" with 22%, which could be due to the congestion to board or disembark, where people are usually pushing each other, and sexual offenders take advantage to touch or brush against their victims. The authors witnessed how offenders wait

Table 4

Security self-reports.

Variable		n	%
Security	Highly secure	15	3%
	Secure	140	28%
	Poorly secure	185	37%
	Insecure	120	24%
	Highly insecure	40	8%
Situations witnessed	Verbal harassment	200	40%
	Exhibitions	45	9%
	Chasing	35	7%
	Physical harassment	130	26%
	None	90	18%
Place of harassment	Inside the vehicle	200	40%
	While boarding/getting off the vehicle	100	20%
	At the station	90	18%
	At the bus station	110	22%
Measures taken	Modal shift	15	3%
	Avoid travelling alone	100	18%
	Avoid overcrowded places	110	22%
	Modify commuting schedules	50	10%
	Staying alert	175	35%
	None	50	10%

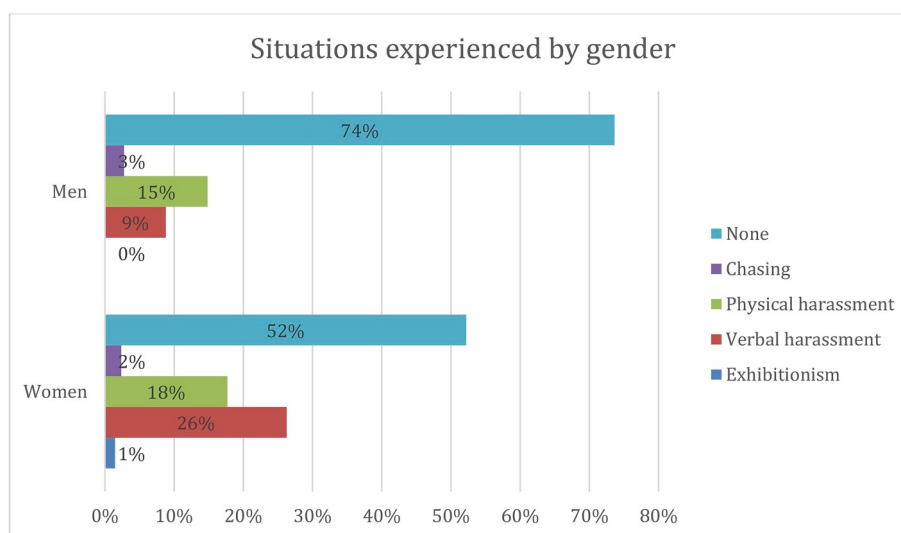


Fig. 4. Situations experienced by gender.

until the victim is getting off the bus to sexually harass them, giving them no time to react (as the offender stays in the vehicle and continues travelling). Overall, buses are the most insecure locations with 62% of SH situations occurring inside buses.

In order to identify how SH situations affect the travel patterns of victims or witnesses, participants were asked if they took any action after these situations. The most common responses were increasing alertness when using the BRT, avoiding travelling alone, avoiding overcrowded places, and modifying commuting schedules. These actions would impact the level of service of the BRT, as well as the overall performance of the transport system in the city. Concerningly, BRT users may consider a modal shift to motorized private vehicles or illegal modes of transportation such as motorcycle taxis. This could potentially result in higher exposure to road safety risk.

4.2. Logistic regression analysis

The results of the estimated model are shown in Table 5. As explained above in the model framework section, a logit model was estimated, which included three different survey locations: buses, stations, and bus stops. Linear and non-linear parameters were used in the estimation, having specific parameters per location and gender. Location specific parameters included attributes related to the environment, such as empty location, illumination, and travelling at night. The overcrowded attribute was specific to buses, as it was not a variable level in the experimental design for station and bus stops. The surveillance attributes included police presence or surveillance cameras.

The model show that the bus is the “safest” place, followed by bus stops, and stations. At first, this could seem counterintuitive, as many of the known cases of abuse occur on buses (as shown in the previous sections) and the perceptions may seem against it. However, crowding in stations can facilitate SH at the moment of boarding the buses and also makes it more difficult for people to react. It could also be related to the higher waiting time “cost” compared to travel time “cost”, that could increase the risk perception as people feel they spend more time than they actually do. On the other hand, there could be a component of fear of crime, related to these locations, that is not being measured in the experiments.

In the case of empty locations, the results show that buses and stations have similar perceptions, with low significance levels. But, the case of bus stops is highly significant, demonstrating that empty locations increase the fear of SH in the population. Additionally, this effect is much higher for women, as the gender specific coefficient shows. In the case of overcrowded buses, the negative effect is the highest among all the attributes studied, as a wide variety of cases of SH take place in this situation. The findings from this study are supported by previous literature on commuters’ security in low- and middle-income countries (Hirsch et al., 2016; Oviedo-Trespalcacios and Scott-Parker, 2017).

Travelling at night also has an important negative impact on the risk perception of SH. In this case, bus stops also have a similar negative effect, followed by buses and stations. Illumination has a positive impact, and the absence of illumination has a negative impact. It can be seen that the coefficient is higher (and statistically equivalent) for stations and bus stops, while it is lower for buses. Illumination has been found to influence the perception of security among pedestrians and public transport users in previous studies in Colombia (Oviedo-Trespalcacios and Scott-Parker, 2017).

For surveillance attributes, the results show that the presence of police officers has higher utility than surveillance cameras. Also, in both cases the utility is lower for women compared to men, as the interaction between police and cameras with women is negative and significant. It is important to note that the Colombian police and the Colombian judicial systems are considered highly ineffective and are not trusted by Colombians (Edelman, 2017; Oviedo-Trespalcacios and Scott-Parker, 2018; Scott-Parker and Oviedo-Trespalcacios, 2017). Also, travelling alone has higher disutility on buses, followed by stations and bus stops. Travelling with a man

Table 5
Statistical model for perceived risk of SH.

