Social Exclusion and the Transit System in Santiago, Chile

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Abstract

We aimed to address a gap in previous Chile-based research, by studying the relationship between transportation and social exclusion from a multidisciplinary and multidimensional perspective, focusing on the public bus transit system in Santiago, Chile. We observed the disadvantages faced by riders of public transit buses in the Santiago metropolitan region. In our qualitative and quantitative analysis, we conducted 4 focus groups and surveyed 512 bus riders. We determined 8 dimensions upon factorial analysis: (1) safety, (2) service quality, (3) bus stops' infrastructure, (4) accessibility, (5) information, (6) drivers' behavior, (7) improvement in buses and (8) harassment. Together, these dimensions explained 58% of the data variability. More than 50% of riders had been unable to use public transit buses at least once, mainly due to safety concerns among women, young people and the elderly. One relevant observation is the need to deepen transportation disadvantage research from a gender perspective.

Keywords

Public transit, factor analysis, transportation disadvantage, social exclusion

Introduction

At the beginning of the 21st century, academic interest about transportation disadvantages related to low-income groups' and communities' social exclusion has grown. Some of the consequences associated with transportation disadvantages include barriers to employability, exclusion from services, fear and perceived lack of safety (Hine and Mitchell, 2001; Hine and Scott, 2000; Sinclair, 2001). Consequently, studies began to explicate the links among poverty, transportation disadvantage and access to key services, in addition to economic and social exclusion (Bocarejo et al., 2016; Church et al., 2000; Kenyon et al., 2002; Lucas, 2012).

On the other hand, it has been difficult for national policymakers to recognize the nature and processes of social exclusion, as reflected in the lack of adequate indicators to address such exclusion. Recent inquiry has shown that social exclusion differs from poverty in that it does not focus on material wealth alone, instead emphasizing the importance of a complex set of interrelated social processes. Social exclusion related to transportation is a multifaceted issue that can be studied from a variety of angles, be disturbed by several influential variables, and affect people with specific demographic characteristics.

The very natures of transportation disadvantage and social exclusion raise questions about how transportation policy should be implemented, considering the types of interventions that can mitigate

their effects. The transportation sector therefore must explore how it can improve inclusivity (Church et al., 2000; Hine and Mitchell, 2017; Hodgson and Turner, 2003; Kamruzzaman et al., 2016; Lucas, 2012; Martínez et al., 2018; Stanley et al., 2012; Xia et al., 2016; Yigitcanlar et al., 2019).

The relevance of transportation and social exclusion are not just related to the provision and use of transit systems, but the understanding that transportation is a link between citizens and their ability to interact and be part of society (Church et al., 2000; Hodgson and Turner, 2003; Lucas, 2012). Thus, public transportation policies can reduce barriers to work opportunities and reduce health inequalities, as well as increase education attainment and participation, among other activities (Lucas, 2012). In simple words, an inadequate public transit system can increase inequities and reinforce social exclusion.

In the case of Santiago's morphology and structural evolution, De Mattos (2004) highlights 3 important transformations during the past 3 decades: i) a trend toward suburbanization with the formation of a diffuse peri-urban area, ii) formation of a polarized and segregated metropolitan structure, and iii) the eruption of a set of new urban artifacts that can strongly restructure metropolitan space. These 3 structural aspects show that a key element in describing Santiago is its sociospatial inequity, which radically defines the experience throughout the city as well as access to goods and services (Jirón et al., 2010). According to Ducci and Rojas-Symmes (2010) Chile's capital is strongly spatially and socioeconomically segmented according to political-administrative units called *comunas* (municipal districts). This spatial structure supports mobility changes such as migration, tourism, residential transfer, and daily transportation. These changes are intertwined with inequity and with multiple service offers that configure the diversity of lifestyles that characterize present-day Santiago.

In March 2019, Chilean government authorities announced that the metropolitan transit system would now be called RED (Red Metropolitana de Movilidad). This communication strategy sought to respond to the commonly held belief that the existing system Transantiago's main problem was one of origin, with no possible solution. Therefore, the only alternatives were mitigation measures and reforms. This perspective is not a comprehensive treatment of the problem—inequity is a profound social phenomenon that originates from Chile's social inequality and is expressed in several urban spaces, including urban mobility. Consequently, a multidisciplinary study combining engineering and social sciences would allow a broader perspective and the ability to observe transportation as a social function—one that affects other aspects of social life and is affected by them.

