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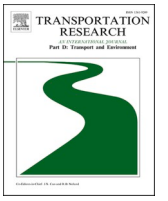

Lifting urban mobility for the poor: Cable-cars, travel satisfaction and subjective well-being

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ABSTRACT

Studies on travel and life satisfaction in vulnerable Global South contexts are scarce. This paper contributes by addressing how travel satisfaction, neighborhood satisfaction, and social capital relate to life satisfaction among a low-income community in Bogotá (Colombia) as a case study. Building on the available literature, we propose six hypotheses to understand such relationships before and after a cable car implementation, considering control and treatment groups. We defined seven latent variables and three objective indicators. We tested the hypotheses using a multiple-cause multiple-indicator modeling approach, which allowed us to identify how the comprehensive cable car intervention impacts perceptions and life satisfaction. Results showed that the principal factors associated with life satisfaction were neighborhood satisfaction as well as leisure activity participation, while travel time and transport affordability had negative effects. Positive changes in satisfaction regarding the travel experience can trigger significant improvements in life satisfaction in low-income communities in Latin America.

1. Introduction

As social agendas have been identified, transport plays a role in (re)producing poverty and social disadvantage (Lucas, 2012). Urban infrastructure investments are highly capital intensive, and their benefits are as much societal as they may be economic, often with the first outweighing the second. Thus, comprehensive public transport projects should address modern concerns in urban planning and development with a focus on health and well-being such as neighborhood and travel satisfaction, better accessibility, and overall subjective well-being. This is particularly important in cities where there are marked social, economic, environmental, and spatial inequalities and low motorization rates. Recent socially-oriented transport research and practice recognize that, besides providing adequate infrastructure and services, it is essential to assess the social contributions of transport through novel methods and data, particularly in contexts of transport infrastructure innovations. Such an understanding of the social function of transport could help to achieve more inclusive, safe, and sustainable cities (Oviedo and Guzman, 2020a). Life satisfaction measures, which have

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progressively become commonplace for public policy, can contribute to the aforementioned need to recognize the social contributions of transport and provide progress indicators. As life satisfaction is recognized as a policy goal itself (Diener et al., 2015), there is an increasing need to focus to understand the well-being experiences of mobility (De Vos et al., 2013). If transport is to be approached as a social policy, its core aim should be the improvement of population well-being, where urban planning and environment contribute to life satisfaction, quality of life (Panagopoulos et al., 2016), and social capital.

A limited number of empirical studies have provided evidence of the relationships between travel and neighborhood perceptions, and life satisfaction. Low-income areas elicit interesting questions about the determinants of life satisfaction, defined as individuals' perceptions of their own life in affective and cognitive terms. That is life satisfaction enables understanding how well somebody's life is going -high life satisfaction means that people feel good, have pleasant emotions, and are satisfied with their life- (Diener, 2000). Considering stark social and spatial inequalities across social groups, the type of inquiry that travel satisfaction promotes can shed light on the perceptions of poor, vulnerable, and excluded people about this issue, which are likely to differ from what the current literature on this topic says, as it has been suggested by emerging research outside of industrialized contexts (Oviedo et al., 2017). Understanding this can help inform policies seeking to improve individual life satisfaction or subjective well-being (SWB henceforth). However, the determinants of SWB are context-dependent, because the needs of each community are different, and vary according to their socio-cultural conditions.

Understanding the implications of perceptions and objective measures on SWB due to new public transport projects is thus necessary. While innovations in transport in urban settlements of the Global South have been highlighted as signs of positive progress in urban and transport planning literature, such interventions have not been evaluated concerning effects on SWB. There is limited research in this area in the context of rapidly developing urban contexts, with only a handful of studies associating well-being definitions with transport (Anand et al., 2005; Chatterjee et al., 2020; Reardon et al., 2019), and even scarcer research examining the links between transport and well-being in socially disadvantaged communities (Oviedo and Sabogal, 2020). Using data from residents of two poor and peripherical areas in Bogotá (Colombia), this study adapts Campbell's model (Campbell et al., 1976) to investigate the influence of perceptions and experiences on SWB. It incorporates indicators in a recently implemented cable car system (TransMiCable) which includes urban interventions such as green, social, cultural space, and recreational facilities (Sarmiento et al., 2020).

The proposed framework identifies three main domains to understand and explain SWB: travel satisfaction, built environment satisfaction, and social capital. We identified the mechanisms by which SWB is affected by those three domains using a Structural Equation Multiple Cause Multiple Indicator (SEM-MIMIC) model. The driving research aim is therefore to understand whether changes driven by the implementation of a comprehensive public transport project can affect the SWB. We decided to use the SEM-MIMIC approach instead of a multigroup CFA because the former requires less sample for its estimation and allows detecting heterogeneity in the measurement of latent variables between different groups (Allen et al., 2020). We illustrate how the aforementioned three domains influence the SWB of residents of our case study. The analysis unpacks how subjective and objective factors change perceptions and travel satisfaction on SWB indicators, contrasting a treatment with a control zone. The paper deploys a quasi-experimental approach to the assessment of the impact on SWB by introducing a control group. This allows us to present a more rigorous estimation of how the TransMiCable project influenced both objective factors and perceptions and their contributions to SWB. The research complements traditional project assessment approaches by identifying perceived and observed variables that explain SWB. Results provide insights into comprehensive public transport projects in a context of social vulnerability that might be extrapolated to other cities. The remainder of the manuscript is organized as follows: the second section presents an overview of how satisfaction with travel and the built environment influence subjective well-being based on existing literature. We then present the case study, the methodological approach, the analysis of results, and the conclusions.

2. 2. Built environment, travel satisfaction and well-being

Transport plays an essential role in reaching activities that have meaning for people's lives. Such activities can be broadly categorized into mandatory activities -i.e., those related to economic participation-, and non-mandatory activities, such as leisure, which are often more closely related to pleasure or personal satisfaction (Mouratidis, 2018). It is in this context, measuring SWB and identifying its drivers (determinants) can provide clues to the population's needs and could help evaluate urban interventions. Frequently, the definition of SWB has been divided into hedonic and eudaimonic. The first encompasses positive and negative emotions and satisfaction with life (Diener, 2000; Diener et al., 2009), while the second is about the purpose or meaning of life and personal growth. According to Diener (2006), plays a significant role in health and quality of life. The OECD (2013) guidelines provide a framework for different domains of SWB, suggesting that the use of these measures allows supporting policy evaluation and helps identify policy problems. In different contexts, common approaches from governments to increase SWB include improvements in public service conditions, promoting leisure activities, and reducing travel times (Adler and Seligman, 2016). However, the contributions of interventions not originally conceived as a well-being intervention are not often evaluated from this perspective, meaning public sector agencies may be underestimating the portfolio of actions that can improve SWB.

In the last decade, research that relates SWB to commuting has increased (Chatterjee et al., 2020; Friman et al., 2017), with more sophisticated research linking SWB with accessibility (Lionjanga and Venter, 2018), neighborhood perceptions (Cao, 2016; Friedman et al., 2012; Parra et al., 2010), disadvantage and inequality (Oviedo and Sabogal, 2020; Reardon et al., 2019) and social capital (Cramm et al., 2013). Commuting is a crucial issue in urban life since allows participation in activities to satisfy human needs, which is closely related to the quality of life (QoL) (Oviedo and Guzman, 2020b; Zheng et al., 2019). However, financial constraints, time availability, spatial barriers, and low access often lead to the exclusion of people from community life and negatively affect their well-being (Simpson, 2003).