			Coefficient	t-test	p-Value
Alternative specific constant					
Bus			0.623	2.85	<0.01
Station			-0.358	-2.02	0.04
Stop			0.208	1.22	0.22
Attributes					
Empty	X	Bus	-0.236	-1.09	0.28
	X	Station	-0.221	-1.2	0.23
	X	Stop	-0.503	-2.89	<0.01
	X	Woman	-0.416	-2.47	0.01
Crowded	X	Bus	-3.64	-12.74	<0.01
Night	X	Bus	-1.46	-7.98	<0.01
	X	Station	-1.32	-9.43	<0.01
	X	Stop	-1.65	-10.66	<0.01
Illumination			0.774	7.55	<0.01
No illumination	X	Bus	-0.497	-3.13	<0.01
	X	Station	-0.654	-4.19	<0.01
	X	Stop	-0.615	-4.11	<0.01
Police presence			3.42	17	<0.01
	X	Woman	-0.491	-2.44	0.01
Surveillance camera			1.98	13.39	<0.01
	X	Woman	-0.666	-4.11	<0.01
Travel Alone	X	Bus	-0.962	-6.26	<0.01
	X	Station	-0.625	-3.94	<0.01
	X	Stop	-0.474	-2.94	<0.01
Travel with a man			0.371	2.84	<0.01
Panel Effect			-0.677	-9.07	<0.01
Number of observations				3992	
Number of MLHS draws				500	
Log-Likelihood				-1866.489	

provides a positive effect on the perceived risk of SH.

At last, a panel effect was added in order to take into account the multiple responses of each individual, given the correlation between them. We added a random parameter with mean equal to zero and variance to be estimated, with the purpose to include the correlation per respondent. This parameter was statistically significant, proving that the perceived risk of SH is not uniform between respondents.

The BRT system in Barranquilla does not gather any kind of information related to SH, so there is no data available to analyze and monitor these situations or compare the results of the present study. A limitation of this study is that SH is a sensitive topic and the majority of people feel uncomfortable sharing experiences or accepting being victims of it. Nevertheless, the sample and answers obtained gave us significant insight into SH on public transportation.

Our results are consistent and similar to other SH studies conducted in Latin America. For example, [Quiñones \(2018\)](#) also found that overcrowded buses are perceived as highly insecure, while [Ceccato and Paz \(2017\)](#) concluded that the busiest metro stations were the most insecure. Sao Paulo Metro System has already been training security personnel to mitigate SH ([Gekoski et al., 2015](#); [Metro, 2019](#)). Moreover, other studies such as [Madan and Nalla \(2016\)](#) concluded that women have more concerns about their ability to safely use public transportation, which is consistent with our findings. Finally, it is important to acknowledge that this study does not include participants who have willingly decided not to use public transport anymore due to security or socio-economic reasons.

To the best of our knowledge, this is one of the first studies using econometric modelling techniques to analyze the perceived risk of SH on public transportation. Also, this study is a novel approach to study sexual harassment in BRT systems in Latin-America and Colombia, where these systems are increasingly widespread in big cities.

5. Conclusion

This study made an assessment of the SH situations inside the BRT system of Barranquilla, Colombia, using stated preferences surveys, in order to characterize the problem and identify the factors that influence perceived risk of SH. A logistic (logit) regression analysis allowed us to differentiate the effect of each variable per gender. For example, while using bus stops, women feel more insecure than men. Overcrowded buses proved to have the largest negative impact on risk perception. Travelling at night, lighting, and being alone all proved to be significant variables, as expected. Regarding surveillance, cameras and police did not increase the sense of security among women compared to men.

The fact that 42% of participants had been victims of some kind of SH and women experience more harassment than men, makes this a serious issue and gender problem that needs to be addressed. The implications of SH for public transportation need to be considered by policy makers, due to its impact in the quality of life, urban planning, travel patterns, security indicators and the health or psychological problems that it generates in victims. Given the seriousness of this problem and the lack of official data, it is

important to integrate SH indicators in measures of public transportation performance at local and national levels. Additionally, it is important to encourage the community to denounce SH and support evidence-based decision making.

The self-reported prevalence of sexual harassment in this study was high. This suggests that legislation and enforcement regarding SH need to be strengthened. In Colombia, the Law 1257 from 2008 sanctions any kind of sexual violence towards women, but as this investigation shows, it is not being enforced. It is clear that SH offenders perceive a low risk of being apprehended and punished. As suggested by Gekoski et al. (2015) and Allen (2018), surveillance needs to be improved to effectively deter SH offenders. The presence of police/guards should increase not only at stations but inside the buses. It may be beneficial to ensure representation of both female and male police officers to support female victims to report incidents of SH. In addition, undercover police operations might increase the deterrent effect. CCTV cameras should also be installed despite not having a significant effect on risk perception in this study, as videos could be used as solid proof for legal matters. In order to maximise success, users of the BRT system should be informed that they are being monitored all the time. Finally, SH is a complex issue that merits the involvement of other stakeholders such as city planners, architects, engineers, etc. Opportunities for intervention can be sourced from systemic initiatives such as Crime Prevention through Environmental Design (Cozens and Sun, 2019).

Future research should seek to study not only victims but also offenders to further identify facilitators of SH, and opportunities for intervention. Importantly, other sexual minorities should be considered in future studies due to their unique vulnerabilities (Demant et al., 2018). In addition, future research needs to overcome the limitations of quantitative studies using a mixed methods approach to better understand victims' experiences. Finally, hybrid choice models should be considered in order to assess effects that cannot be measured directly, like personality, and to reduce the dimensionality of data.

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