We aimed to address a gap in previous Chile-based research by studying the relationship between transportation and social exclusion from a multidisciplinary and multidimensional perspective, focusing on the public bus transit system in Santiago, Chile.

Literature review

Several studies have highlighted that certain variables affect the amount and type of transportation available, such as neighborhoods' locations; their populations' structure in terms of age, race, disabilities and gender; type of housing and residential tenure; employment status and unemployment levels; and income levels (Hamilton and Jenkins, 2000). The groups most vulnerable to transportation disadvantages are generally considered more likely to be socially excluded, suffering the consequences of poor transportation accessibility more than others. These groups are often recognized as the elderly, people with health problems, women, the unemployed, low-income people and adolescents (Clifton and Lucas, 2004; Delbosc and Currie, 2011b; Lucas, 2012). Lower-income households generally have fewer private vehicles, leading to greater reliance on public transportation (Welch and Mishra, 2013). Stanley et al. (2011) and Stanley et al. (2019) found that people at greatest risk of social exclusion traveled less frequently and over less distance, had fewer cars and used less public transportation than those with more advantages. In other words, socially excluded people have less access to motorized mobility.

Church et al. (2000) established that few studies explicitly linked transportation and social exclusion as relevant issues for UK policymakers, concluding that the lack of connection between 25% of London's residents and many of the activities and opportunities they required to participate fully in society caused social exclusion in London. Focusing on workers' exclusion from job opportunities, the authors proposed that this disconnect occurred based on 7 dimensions: physical exclusion, geographical exclusion, exclusion from facilities, economic exclusion, time-based exclusion, fear-based exclusion and space exclusion (Kamruzzaman et al., 2016; Lucas, 2012; Stanley et al., 2019; Yigitcanlar et al., 2019).

Harvey (2014) stated that urban design considers power relationships that radically affect a city's construction and daily experience, unbalancing access to goods and services offered. From this perspective, a city would not likely amend social structural inequity; it would more likely deepen such differences instead. The daily experience of inhabiting urban spaces has emerged as a research object, targeting specific ways of socializing and transitioning between physical and symbolic spaces within the city (Araujo, 2009; Araujo and Martuccelli, 2012). Day-to-day interactions happen on the streets, during bus trips or at public meeting places, producing not only information and symbolism

(Castells, 2004; Lange Valdés, 2011), but also a corporal experience on individuals who inhabit the city (Le Breton, 1995), expressing a way of living the urban dimension on a human scale.

Studies seeking to improve urban planning have used techniques such as econometric models structural or equation models (Stanley et al., 2011, 2019), spatial tools (Preston and Rajé, 2007) and economic tools such as Gini coefficients (Delbosc and Currie, 2011a; Welch and Mishra, 2013). Despite this growing body of research, there is still a great deal of confusion about the concepts and definitions of transportation-related social exclusion, how they can be measured and modelled successfully, and whether investigating transportation disadvantages from this perspective is a useful approach for policymakers and practitioners. As social exclusion in the transportation sector is a relatively new concept, there is no established framework for measuring it. Researches have established 2 general results in the field of transportation planning over the last decade: (i) a growing demand to incorporate social inclusion objectives and (ii) recognition of the role of transportation in maximizing people's well-being and participation in social and economic life (Priya and Uteng, 2009).

Delbosc and Currie (2011a) argued that social exclusion based on transportation is a potential consequence of a "transport disadvantage" situation, which is generally recognized as a multidimensional construct related to location; access to mobility; and personal limitations such as physical, social, and psychological issues (Church et al., 2000; Dodson et al., 2004; Schönfelder and Axhausen, 2003).