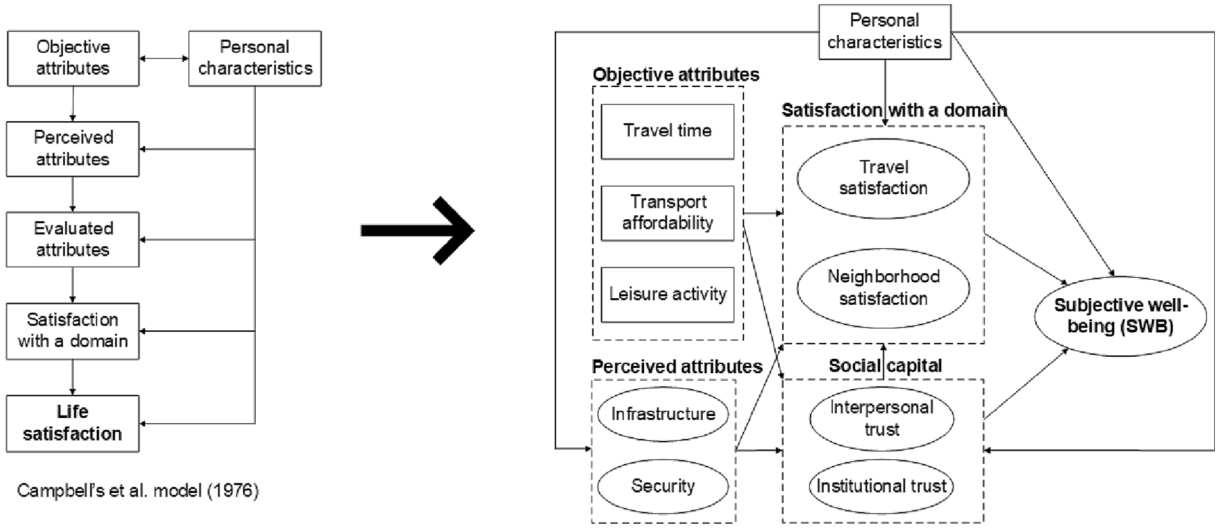

Fig. 1. Conceptual model.

Approaches to link mobility with SWB through subjective and objective factors in the literature are diverse. Delbosc (2012) highlights that objective indicators of transport systems are more frequently studied than the social impacts and perceptions of transport infrastructure. Although objective indicators provide insightful information, perception measures and well-being can complement the traditional perspective and assist policymakers in making better decisions (Nahmias-Biran and Shiftan, 2016). The objective factors chiefly include travel time, modal choice, affordability, and leisure activity participation. Travel time has been found to have a negative correlation with SWB in some contexts (Hilbrecht et al., 2014; Morris, 2015), although several studies did not find evidence of this relationship (Dickerson et al., 2014; Lorenz, 2018). Research examining accessibility's effects on the SWB of lower-income households have found that positive contributions from the first to the second (i.e., more free time) are driven by improved affordability (Lionjanga and Venter, 2018). This is consistent with policy-oriented research examining affordability through focalized public transport subsidies, which has found that reductions in the economic burdens of mobility also improve accessibility and equality (Guzman and Oviedo, 2018). Other findings show that leisure participation is an important contributor to SWB (Hilbrecht et al., 2014). Activity participation strengthens social networks, thus increasing SWB. However, research from transport-related disciplines suggests that greater generalized travel costs can reduce the amount of participation in social activities (Archer et al., 2013; Guzman et al., 2017a). The examination of the combined effects of objective and subjective factors found that travel satisfaction influences, directly and indirectly, SWB. The examination of different experiences of travel satisfaction suggests that driving and active modes had more positive effects on SWB than public transport (Friman et al., 2017). In summary, previous results suggest that SWB is directly affected by satisfaction with leisure activities and indirectly affected by travel satisfaction (De Vos, 2019; He et al., 2020).

Research outside of mobility studies suggests that the neighborhood environment is another relevant domain of SWB. Individual perceptions of the built environment affect individual SWB since people spend a significant amount of time in their neighborhoods where they do different activities and have social interactions (Kent et al., 2017; Ma et al., 2018a). Nevertheless, the way that the objective and subjective variables affect the SWB differs across studies and contexts. Perhaps the first case where objective neighborhood attributes were found to indirectly affect life satisfaction was presented by Campbell et al. (1976). They argued that life satisfaction is affected directly by other satisfaction factors, which are in turn affected by perceived attributes and objective characteristics. This model was later adapted to explain life satisfaction through residential satisfaction and perceived and objective neighborhood attributes, finding that density and street connections affect perceived accessibility and nuisance, which in turn affect residential satisfaction, and, as a consequence, life satisfaction (Cao, 2016). Mouratidis (2018) presents a conceptual framework that explains how objective and perceived neighborhood characteristics can affect SWB determinants. Other perceived aspects such as safety, neighborhood aesthetics, and social environment also influence SWB and QoL (Friedman et al., 2012; Ma et al., 2018a, Ma et al., 2018b).

Another aspect considered in this study is social capital. There seems to be a fine line between SWB and social capital definitions. Some studies found that social capital is closely related to neighborhood satisfaction, but this relationship was stronger at the neighborhood scale than at the individual level (Vemuri et al., 2011). Social capital indicators have been used as mediators between neighborhood variables such as a sense of community (a component of social capital), finding that dissatisfaction with environmental factors may result in low trust in the community and low SWB (Zhang and Zhang, 2017).

The above studies and definitions relate SWB with the domains framing our case study. Travel experience, neighborhood perceptions, and social capital are related and have effects on SWB. Although the relationship between those three domains is widely accepted, their empirical integration and effects on SWB are less studied. In this case, SWB is defined as the psychological component of the QoL, a definition given by the WHO (Orley, 1996). Among the studies that encompass those three domains, the use of structural equation modeling (SEM) is common (Curl and Mason, 2019; He et al., 2020; Ma et al., 2018a).