That said, transportation-related social exclusion can be defined as: i) a process that is generally considered to be connected to society's systems and/or agencies (e.g. labor market, transportation, legal system) in which ii) these processes are dynamic in nature and interact with each other (Atkinson, 1998; Burchardt et al., 1999; Kamruzzaman et al., 2016; Kamruzzaman and Hine, 2011). As a result, iii) people face deprivation due to multiple dimensions simultaneously, including poverty (Cattell, 2001; Higgs and White, 2000). In other words, the lack of adequate access to transportation contributes to social exclusion, as lesser transportation access is detrimental to social opportunities. This allows us to differentiate between limitations related to individuals and those related to the transit service (Church et al., 2000; Hine and Mitchell, 2001; Lucas, 2012).

Few national studies investigating the relationship between social exclusion and transportation have been carried out. Jara and Carrasco (2010) defined a series of indicators that can be applied in an analysis of social exclusion related to the role of transportation, but always focused on a particular dimension. These indicators were mainly related to accessibility criteria, number of trips and modes

of transportation used. However, Jara and Carrasco (2010) identified a series of limitations when using these indicators, for example with regard to the level of aggregation used.

Martínez et al. (2018) concluded that in Santiago, people living in social housing sectors require more time and resources to access their jobs and health facilities because these resources are concentrated in central areas of the capital. In addition, the public transit service is not capable of reducing access times, so instead of improving this pattern of social exclusion, it exacerbates geographic exclusion in terms of transportation services and facilities.

Tiznado-Aitken et al. (2018) proposed a methodology that considered 2 indicators: accessibility to public transit stops on foot and quality of the environment for walking. They found that 12 out of 34 Santiago *comunas* were deprived of one or both dimensions, not managing to achieve minimum fairness standards. Finally, Sagaris et al. (2020) concluded that despite the fact that Santiago's urban planning system favors high-income households whose members move mainly by car, a majority of pedestrians, cyclists and riders of public transit and even motorists would prefer a redistribution of road space and investment in favor of more active public transportation.

Methodology

Our research design was exploratory, quantitative-qualitative, cross-sectional, non-probabilistic and empirical. The qualitative stage consisted of 4 focus groups with the aim of identifying different elements of the disadvantages preventing the use of public buses. We carried out focus group sessions in May 2019. Participant selection was strategic and snowballed according to the following characteristics: male students, female students, working women, and bus riders over 65 years of age. Each group consisted of 5 to 8 riders, and conversations lasted between 70 and 90 minutes. The set of questions was related to 8 general dimensions: general perception of the service, coverage, quality of facilities, availability of information sources, use of time, safety level, facilities' access to buses and economic aspects. We used participants' answers to complement our bibliographic review and to develop a survey to collect quantitative data based on 4 sets of questions:

Observable data: This information was obtained through pollsters' observations, focusing on variables such as respondents' gender and mobility.

Identification inquiries: consisted of 10 questions related to respondents' sociodemographic characteristics, travel and experiences.

Perceptions: 48 questions related to the dimensions mentioned above aimed to capture riders' perceptions. Items used a 7-point Likert scale (1 = worst to 7 = best). This scale replicated school

grades, and was easy for respondents to understand. In this analogy, 1, 2 and 3 are considered insufficient, expressing a bad opinion on the subject; 4 and 5 are good; and 6 and 7 express an excellent opinion or perception of an item.

Exclusion variables: Riders were asked if they were ever forced to avoid getting on the bus in the last week. Another question explored the existence of alternatives to complete the trip.

The survey was carried out between July and August 2019 from 9 AM to 10 while passengers were riding a bus or waiting at a bus stop. We obtained a total of 512 valid surveys, approximately 80% of riders approached by researchers. A descriptive summary of the sample is presented in Table 1.

Table 1. Descriptive summary of the sample

Item	Class	Total		Riders forced to avoid getting on the bus		Riders who could board the bus	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Gender	Female	263	51.4%	178	67.7%	85	32.3%
	Male	249	48.6%	162	65.1%	87	34.9%
Nationality	Chilean	468	91.4%	312	66.7%	156	33.3%
	Other	44	8.6%	28	63.6%	16	36.4%
Age	<18	8	1.6%	6	75.0%	2	25.0%
	18-25	166	32.4%	123	74.1%	43	25.9%
	26-39	173	33.8%	114	65.9%	59	34.1%
	40-49	70	13.7%	41	58.6%	29	41.4%
	50-59	46	9.0%	27	58.7%	19	41.3%
	60-69	39	7.6%	22	56.4%	17	43.6%
	>70	10	2.0%	7	70.0%	3	30.0%
Occupation	Employed	285	55.7%	189	66.3%	96	33.7%
	University student	141	27.5%	102	72.3%	39	27.7%
	School student	15	2.9%	12	80.0%	3	20.0%
	Stay at home	32	6.3%	15	46.9%	17	53.1%
	Retired	18	3.5%	11	61.1%	7	38.9%
	Unemployed	21	4.1%	11	52.4%	10	47.6%
Transportation mode	Bus	190	37.1%	107	56.3%	83	43.7%
	Bus and metro	322	62.9%	233	72.4%	89	27.6%
Daily commute duration	0-15 minutes	50	9.8%	32	64.0%	18	36.0%
	16-30 minutes	171	33.4%	112	65.5%	59	34.5%
	31-45 minutes	138	27.0%	85	61.6%	53	38.4%
	46-60 minutes	95	18.6%	65	68.4%	30	31.6%
	61-90 minutes	44	8.6%	35	79.5%	9	20.5%
	>90	14	2.7%	11	78.6%	3	21.4%
Reduced mobility	No	488	95.3%	326	66.8%	162	33.2%
	Yes	24	4.7%	14	58.3%	10	41.7%
Multidimensional poverty in home district*	Low	138	27.0%	91	65.9%	47	34.1%
	Middle-low	118	23.0%	75	63.6%	43	36.4%
	Middle-high	154	30.1%	105	68.2%	49	31.8%
	High	102	19.9%	67	65.7%	35	34.3%

Total	-	512	100%	340	66.4%	172	33.6%

*Multidimensional poverty levels obtained from respondents' home districts using information from the Ministry of Social Development

From the answers to the 48 Likert-scale items, we applied a factor analysis (Pituch and Stevens, 2015) to identify the elements that explained the phenomenon of exclusion in the Santiago bus system.

Results and discussion

For factor analysis, we obtained a Kaiser–Meyer–Olkin value of 0.866, indicating high correlations, and Bartlett's test yielded a significance value less than 0.05. From the principal components analysis and taking into account selection criteria such as Kaiser´s rule (Pituch and Stevens, 2015; Yong and Pearce, 2013), we selected 8 factors with eigenvalues greater than 1 and that together explained 57.83% of the variance in data. Table 2 shows the selected factors, the eigenvalues and the percentage of variation explained by each factor.

Table 2. Factors, eigenvalues and explained variance

Factor	Name	Eigenvalue	Explained variance (%)	Cumulative explained variance (%)	M	SD	Below 4 (%)
1	Safety	9.8	24.4	24.4	3.19	1.75	70%
2	Service quality	3.7	9.1	33.6	3.70	1.51	55%
3	Bus stop infrastructure	2.1	5.3	38.8	3.98	2.00	17%
4	Accessibility	1.8	4.5	43.4	4.28	1.85	39%
5	Information	1.7	4.3	47.7	4.93	1.69	3%
6	Driver behavior	1.5	3.7	51.3	4.40	1.47	20%
7	Improvements in buses	1.4	3.4	54.7	5.70	1.75	12%
8	Harassment	1.2	3.1	57.8	3.88	2.16	45%

Safety

This factor explained 24.4% of data variance and 70% of the total respondents rated the variables associated with this factor lower than 4. In other words, the vast majority of those surveyed disagreed that the state of safety levels on buses were adequate, which confirms the relevance of this disadvantage in public transportation in Santiago

Table 11 (annexes) shows the rotated factor loadings matrix and the commonalities of each variable. "How safe do you feel faced with the possibility of being harassed at the bus stop?" and "How safe do you feel faced with the possibility of being harassed inside the bus?" loaded on Factors 1 and 8, but we grouped them within Factor 8 because they had a higher load on that factor. A lack of safety was the main factor explaining transportation exclusion in Santiago's bus system. Harassment, although a subcategory of safety concerns, seems to have been relevant enough to conform to a different factor. This decision was also consistent with our focus group results and public discussion expressed in communication campaigns against street harassment.