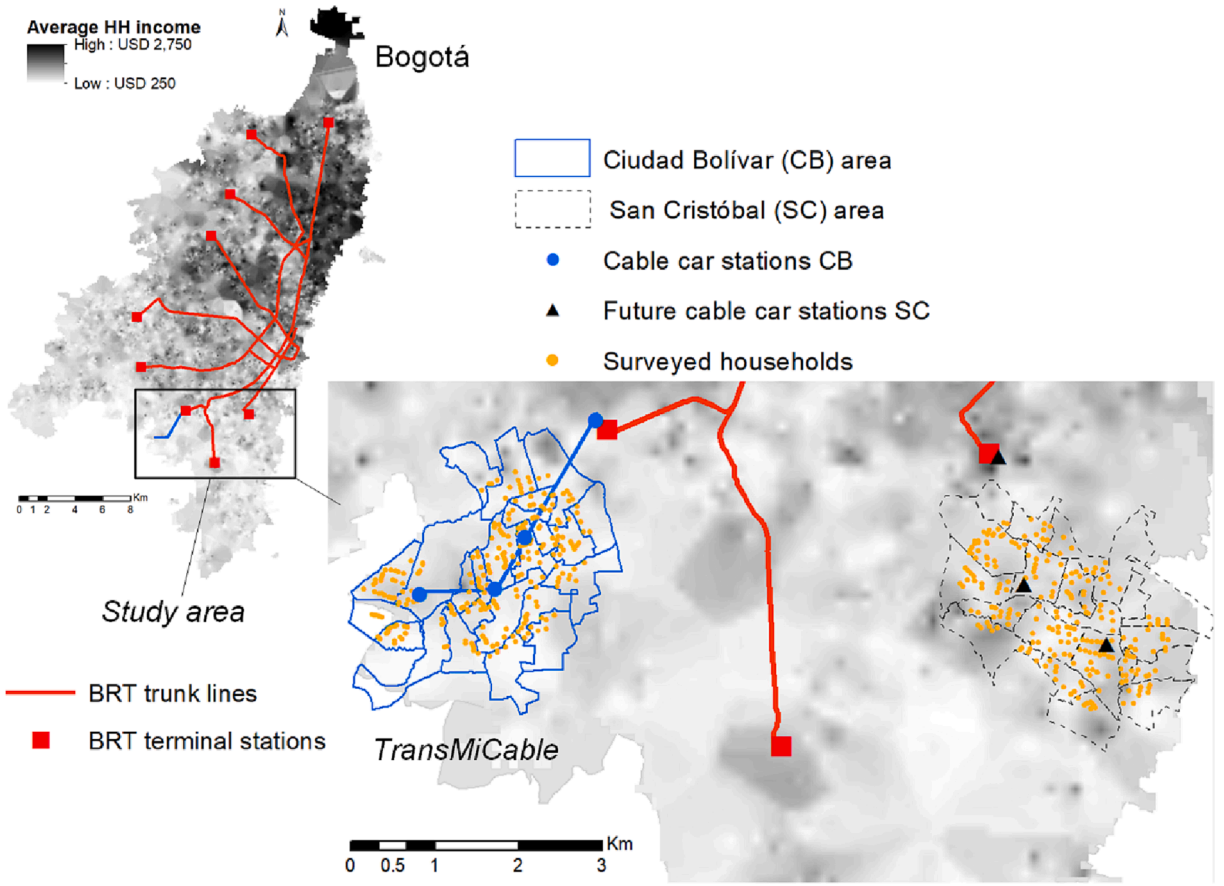

Fig. 2. Study area.

Putting it together, the conceptual framework for SWB and travel satisfaction is shown in Fig. 1. This study proposes a conceptual model to explore the influence of personal characteristics, objective attributes (i.e., mobility indicators), perceived attributes (i.e., travel experience and neighborhood perceptions), and satisfaction with three domains (i.e., travel satisfaction, neighborhood satisfaction, and social capital) on SWB. Mobility indicators refer to travel time, transport affordability, and leisure activity participation. Perceived attributes relate to individual perceptions about infrastructure in the neighborhood and security, which is quite relevant in developing cities (Arellana et al., 2020; Guzman et al., 2022a).

This conceptual framework for the assessment of SWB involving several domains can support public policy and be applied to contexts with high levels of social and transport disadvantage. Also, one of the important contributions of this study is to measure the associations between factors that affect SWB in low-income areas, characterized by segregation, informality, and disconnection in Latin American cities. In the next section, we describe the proposed case of study.

3. Urban transport by air: The TransMiCable case study

As a consequence of recent progress in the recognition of the challenges for urban mobility in peripheral and marginal communities, several Latin American cities have developed alternatives to traditional urban transport solutions, such as cable cars, often in conjunction with complementary interventions on the built environment and urban services (Brand and Dávila, 2011; Sarmiento et al., 2020). Such a transport alternative has gained traction in urban policy agendas in recent years, partly as a result of a growing body of evidence of its effects on the mobility and accessibility of poor and segregated urban communities, but also because of a relatively straightforward planning and implementation process that enables speedy delivery often within a single political cycle. According to the literature on existing cable cars, some of their main are positive impacts related to accessibility through the reduction of travel times and travel costs (Garsous et al., 2019; Heinrichs and Bernet, 2014), a decrease in crime and homicide rates (Bea, 2016; Cerda et al., 2012), changes in quality of life (Milan and Creutzig, 2017) and travel behavior (Okami et al., 2022), air pollution exposure reduction (Morales-Betancourt et al., 2023), and have also met their user's expectations (Guzman et al., 2022b). However, there is no research regarding the effects of cable car satisfaction and SWB.

TransMiCable, our case study intervention, consists of one aerial cable car line with four stations, with a total length of 3.43 km. Its capacity is 3,600 passengers per hour, moving around 27,000 passengers daily. It is connected to a terminal station of the Bogotá Bus

Table 1
Sociodemographic characteristics of respondents.

Attribute		Treatment group Ciudad Bolívar (CB) *n = 1,031*	Control group San Cristóbal (SC) *n = 1,021*
Gender	Male	35.2%	39.2%
	Female	64.8%	60.8%
Age	18–27 years	24.8%	24.3%
	28–40 years	22.8%	27.2%
	41–57 years	24.5%	25.2%
	>57 years	27.8%	23.3%
Education level	Low [none, primary school]	38.8%	25.1%
	Medium [high school]	45.2%	50.3%
	High [professional or postgraduate]	16.0%	24.6%
Marital status	Single	20.8%	32.4%
	Married	53.4%	50.0%
	Divorced/widowed	25.8%	17.6%
Employment status	Unemployed	36.3%	35.7%
	Employed	50.0%	52.5%
Income	Very low [< US$265]	54.3%	35.6%
	Low [US$265-US$530]	37.7%	49.3%
	Medium-low [≥ US$530]	7.9%	15.1%
Time in dwelling	0–8 years	31.7%	35.4%
	9–25 years	35.8%	31.2%
	>25 years	32.5%	33.4%
Dwelling type	Own	41.7%	46.9%
	Leased	30.2%	34.1%
	Other	28.1%	19.0%
Household size	< 4 people	54.2%	53.5%
	≥ 4 people	45.8%	46.5%

Table 2
Transport characteristics in the intervention and control groups.

	Baseline measurement (T0) Intervention (CB) (N = 1,031)	Control (SC) (N = 1,021)	*p-value*	Follow-up measurement (T1) Intervention (CB) (N = 825)	Control (SC) (N = 854)	*p-value*
Daily spending on transport (x1,000 COP) (SD)	5.2 (8.3)	5.3 (6.9)	0.876	4.2 (3.8)	5.5 (11.7)	0.032
Public transport satisfaction (*1: Non-satisfied – 10: Totally satisfied*) (SD)	4.4 (2.6)	4.2 (2.5)	0.105	5.4 (2.6)	4.4 (2.5)	<0.001
Main transport mode - Commuting trips						
	Modal split [%]			**Modal split [%]**		
Public	62.1	67.8	<0.001	46.7	62.8	<0.001
Public-active	21.4	19.5		23.7	22.7	
Public-private	4.1	2.6		3.8	2.6	
TransMicable	–			11.9	–	
Public-informal	6.2	1.4		5.6	1.7	
Private	6.2	8.6		8.3	10.2	
TransMiCable ever used since the inauguration	–		–	75.8	–	–
Travel time - One way (SD)	110.0 min (67.3)	89.9 min (54.1)	<0.001	90.2 min (53.9)	85.9 min (64.8)	0.280
Avg. trips/day per person	0.8	0.9	–	1.0	1.1	–
Discretional trips - One way						
Avg. trips/day per person	2.8	1.8	–	3.0	1.9	–
Time on weekday (SD)	40.1 min (29.2)	45.2 min (38.4)	0.077	38.2 min (51.7)	41.4 min (38.2)	0.192
Time on weekend (SD)	41.0 min (46.5)	46.9 min (42.3)	0.013	33.4 min (36.0)	43.6 min (45.6)	<0.001

Rapid Transit (BRT) system named *Portal Tunal* (Fig. 2). Before the cable car, a typical peak hour journey between the *Portal Tunal* and *Mirador del Paraíso* (i.e., the highest cable station) could take up to one hour, so the cable car offers a saving in travel times of almost 80%. The project also includes a complementary urban redevelopment plan, including additional facilities for cultural, recreational, and social activities, community centers, and a program to support home improvements to reduce geomorphological hazards in the

zone (Sarmiento et al., 2020).