As shown in Table 3, all variables had high correlations and mean values showed disadvantages in all of them, except for traveling alone. The variables with the lowest averages were waiting for the bus at night and using a cell phone while waiting for the bus, both with an average of 2.68.

Table 3. Safety variables

Variable	M	SD	Factor loadings
How do you evaluate your safety using a cell phone inside the bus?	3.23	1.76	0.803
How do you evaluate your safety using a cell phone while waiting for the bus?	2.68	1.69	0.798
How do you evaluate your safety with the possibility of being robbed while waiting for the bus?	2.95	1.66	0.760
How safe do you feel with the possibility of being robbed/attacked inside the bus?	3.38	1.69	0.746
How safe do you feel with the possibility of being robbed/attacked while riding the bus at night?	3.21	1.67	0.718
How do you evaluate your safety while waiting for the bus at night?	2.68	1.61	0.689
How do you evaluate your safety when traveling alone?	4.13	1.72	0.636

Among women, 85% rated the variables of this factor with average scores of less than 4, while only 53% of men did so, showing that gender is one of the most relevant variables associated with perceptions of public bus travel safety. By age, 70.3% of riders who felt insecure were under 40, while 29.7% were riders over 40, exposing that younger people perceived greater risk.

Another relevant variable was multidimensional poverty, showing that greater perceptions of danger could be found at both extremes: riders living in communes with the lowest multidimensional poverty (richer districts, 60%) and riders living in communes with the highest multidimensional poverty (poorer districts, 59%). When analyzing all riders who felt unsafe while traveling via public buses, 68% declared they had avoided getting on the bus for this reason.

According to focus groups, danger is experienced in relation to violence and criminal situations. Conflict circumstances with insults, punching and even the use of weapons were all mentioned. Thefts were also frequent—not only on the bus, but also while waiting at the bus stops. Finally, safety seems to be a relevant factor for women, who mainly avoided using the bus at night, radically reducing their travel possibilities, restricting them from activities such as working night shifts or entertainment.

Service quality

Table 4 shows the means, standard deviations and factor loadings of the variables associated with this factor, which explained 9.1% of the variance in the data. Most variables in this dimension yielded means between 3.18 and 4.45, showing that riders evaluated the performance of various aspects of

public bus service quality as moderately deficient on average. The lowest averages were night service (3.18), followed by rush hour service (3.30). Among our total sample, 55% evaluated the variables of this factor with grades lower than 4, meaning they perceived service quality as insufficient.

Table 4. Service quality variables

Variable	M	SD	Factor loadings
Service is adequate in general	4.20	1.14	0.712
Evening service is adequate	3.18	1.47	0.701
Service during rainy days is adequate	3.51	1.45	0.696
Weekend service is adequate	4.06	1.57	0.694
Service during rush hour is adequate	3.30	1.45	0.688
Service in my commune is adequate	4.45	1.41	0.660
Relationship between ticket price and service quality is acceptable	3.34	1.50	0.631

Young respondents (younger than 25 years of age, 44.8%) showed a higher proportion of passengers who disagreed with the service quality, but the elderly (older than 60 years, 26.6%) reflected a clear tendency not to perceive disadvantages because of the service quality. This is consistent with occupation, where university respondents (43.3%) showed the second greatest perception of service quality disadvantages, preceded by the unemployed (47.6%). On the other hand, stay-at-home moms and dads (21.9%) and those who are retired from the workforce (11.1%) evaluated service quality better. Regarding multidimensional poverty, riders living in districts with the highest multidimensional poverty had lower perceptions of service quality (poorer districts, 47%).

Focus groups show an outstanding problem is the rush-hour bus service because of agglomerations. Buses are heavily crowded, making boarding impossible and resulting in the rejection of passengers boarding the bus due to the discomfort of others' proximity or the idea of having to get inside the bus by force (pushing others). This situation excludes some riders from traveling during rush hours, especially women, the handicapped and the elderly.