The project was implemented in a poor and peripheral area in late 2018 in the Ciudad Bolívar district (CB henceforth), as shown in Fig. 2. This area (the treatment area) comprises a set of households located in blocks and neighborhoods within an 800-m airline buffer around each TransMiCable station. The control area includes households in the area of influence of a future cable car in the San Cristóbal district (SC henceforth). The potential area of influence of the cable car in this group also comprised an 800-m buffer around future stations. SC is an adequate control area for the following reasons: 1) This cable is in the process to tender for construction works; 2) there are geographical barriers separating intervention and control groups, limiting contamination; 3) both groups have similar topography characteristics and similar cable car system characteristics (length, elevation difference); and 4) household socioeconomic characteristics of the two zones are very similar (see Table 1).

The population in the zone of influence of the treatment and control groups represents a socially vulnerable population with low income, a high percentage of self-built informal urban settlements, unplanned urbanization, and poor accessibility. According to local data, 94% of the households around TransMiCable have an income lower than a monthly minimum wage (approximately 265 USD in 2021). Moreover, around 96% of the households are cataloged at the lower level of socioeconomic strata (SES), an official housing classification system with six levels according to physical characteristics usually associated with urban quality, used primarily to focalize public service subsidies (Cantillo-García et al., 2019).

Table 1 shows the statistical description of the sample collected in both groups. Most of the sample is composed of women with>60%, and around 50% are married and employed. Primary and secondary educational levels are the most common, with 75% of the sample. Most of the population in Ciudad Bolívar report that the household income is less than one minimum wage. The employment status is similar between the two groups.

Before the inauguration of the TransMiCable, the most frequently used transport modes were regular bus and paratransit services. Approximately 90% of trips include public transport. When comparing T0 (baseline, before cable car) and T1 (follow-up, after cable car) we see that in CB around 12% of the participants report using TransMiCable for their regular trips. In the control group of SC, there is no change in the modal share. When we asked the population of CB who have used the cable car, at least 76% have used the cable car. The main reasons to use it are for personal security and travel time savings. Among the 24% who have not used the cable car, the main reasons are that the route does not serve them, it is an access problem, fear heights, and because of the (high) cost (see Table 2).

Mobility was characterized by high travel times due to the congestion generated by the interaction between traffic, the steep hills, and the circuitous streets that form the urban structure of the zone. Adding to the limited travel choices, such a situation can lead people to be socially excluded, having to spend valuable resources and time to fulfill their mobility requirements. The average travel time was reduced for TransMicable users who have very long trips: almost 2 h per commuting trip. By breaking down the trip by stage, the in-vehicle time is reduced by 11 min, but it is most reduced in the waiting time, which is a significant burden on users. It is also observed that public transport satisfaction improves, although it remains low.

Against this background, TransMiCable's social contributions are likely to meet the objective of improving citizens' SWB by improving accessibility and the built environment. In particular, analyzing the impacts of comprehensive public transport projects on SWB can help to understand why and how this type of project contributes to the perceptions of residential neighborhoods and travel satisfaction. The following section explains the hypotheses to be evaluated in the case study, the indicators to be evaluated, and the proposed modeling framework.

4. Hypotheses and methodological approach

We applied a panel survey in the study area to gather answers related to physical environment perceptions, social determinants of health, physical activity, mobility measures, and QoL. The panel consists of two periods: a baseline face-to-face survey before the implementation of TransMiCable in 2018 (T0) and a follow-up measurement (T1) between July 2019 and March 2020. In total, we collected 3,670 household surveys composed of 2,052 at baseline and 1,670 at follow-up (Sarmiento et al., 2020).

To estimate SWB determinants we focus on the survey questions related to the definition of travel and neighborhood satisfaction, institutional and interpersonal trust, infrastructure, and security. SWB has been defined through some indicators from the psychology domain of health-related QoL of WHO definition.

4.1. Hypotheses

Based on the conceptual framework from Fig. 1 and the data collected, we developed six hypotheses (H*x*) that seek to understand the relationship between different domains on SBW in both groups (i.e., treatment and control) before and after implementing TransMiCable:

- Effects of objective attributes, perceived attributes, satisfaction with a domain, and social capital on SWB:

  H1: Objective attributes related to (public transport) travel satisfaction such as travel time, transport affordability, and leisure activity participation influence SWB.
  H2: Security and infrastructure perceptions influence SWB.
  H3: Travel and neighborhood satisfaction influence SWB.
  H4: The social capital domain influences SWB

- Effects of individual characteristics and TransMiCable on satisfaction with a domain, social capital and SWB:

H5: Satisfaction with domain variables, social capital, and SWB vary according to sociodemographic characteristics.
H6: The urban transformation of TransMiCable affects satisfaction with a domain, social capital, and SWB.

Hypotheses H1 to H4 aim to estimate how the objective and perceived attributes, and the satisfaction and social capital domains affect the SWB of the targeted population. Hypothesis H5 aims to explore differences between individuals regarding latent constructs within the conceptual model (i.e., perceived attributes, satisfaction, social capital, and SWB). The existing evidence suggests that SWB varies across individuals. Then, the effects of SWB determinants may also differ across groups (OECD, 2013). Finally, the aim of hypothesis H6 allows an understanding of how TransMiCable implementation changes satisfaction, social capital, and SBW considering both evaluation periods (i.e., T0 and T1).

We assume that there are no SWB changes either in the territory or over time. As we have seen, the control group is similar to the treatment group, so it is reasonable to assume the perceptions and the SWB do not differ. Also, it's difficult for the perceptions and QoL to change from T0 to T1 unless something happens. The only major intervention in the study area was the TransMiCable and its urban transformation.

4.2. Objective and perceived attributes

Considering the studied groups' location in the urban periphery, with low car ownership, and few local economic opportunities (Guzman et al., 2017b), we analyzed different constraints at an individual level related to activity categories. We use three objective attributes related to travel satisfaction by public transport. The first two are travel time to work/study and transport affordability. The first indicator refers to the travel times reported by each person from home to their principal activity. The second refers to an affordability indicator representing the monthly transport costs associated with the mandatory activity considering the household income.

The third travel satisfaction indicator is associated with the diversity of leisure activities, which measures non-mandatory activity participation and is also related to personal satisfaction. This indicator consists of the number of leisure activities carried out in the last 30 days at the survey time. We assessed eleven types of activities: physical activity in parks, *ciclovía*[1], attending sports events, theater, dance or live music, art or museum exhibitions, going to the library, cinema, parties or discos, eating out, recreational parks, and leisure walking. We propose an indicator that goes from 0 to 1, where 0 represents people who did not do these activities and 1 is when a person made activities more times than the third quartile of the sample combined with the maximum number of diverse activity types (see Eq. (1).

$$Leisure_{act} = \begin{cases} \frac{N_i}{N_{q3}} * 0.5 + \frac{D_i}{11} * 0.5 N_i < N_{q3} \\ 0.5 + \frac{D_i}{11} * 0.5 N_i \geq N_{q3} \end{cases} \quad (1)$$

Where N_i is the sum of the times each individual performed activities in the last 30 days. N_{q3} is the third quartile of N_i in the sample. D_i is the sum of the number of leisure activities that a person made during the previous 30 days of survey administration. Note that we assumed 50% importance for both diversity and the number of activities.

Regarding perceived attributes, security refers to this perception at the neighborhood level and when walking to reach public transport. The infrastructure indicator encompasses the perception concerning roads and sidewalks in the neighborhood, the path to get public transport, and the presence of flooding in the zone.