Bus stop infrastructure

We previously categorized the variables associated with this dimension as facility disadvantages and addressed different infrastructure aspects. Items selected in the factorial analysis indicated the variables that explain greater variances were only those related with the facilities at the bus stops, thus redefining the dimension, with 5.3% of data variability.

Table 5 lists items related to bus stop infrastructure. The average of the variables associated with this factor is close to 4, and only 17% of the respondents rated the questions associated with this factor lower than 4.

Table 5. Bus stop infrastructure

Variable	M	SD	Factor loadings
With which grade would you evaluate ceilings in bus stops	4.07	2.00	0.816
With which grade would you evaluate lighting at bus stops	3.88	2.05	0.780
With which grade would you evaluate seats at bus stops	3.82	1.99	0.768
With which grade would you evaluate bus stop capacity	4.16	1.91	0.663

According to the focus groups, some of the obstacles related to bus stop infrastructure were its surroundings, which included poor street and sidewalk maintenance and poor public lighting. A bus stop is described as a simple post with a small sign that cannot be seen at night because it lacks lighting. The bus stop infrastructure was also unable to protect users from the rain, the cold or the summer sun. A relevant complaint, was the lack of public toilets required for passengers who usually spend long periods traveling. Consequently, riders make use of several strategies, such as drinking less water in the morning or before leaving work and requesting permission in commercial places (such as restaurants) to use the bathroom, which is not always allowed. Although it is understood that this problem is especially uncomfortable for women, it is also relevant for bus drivers, who need to solve the problem by urinating in plastic bottles or bags to allow for uninterrupted travel.

Accessibility

This dimension (Table 6) explains 4.5% of the data variability, and 39% of respondents rated this factor below 4. Most evaluated variables had a mean between 3.10 and 5.36, showing that, on average, passengers evaluated the performance of accessibility aspects in the public bus service in a moderately deficient way. The variable with the lowest average was “The number/variety of routes that help you reach your destination at night” (3.10).

Table 6. Accessibility

Variable	M	SD	Factor loadings
With which grade would you evaluate the number/variety of routes that help you reach your destination during daytime	4.16	1.83	0.833
With which grade would you evaluate the number/variety of routes that help you reach your destination at night	3.10	1.74	0.758
With which grade would you evaluate it is easy to access public transportation from your home	5.36	1.54	0.549

With which grade would you evaluate the frequency with which the bus helps you get to your destination passes	4.37	1.57	0.520

The group of riders aged 60 or older (59.2%) showed a clear tendency to be disadvantaged in this factor. A similar tendency can be observed with multidimensional poverty, where the highest proportion of those disadvantaged by accessibility were passengers residing in districts with high multidimensional poverty, that is, the poorest districts (55.4%).

Focus groups reported a lack of bus routes and the need to make multiple transfers to reach their destinations. They mentioned that the flow of buses is greater in routes less used than in those with greater demand, and they questioned the number of bus stops close to their homes. Nevertheless, participants considered that, in general, public bus service allowed access to numerous destinations, somehow covering the city as a whole.

Information

This dimension explains 4.3% of the variance or variability of the data, and only 3% of those surveyed had a bad perception associated with information. Most evaluated variables had a median between 4.03 and 5.63 (see Table 7), showing that passengers, on average, evaluated this dimension's performance as regular.

Table 7. Information

Variable	M	SD	Factor loadings
Information about arrival times is accurate	5.40	1.45	0.897
The information provided by mobile applications is adapted to your needs	5.63	1.38	0.893
The information of routes in the stops is adequate	4.03	1.68	0.346

These results contrasted with the focus group participants' opinions; they noted it was difficult to estimate the arrival time of the bus or the duration of the trip because there was no precise information on the routes at the stops or platforms. Although there are applications to visualize the waiting time, they argued these were not precise, making it difficult to plan their trips.

Those most affected by this disadvantage are the elderly, who experience the digital divide by having less experience and skills using smart phones. The experiences reported in the focus groups show that elderly passengers use the bus system based on their memories or after consulting other people to gather information. Rationalization of time based on real time information is less accessible to this group of passengers.

Driver's Behavior

We previously categorized the variables correlated with the driver's behavior as disadvantages related to the travel experience, which addressed different aspects of the service. Variables here selected by the factorial analysis were only associated with the bus drivers' behavior toward passengers, thus redefining the dimension, which explains 3.7% of the data variability.

The medians for these variables are between 4.52 and 4.72 (Table 8), representing a regular–deficient general evaluation on this aspect of bus travel. However, 20% of respondents rated the questions of this factor with a score less than 4 on the Likert scale; 26% of women perceive a disadvantage on this dimension, compared to 14% of men. On the other hand, riders who reside in low multidimensional poverty districts, showed greater disadvantage on this matter (32%).

Table 8. Driver's Behavior

Variable	M	SD	Factor loadings
Behavior of drivers toward elderly or disabled passengers is correct	4.72	1.56	0.891
The treatment of drivers toward passengers is adequate	4.52	1.45	0.862

Improvements in buses

Variables selected by the factorial analysis here indicate a strong correlation, explaining 3.4% of data variability. The medians for these variables are between 5.13 and 6.35 (see Table 9), stating that improvements to the public bus system have been well received by passengers. This disadvantage impacted only 12% of the sample. University students and the unemployed passengers perceived the most disadvantage on this matter.

Table 9. Improvements in buses

Variable	M	SD	Factor loadings
The new electric buses are an improvement to the system	6.35	0.90	0.772
The location of preferential seats are adequate	5.13	1.60	0.622

Harassment

Variables associated with harassment have strong correlations, showing a specific aspect of security relevant to Santiago's bus passengers, and explaining 3.1% of data variability. As previously mentioned, these variables loaded in factor 1, but we decided to present them in a different factor because of a higher load.

Table 10. Harassment

Variable	M	SD	Factor loadings
How safe do you feel faced with the possibility of being harassed at the bus stop	3.87	2.19	0.763
How safe do you feel faced with the possibility of being harassed inside the bus	3.89	2.13	0.738

Table 10 shows the medians for these variables are 3.87 and 3.89. Although the evaluation is approximately half the scale, it is important to note that this disadvantage affected 45% of the sample, which is significant considering differences according to sex and age. Of women, 65% perceive a disadvantage on this dimension, compared to only 23% of men. On the other hand, when observing data related to age, young people (55%) and young adults (49%) had greater perceptions of harassment, compared to adults (37%) and the elderly (29%). In the focus groups, women reported that they preferred to avoid traveling longer distances in order to avoid waiting at stops located in dangerous sectors, as well as avoiding the use of highly congested routes for fear of harassment.

Conclusions

This research observes the disadvantages faced by passengers of public transit buses in the Chilean Metropolitan Region through qualitative and quantitative analyses. We presented a descriptive analysis to observe the sociodemographic variables, the characteristics of the respondents' trips, and the characteristics of the respondents who had been excluded from a public transit bus at least once. We used a methodology based on multivariate techniques, with variables associated with public transportation, such as physical, geographical, temporal, security, economic, travel experience, facilities, informational and general aspects, for the evaluation of eight factors (dimensions) that explain the disadvantages faced by passengers of public transit buses.

The research shows that more than 50% of riders have at least once been unable to use public transit buses; the main reason is safety, specifically when the bus is crowded and they must avoid uncomfortable friction with other passengers. Those who have the ability to do so (they can afford a larger fee or have the extra time), prefer to use another means of transportation to reach their destination. Thus, the public bus service does not respond to passengers' needs, and passengers choose it primarily because it is the cheapest alternative.

The factorial analysis shows the exclusion and disadvantages of public bus travel. Data confirm the hypothesis that the experience and/or decision to use public transit buses is influenced by

various factors, of which we considered seven of the dimensions originally proposed as effectively relevant.