4.3. Satisfaction, social capital and SWB

A domain is a group of latent variables (LV), which define travel and neighborhood satisfaction, and social capital. Travel satisfaction includes the satisfaction of travel experience (*Tt_SAT*), the satisfaction with public transport in the neighborhood (*Tpu_SAT*), and public transport access (*Tpu*). Neighborhood satisfaction is related to the perception of how adequate living conditions are in the area (*Neigh_SAT*) and the pleasure of living in the neighborhood (*Like_neigh*). The concept of social capital encompasses social relations and potential cooperation between individuals and groups. We define social capital by measuring two variables, institutional and interpersonal trust. The first includes the level of trust in the government (*Trust_gov*) and police (*Trust_police*). The second considers the level of trust in family, neighbors, and friends in aspects such as child care (*Trust_child_care*), money lending (*Trust_borr_money*), and lodging (*Trust_accom*).

This study uses WHO Quality of Life Assessment (WHOQOL) psychology domain to define hedonic SWB. SWB is related to individuals' self-definitions of life satisfaction based on the vision "people are the best judges of how their own lives are going" (OECD, 2013). Table 3 shows the description of all model variables. Each indicator represented a survey question, measured according to the specialized literature.

[1] Is a program in which streets are closed off to motorized traffic (sundays and holidays) so that people have a safe and inclusive space for recreation and for being physically active.

Table 3
Indicators of latent variables.

Latent variable (LV)	Indicator	Indicator definition	Scale	mean CB	mean SC
Travel satisfaction	Tpu_SAT	Satisfaction with the public transport in the neighborhood	1:10 (not satisfied-totally satisfied)	4.38	4.18
	Tt_SAT	Satisfaction with transport in the last two weeks	1:5 (very bad-very good)	2.41	2.49
	Tpu	Urban public transport of the neighborhood	1:5 (very bad-very good)	2.52	2.39
Neighborhood satisfaction	Neigh_SAT	Satisfaction with living in the neighborhood	1:10 (not satisfied-totally satisfied)	7.04	7.25
	Like_neigh	Do you like to live in the neighborhood?	yes = 1	0.80	0.81
Social capital: Institutional trust	Trust_gov	Trust in government	1:5 (no trust - much trust)	1.32	1.60
	Trust_police	Trust in police	1:5 (no trust - much trust)	1.69	1.92
Social capital: Interpersonal trust	Trust_child_care	Trust for care your children (family, friends, neighbors, and others)	1:4 (no trust - trust several people)	1.98	2.04
	Trust_borr_money	Trust for borrow money (family, friends, neighbors, and others)	1:4 (no trust - trust several people)	2.07	2.14
	Trust_accom	Trust to ask for temporary accommodation (family, friends, neighbors, and others)	1:4 (no trust - trust several people)	2.08	2.12
Perceived attribute: Infrastructure	Sidewalks	Sidewalks condition in the neighborhood	1:5 (very bad-very good)	2.90	3.11
	Roads	Roads condition in the neighborhood	1:5 (very bad-very good)	2.87	2.77
	Flooded_areas	There are flooded areas on the path to access to public transport?	no = 1	0.49	0.57
	Unpaving_roads	There are roads without paving on the path to access to public transport?	no = 1	0.44	0.65
	Missing_sidewalks	There are missing sidewalks on the path to access to public transport?	no = 1	0.36	0.47
Perceived attribute: Security	Security_prob	There are insecurity problems in the neighborhood?	no = 1	0.14	0.16
	Security	Security in the neighborhood	1:5 (very bad-very good)	2.30	2.41
	Thefts	There are thefts on the path to access to public transport?	no = 1	0.10	0.16
	Drugs_env	People are drinking or using drugs on the path to access to public transport?	no = 1	0.07	0.18
SWB (life satisfaction)	Acceptance	Acceptance of physical appearance in the last two weeks	1:5 (very bad-very good)	3.91	3.70
	Oneself_SAT	Oneself satisfaction in the last two weeks	1:5 (very bad-very good)	3.80	3.55
	Negative_feelings	Frequency of negative feelings in the last two weeks	1:5 (very bad-very good)	3.46	3.73
	Enjoy_life	Enjoyed life in the last two weeks	1:5 (very bad-very good)	3.28	3.38
	Sense_life	Life made sense in the last two weeks	1:5 (very bad-very good)	3.84	3.61
	Concentration	Capacity concentration in the last two weeks	1:5 (very bad-very good)	3.42	3.35

4.4. Modelling approach

Firstly, we ran a confirmatory factor analysis (CFA) to confirm the validity of the LVs. We assessed the reliability and internal validity of each LV using the standardized Cronbach's alpha. Values higher than 0.6 suggest an acceptable correlation between survey indicators. After that, we used the SEM-MIMIC approach (Allen and Farber, 2020) to test all hypotheses. This approach allows for identifying the associations between the objective and perceived attributes, and satisfaction with a domain on SWB. Particularly, we identified the direct, indirect, and total effects of independent variables on the dependent variable SWB. The mode includes dummies to represent sociodemographic categories and if the individual belongs to the treatment group (CB) and linked them with each LV. This procedure allows for testing how different groups perceive latent constructs (Allen et al., 2018). We also included a dummy variable to identify how perceptions change after TransMiCable implementation (CB-T1 variable, see Table 6). The use of objective and perceived attributes provides an opportunity to identify the effects of observable attributes on people's cognitive processes, which cannot be considered without LVs (Vij and Walker, 2016). We estimated this model using the *lavaan* package in R (Rosseel, 2012).

The SEM-MIMIC model was formulated from the conceptual framework (see Fig. 1), testing the different associations between the variables to find the model that best represents the significative effects on SWB. We used three goodness of fit indices to assess the models, following the thresholds established by Schreiber et al. (2006):

- RMSEA: it determines the model fit to the covariance matrix of the sample with unknown coefficients. An index of$<$0.06 commonly suggests a good fit.
- CFI: compares the proposed model with a non-correlated model between latent variables. This index goes from zero to one. Values higher than 0.90 represent a good fit.
- SRMR: calculates the square root of the difference between the sample and the hypothesized model covariance matrix residuals. The accepted threshold values are$<$0.08.

Considering that the TransMiCable had a significant impact on its catchment area, the transport mode used before and after the project may influence the perception and objective variables, particularly in T1. To account for this, we estimated a model including

Table 4
Confirmatory factor analysis model.

Latent construct	Indicator	Estimate	Z-value	Cronbach's alpha (α)
Travel satisfaction	Tpu_SAT	0.78	67.41	0.73
	Tt_SAT	0.68	53.66	
	Tpu	0.74	59.98	
Neighborhood satisfaction	Neigh_SAT	0.86	33.28	0.64
	Like_neigh	0.75	28.22	
Social capital: Institutional trust	Trust_gov	0.69	22.92	0.65
	Trust_police	0.89	25.14	
Social capital: Interpersonal trust	Trust_child_care	0.40	16.35	0.46
	Trust_borr_money	0.62	19.92	
	Trust_accom	0.59	19.16	
Infrastructure perception	Sidewalks	0.65	36.21	0.71
	Roads	0.67	47.67	
	Flooded_areas	0.65	35.39	
	Unpaving_roads	0.74	45.41	
	Missing_sidewalks	0.67	46.92	
Security perception	Security_prob	0.76	37.81	0.66
	Security	0.72	46.25	
	Thefts	0.80	38.35	
	Drugs_env	0.61	23.57	
SWB	Acceptance	0.61	51.07	0.80
	Oneself_SAT	0.70	61.97	
	Negative_feelings	0.35	20.83	
	Enjoy_life	0.65	55.03	
	Sense_life	0.74	67.98	
	Concentration	0.62	48.80	
RMSEA		**0.038**		
CFI		**0.968**		
SRMR		**0.046**		

All variables are statistically significant at the 90% level. Z > 1.645: statistical confidence level > 0.90 (p-value < 0.1). Z > 1.96: statistical confidence level > 0.95 (p-value < 0.05). Z > 2.58: statistical confidence level > 0.99 (p-value < 0.01).

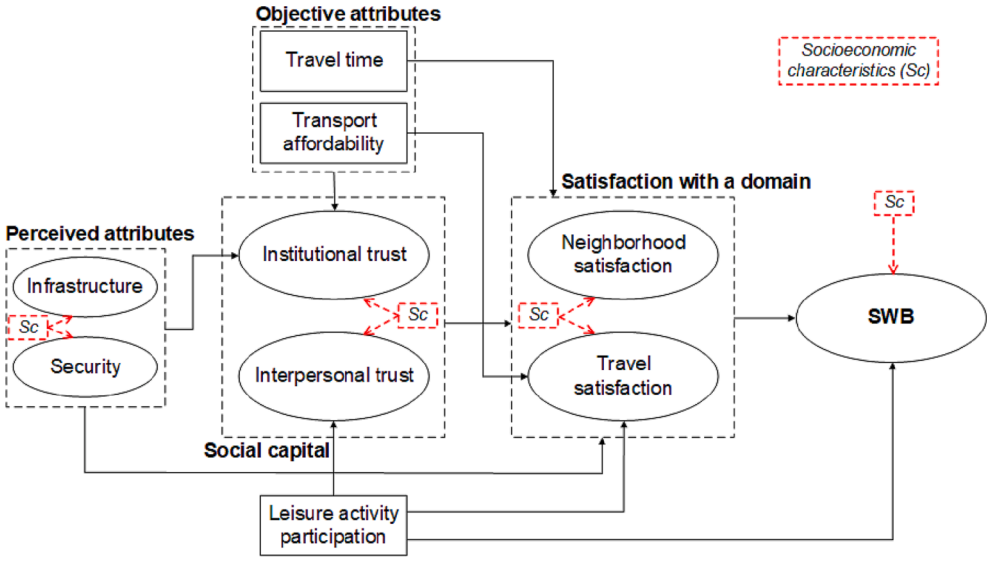

Fig. 3. Model diagram.

the main transport mode as a variable, obtaining that this variable is not significant since>90% of participants in our sample are public transport users or travel using a combination of transport modes that involve public transport.

5. Results

The CFA model shows the relationships between LVs (i.e., perceived attributes, satisfaction with a domain, and social capital) and their indicators, verifying the relationships between studied indicators and their LVs. The SEM-MIMIC model captures the relationships

Table 5
Total effects of model variables on SWB.

Variable	Estimate	z
Objective attributes related to travel		
Leisure activity participation	0.19	10.31
Travel time	−0.04	−4.60
Affordability	−0.002*	−0.85
Perceived attributes		
Security	0.14	11.72
Infrastructure	0.08	8.57
Satisfaction with a domain		
Neighborhood satisfaction	0.21	9.32
Travel satisfaction	0.10	4.61
Social capital		
Institutional trust	0.02	2.25
Interpersonal trust	0.02	2.49

* Not statistically significant variables at the 90% confidence level.

between LVs and assessed the association of observed and perceived attributes with travel satisfaction, neighborhood satisfaction, social capital, and SWB.

5.1. CFA model

Table 4 shows the CFA model results confirming that LVs can be logically inferred from observed indicators. The goodness of fit indices for the model suggests a good fit. All estimates are statistically significant at the 90% confidence level (Z-values > 1.64). Almost all standard coefficients show higher values than 0.60, indicating high reliability. Trust for childcare (*Trust_child_care*), trust for accommodation (*Trust_accom*), self-physical acceptance (*Acceptance*), and frequency of negative feelings (*Negative_feelings*) presented standard coefficients lower than 0.5, suggesting a low correlation between them and their LV. All Cronbach's alpha indexes show an acceptable correlation between indicators, except for the *interpersonal trust* LV. However, we decided to keep this LV as it was built based on theory.

5.2. SEM-MIMIC results

The results build on the proposed conceptual model defined in Fig. 1. After several iterations, we selected the model that allowed us to best assess the hypotheses and presented the largest number of significant parameters. The final models exhibit adequate goodness of fit according to the thresholds established in the literature (Schreiber et al., 2006). Although four of the parameters in the final model structure were not statistically significative, we decided to keep them to estimate differences between groups. Fig. 3 shows the SEM-MIMIC model diagram, where rectangles represent observed variables while ellipses refer to LVs. Here, LVs include socioeconomic characteristics as dummy variables in the regressions.

Table A1 in the Appendix presents the estimation results, where estimates refer to standardized coefficients of direct effects of independent variables. The RMSEA and SRMR values (i.e., RMSEA < 0.06 and SRMR < 0.08) suggest a good fit for our SEM-MIMIC model. The CFI values are higher than 0.90, being in an acceptable range for these models (Lucchesi et al., 2021). All coefficients are significant at the 90% confidence level, except for the direct effect of six variables.

Considering that we are interested in estimating the total effects of all objective and subjective variables, as well as the satisfaction and social capital variables on SWB, we performed a mediation analysis on the model depicted in Fig. 3. Table 5 presents the estimation of the total effects for all the variables, which correspond to the sum of direct and indirect effects on SWB. Understanding the total effects allowed us to test hypotheses H1 to H4. According to Fig. 3, the satisfaction variables mediate the relationship between the remaining model variables (i.e., travel indicators, perceived attributes, and social capital) with SWB. The only objective variable related to travel with a direct influence on SWB was the possibility of participating in leisure activities.

Although not all the model variables have a direct effect on SWB, all total effects are significant at the 90% confidence level, except for the *affordability* variable. The above results allow us not to reject our first four hypotheses. They confirm that objective variables related to travel, security and infrastructure perceptions, travel and neighborhood satisfaction, and social capital influence the SWB. I.e., the larger the estimate value, the greater the variation in SWB. The neighborhood satisfaction and the leisure activity participation variables have the largest effect on SWB. Therefore, the higher the satisfaction with the neighborhood and the possibility of participating in leisure activities, the higher the SWB. In contrast, an increase in travel times is associated with a decrease in SWB.

The third-largest impact on SWB is associated with perceptions of security. Hypotheses H2 and H3 refer to the previous effects, all of them showing a positive relationship with SWB. Moreover, the social capital domain had a positive influence on SWB. In general, the higher the individual capacity to engage in social relations and cooperate with other individuals and groups in the neighborhood, the greater their SWB. The results suggest that the greater the trust in local institutions, the higher the SWB. Along the same line, the greater the social support network, which traduces on more people and groups the individual can trust, the higher the SWB.

The SEM-MIMIC model includes dummy variables representing sociodemographic characteristics described in Table 1 and if the respondent lives in the treatment area (CB), where the TransMiCable urban transformation took place, or in the control area (SC). Also,

Table 6
SEM-MIMC results – total effects of sociodemographic characteristics and treatment area.