Although service quality and accessibility are the issues commonly highlighted in evaluations of the public transit bus service in Chile, this study shows that security is the dimension users evaluated as the worst and presents a greater disadvantage for the use of this mode of transportation. Harassment, although an element that is usually evaluated within security, conforms to a different dimension, particularly relevant for women, reducing their access to public bus travel in several conditions: when a bus is overcrowded, during the night, or crossing through specific urban zones defined as dangerous. This results in longer trips (women chose longer but safer routes), time disadvantages, more expensive means of travel (experiencing economic disadvantage) or decisions to stay home, thus avoiding the dangers of harassment (experiencing social exclusion). These observations indicate a need to study transportation disadvantage from a gender perspective and to identify how women and sexual minorities are more excluded from social opportunities and services from the perspective of public transportation access.

A low percentage of the sample was affected by disadvantage associated with information. The most efficient and reliable way to obtain information about times and routes are cell phone applications (external to those offered by the bus service), which are not available for the elderly, as they do not have experience in their use.

Having exposed the above, Hine and Mitchell's (2004) propositions are confirmed in the public bus system in Santiago. We found that the most exposed groups to the disadvantages of transportation are the elderly, women, the unemployed, low-income people and youth. According to the evidence, there are greater inequalities for women (influenced in a greater proportion by the dimension of security, driver behavior and harassment), young people (affected with greater intensity in the dimensions of safety, service quality and harassment) and the elderly (disadvantaged in greater proportion due to the dimension of infrastructure, bus stops infrastructure, accessibility and information).

Some recommendations for public policy include the following. (i) Resources should focus on aspects related to safety at bus stops, as well as during rides, by considering elements such as lighting or remote video control and allowing for better perceptions of security, especially for women. (ii) Methods should be implemented to reduce the travel times of passengers residing in peripheral sectors; knowing most usual destinations, implementation of express routes that allow riders a more

expeditious ride without the need for transfers is advisable. (iii) The lack of night service is relevant, so emphasis should be placed on improving and increasing the fleet of buses that circulate at those times. (iv) Finally, it is important to study the factors that affect or benefit older adults and propose improvements in those areas, given that the Chilean population is aging rapidly.

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Appendices

Table 11. Rotated factors loading Matrix

Variable	Factor								Communality
	1	2	3	4	5	6	7	8	
How do you evaluate your safety using a cell phone inside the bus?	0.80								0.74
How do you evaluate your safety using a cell phone while waiting for the bus?	0.80								0.75
How do you evaluate your safety with the possibility of being robbed while waiting for the bus?	0.76								0.65
How safe do you feel with the possibility of being robbed/attacked inside the bus?	0.75								0.67
How safe do you feel with the possibility of being robbed/attacked while riding the bus at night?	0.72								0.67
How do you evaluate your safety while waiting for the bus at night?	0.69								0.60
How do you evaluate your safety when traveling alone?	0.64								0.57
Service is adequate in general		0.71							0.58
Evening service is adequate		0.70							0.68
Service during rainy days is adequate		0.70							0.61
Weekend service is adequate		0.69							0.62
Service during rush hour is adequate		0.69							0.60
Service in my commune is adequate		0.66							0.58
Relationship between ticket price and service quality is acceptable		0.63							0.63
With which grade would you evaluate ceilings in bus stops			0.82						0.76
With which grade would you evaluate lighting at bus stops			0.78						0.66
With which grade would you evaluate seats at bus stops			0.77						0.73
With which grade would you evaluate bus stop capacity			0.66						0.66
With which grade would you evaluate the number/variety of routes that help you reach your destination during daytime				0.83					0.79
With which grade would you evaluate the number/variety of routes that help you reach your destination at night				0.76					0.73
With which grade would you evaluate it is easy to access public transportation from your home				0.55					0.57
With which grade would you evaluate the frequency with which the bus helps you get to your destination passes				0.52					0.53
Information about arrival times is accurate					0.90				0.83
The information provided by mobile applications is adapted to your needs					0.89				0.86
The information of routes in the stops is adequate					0.35				0.51
Behavior of drivers toward elderly or disabled passengers is correct						0.89			0.84
The treatment of drivers toward passengers is adequate						0.86			0.82
The new electric buses are an improvement to the system							0.77		0.65
The location of preferential seats are adequate							0.62		0.54
How safe do you feel faced with the possibility of being harassed at the bus stop	0.51							0.76	0.85
How safe do you feel faced with the possibility of being harassed inside the bus	0.56							0.74	0.87