Latent variable ↓	Dummy variable →	Married	Divorced	Medium education level	High education level	Employed	Older than 57 years	Female	Medium-low income	Low income	CB	CB-T1
Travel satisfaction	Estimate	−0.1	−0.01	−0.01	−0.04	0	0.04	−0.02	0.07	0.04	0.05	0.19
	Z	−4.27	−2.51	−2.77	−3.87	NA	3.79	−2.44	3.31	1.84	2.31	8.89
Neighborhood satisfaction	Estimate	0.01*	0.06	−0.12	−0.16	0.07	0.02	−0.03	0.01*	0	−0.09	0.04*
	Z	0.32	2.33	−4.67	−6.09	2.78	1.87	−2.44	1.53	NA	−3.52	1.56
SC: institutional trust	Estimate	−0.03	−0.06	−0.08	−0.03	0	0.01	−0.02	0.01*	0	−0.20	0.028*
	Z	−2.84	−2.31	−3.11	−3.77	NA	2.76	−2.41	1.5	NA	−8.02	1.2
SC: interpersonal trust	Estimate	−0.1	−0.06	0	0	0	−0.11	0	0	0	−0.07	0.22
	Z	−2.87	−1.83	NA	NA	NA	−3.87	NA	NA	NA	−2.21	7.93
Security perception	Estimate	−0.06	0	0	−0.11	0	0	−0.05	0	0	−0.14	0.08
	Z	−2.4	NA	NA	−3.98	NA	NA	−2.47	NA	NA	−5.38	3.32
Infrastructure perception	Estimate	−0.055	0	0	0	0	0.07	0	0.03*	0	−0.19	0.04
	Z	−2.35	NA	NA	NA	NA	3.11	NA	1.54	NA	−7.9	1.86
SWB	Estimate	0.03*	−0.03*	0.11	0.13	0.09	−0.04	−0.13	0.08	0.14	0.08	0.14
	Z	1.57	−1.39	5.02	5.74	4.65	−1.74	−7.11	3.91	7.06	3.89	7.36

* Not statistically significant variables at the 90% confidence level. CB = Ciudad Bolívar (treatment group). T1 = Follow-up measurement (after TransMiCable).

the *CB-T1* dummy variable is a control of the respective dependent variable in the treatment group (CB) and in the follow-up time (T1). The inclusion of this dummy variable seeks to represent the difference in each of the LVs after the TransMiCable implementation regarding the control group. This formulation allows us to test hypotheses H5 and H6. Table 6 presents the total effects of the SEM-MIMIC model.

Almost all the total effects of socioeconomic characteristics on the model LVs were significantly different from zero. This allows us to not reject H5 at a 90% confidence level. The above suggests that satisfaction variables, social capital, and SWB vary across the population. For instance, in the travel satisfaction results, single individuals are more satisfied with their travel experience than married and divorced. Also, the higher the education level, the lower the travel satisfaction. Older people have a better perception of their travel experience than younger residents do. We also found a gender gap in travel satisfaction. Women have a worse perception than men. The higher the income, the better their travel satisfaction. The last could be because wealthier individuals (or less poor in this context) living in the lower areas of the mountain tend to have access to more transport alternatives than the poorer (who live uptown). Before the TransMiCable implementation, people in CB have slightly better travel satisfaction than SC (+0.05). With TransMiCable working, this satisfaction increased significantly (0.19 + 0.05).

Regarding satisfaction with the neighborhood, the differences between individuals in the study area seem to be guided mainly by education level. Individuals with higher education levels are the least satisfied with the neighborhood conditions. Older people are more satisfied with their neighborhood than the young. The divorced and the employed were found to be more satisfied than the single and unemployed, respectively. Women reported being less satisfied than men at the same level of travel satisfaction. Also, in T0 people in CB were less satisfied with their neighborhood conditions than people in SC. Then, this satisfaction improves in CB, but without significative differences with SC. In short, thanks to TransMiCable, neighborhood satisfaction increased in CB, although it is not higher than in the control group.

The model results suggest that the security perception varies according to marital status, education level, and gender. This is consistent with an increasing volume of literature about gender, travel, and security. Married people perceive lower security in the neighborhood than those with other marital statuses. Similarly, people with higher education levels have a lower security perception than those with lower levels of education. Women reported feeling more insecure in the neighborhood than men, which aligns with a large body of literature about travel and gender barriers (Jirón et al., 2020). In summary, security perception improved in the area of TransMiCable but it is still very low (-0.14 + 0.08 = -0.06).

Regarding interpersonal trust, we only found differences between elderly and married people compared to other age and marital status groups, respectively. Married people reported lower trust in other people and institutions. In the same direction, those older than 57 also reported lower interpersonal trust than younger people. All the total effects associated with sociodemographic characteristics on institutional trust were significative at the 90% confidence level, except for occupation (i.e., employed) and income level. Overall, single individuals reported higher institutional trust than people with another marital status. Also, individuals with lower education levels and young people tended to have higher institutional trust. Similarly, women reported less trust in institutions than men. Without the TransMiCable, both institutional and interpersonal trust were lower in CB. The project had a positive effect on improving interpersonal trust in CB but it did not have a significative effect on institutional trust (although it did improve it). Similar to what happened with the security perception, before, institutional trust was at a very low level. With the cable car, trust has improved, but it is still low.

People over 57 years of age reported a better perception of the infrastructure in the neighborhood than younger residents. A possible explanation of the above is that the elderly living in low-income zones is used to poor infrastructure conditions and travel using low-quality, often informal, services, which is in line with previous studies highlighting the role of experience and age on transport infrastructure quality perceptions (Lucchesi et al., 2021). In this LV the same happens with institutional trust and security perception. Infrastructure perception was much worse in CB than in SC in T0 (-0.19). Then, this perception improves compared to the control group in T1 (+0.04). In these last cases, there is a difference in the perception of infrastructure and institutional trust in T0 between CB and SC, being better in SC. The real effect of TransMiCable is positive in the perception of these elements, but not enough to be greater than in SC.

Finally, there is reliable evidence that the SWB varies according to the individual characteristics evaluated. Less educated people reported lower SWB than more educated participants. Employed individuals reported higher SWB than the unemployed, which is to be expected as economic security is a significant source of stress and worry. The above is in line with the total effect of income on SWB, suggesting that the lowest income category of residents also has lower SWB than those of higher income. Another interesting result points to gender gaps in perceived life satisfaction since women reported lower SWB than men. With TransMiCable in place, SWB improves in CB and is much higher than in SC (+0.22).

The SEM-MIMIC model also allowed assessing H6. At the 90% confidence level, it is possible to confirm the actual effect of the TransMiCable on satisfaction with a domain, social capital, and SWB. Residents in the treatment group (CB) have more travel satisfaction than people in the control group (SC). The estimates for CB-T1 suggest that TransMiCable increased the travel satisfaction of people in CB (see Table A1 and Table 6). At T0, CB inhabitants reported lower neighborhood satisfaction than SC residents. However, we found no differences between CB and SC respondents' neighborhood satisfaction at T1.

Regarding social capital, TransMiCable had a mixed effect. Although the institutional trust continued to be lower in both areas, this social capital dimension improved as the difference between the control and treatment groups decreased after the project. Interpersonal trust showed a drastic improvement. At T1, trust in social support networks became higher in CB than in SC, since before (at T0), the level of this social capital dimension was lower for CB than SC. The above suggests that the TransMiCable project allowed increasing social interactions in the influence area.

In summary, objective attributes related to transport, travel and neighborhood satisfaction, security and infrastructure perceptions,

and social capital influence SWB. However, the satisfaction and perceptions, even the SWB, vary according to socioeconomic characteristics. TransMiCable increased travel satisfaction in the area, although with differential effects: women are less satisfied with their travel experience, and with their neighborhood, and feel more insecure than men. The more educated residents are less satisfied with travel and neighborhood, and also perceive more insecurity. By contrast, the elderly are more satisfied with these and perceive the infrastructure as better. Regarding SWB, it is higher in people who are more educated and employed, although women report a lower SWB than men. Comparing both groups, TransMiCable increased travel satisfaction in people in CB compared to SC. In terms of neighborhood satisfaction, the cable car also improved it, but it is not different from SC. The project made it possible to increase social interactions in its area of influence. Overall, TransMiCable improved satisfaction with the neighborhood and the perception of security, but it is still low. The project has significantly improved SWB in CB. This is relevant to take policy actions.

6. Policy discussion

The above results and overall design of the research presented across this paper encompass significant contributions to the understanding of the links between travel and life satisfaction, transport infrastructure and its use, and SWB. It does so by proposing a novel application of a quasi-experimental approach to the assessment of outcomes not often addressed in traditional transport intervention assessment. It provided findings that confirm relationships previously suggested by earlier research, but that had not been tested in low-income and vulnerable contexts, even less against a backdrop of integral transport-driven urban transformations. The transport benefits of the aerial cable car are relevant and are consistent with previous literature on these modes of transport.

As people living in poor urban peripheries spend a large share of time in transport and much time in their neighborhoods for social interaction and leisure activities, travel and neighborhood satisfaction are important domains relevant to their SWB. Our study, therefore, suggests that although the infrastructure investment was conceived as a mechanism for connecting the neighborhood with the rest of the city (i.e., getting out more easily), the localized benefits in terms of social cohesion and non-commuting benefits cannot be overlooked. In this regard, infrastructure investments not only contribute to improving travel satisfaction in deprived neighborhoods but also can act as catalysts for wider urban transformations that can contribute to addressing SWB.

Perhaps due to a lack of evidence to date, these benefits have not received the required wider attention from policy and decision-makers that these added benefits demand at all levels. The intangible and positive effects, such as changes in the expectations of people about their neighborhoods and their trust in public services and institutions, are significant findings that deserve further attention from local and national policymakers and decision-makers, as well as practitioners. Traditional policy evaluations and analyses of feasibility do not consider the effects of the material infrastructure on trust, satisfaction, social capital, and community cohesion. Yet these benefits could possibly carry otherwise "unfeasible" interventions on low-income communities by traditional criteria to the other end of the cost-benefit ratio of infrastructure investments. The comparative effect on institutional trust when examined against the control area (SC) suggests it may as well be an excellent entry point for a more targeted and consistent public presence in these areas as observed in previous successful experiences (Davila et al., 2013).

The comparison of the total effects changes between treatment and control groups shows the direct and indirect effects on SWB whereby it can improve after an intervention such as TransMiCable. By focusing the analysis on a large-scale intervention at the neighborhood level, it is possible to separate some of the effects -albeit constrained by the short timeframe- of investments in public transport infrastructure on variables not previously considered as explicit social outcomes of the project and often overlooked in the practice of transport policy evaluation. After adding the sociodemographic and group variables, our findings show the importance of controlling by different personal and location attributes, which can make explicit inequalities between different population groups. This suggests the need for a more nuanced understanding of the role of intersecting social identities and individual and collective social positions in the definition of mobility needs and choices and their effects on SWB. Furthermore, it speaks broadly to the way low-income communities find their life satisfaction influenced by broader features of transport and the built environment. It also speaks about the need for concerted and targeted action that follows up on the wider benefits of infrastructure after achieving the neighborhood-scale benefits the infrastructure and built environment interventions can create to narrow the gaps between social groups. Policies oriented to improve women's perceptions of security and ability to reach opportunities other than work such as care mobilities can maximize some of the potentials of cable car investments.

Despite relationships between travel satisfaction and SWB being not consistent in the literature, our findings indicate that travel satisfaction influences SWB directly. This adds depth to the interpretation of mainstream performance indicators commonly used in transport assessment. These developments can contribute to dialogues between different sectors of urban development policy and the construction of a common language for the analysis of the effects of transport infrastructure on SWB. But more importantly, can help think about cross-sectoral policies that take advantage of the public space and physical interventions that this kind of project enable. Examples include recreation and cultural activities that use the public space in and around the station. This is consistent with the effect of participation in leisure activities on SWB is perhaps one of the most noteworthy findings. More generally, it speaks volumes about the importance of transport improvements beyond mainstream concerns with commuting and mandatory travel purposes in line with recent literature (Allen and Farber, 2020; Oviedo and Guzman, 2020b). Transport projects should be comprehensively seen as urban transformation projects, but this does not mean they should be expected to achieve all their potential social benefits automatically. Specifically, it adds weight to recent calls for adopting a broader lens for the assessment of the impacts of transport infrastructure, particularly in deprived urban areas, as they provide a vehicle not only for sustaining and improving livelihoods but for the creation and nurturing of key capitals for social development such as social capital.

These considerations are useful for policymakers to face the challenges related to the (poor) experience and satisfaction of travel and the built environment, and generally to meet the travelers' preferences disregarding whether serving disadvantaged or wealthy

populations. Despite the significance of SWB for transport and urban policies in Global South contexts, available scholarship about the links between travel and neighborhood satisfaction and SWB in those cities is scarce at best, in particular in relation to its potential for policy definition and evaluation.

7. Conclusions

The links between travel satisfaction and well-being have been widely discussed in the academic literature. Transport investments represent a positive approach to reducing social exclusion by enhancing the accessibility to daily activities and personal growth, particularly in populations that have been historically bypassed in the process of urban development and infrastructure provision. Infrastructure related to affordable and high-quality public transport services, especially in dense, poor, and peripheral neighborhoods with low accessibility levels become a necessity to narrow the large gaps between groups and to rebalance the role the State plays in the integration of these communities into the wider social and urban fabric. These visible interventions are a vehicle not only for connectivity but for a wider presence of the public sector in historically deprived areas of cities, but this potential needs to be recognized and leveraged.

We explored the potential effect of an alternative and comprehensive public transport project on SWB using treatment and control groups. We set out to know how travel and neighborhood satisfaction, and social capital influence inhabitants' SWB of socially vulnerable areas. Then, we compared the differences in SWB between intervention and control groups before and after TransMiCable implementation (2018 and 2019/20, respectively), to know how a project can change the effects of those factors and perceptions on SWB. In short, the SWB improved due to the TransMiCable implementation.

Our findings showed that the assessment of new urban projects should consider individual perceptions in addition to objective mobility measures, as well as effects on tangible and intangible outcomes associated with urban infrastructure. Comprehensive urban transformations like the TransMiCable have positive changes in travel satisfaction regarding the experience in the transport system and neighborhood improvements. Urban transport policy, as a social policy, should be oriented towards the development of mobility and accessibility goals, in which demands and needs of the population are recognized, and incorporate the physical planning and spatial organization of cities, considering use's differences and promoting more sustainable forms of mobility (Oviedo and Guzman, 2020a). To recognize and address these differences, it is necessary to design and implement actions targeting those usually left behind, such as women, the elderly, and people with disabilities, through better information and communication channels as well as tailoring of spaces and infrastructure to close some of the gaps that come naturally from the design of infrastructure.

We demonstrate that the improvement in SWB through TransMiCable intervention was driven, in part, due to travel satisfaction. Indicators that capture dimensions of SWB beyond traditional measures of efficiency and performance of transport investments contribute to a broader understanding of the role of infrastructure in sustainable and inclusive development. Neighborhood satisfaction and leisure activity participation have the highest effects on SWB, while travel time had lower effects on SWB. Also, security satisfaction had a higher indirect effect on SWB, more than infrastructure, interpersonal trust, and institutional trust. Although institutional trust had lower effects on SWB than the other variables, it seems to be an important measure because is influenced by infrastructure, insecurity, travel time, and affordability. This variable holds important reflections about politically motivated decisions to intervene in deprived communities. While not all can be solved by infrastructure, its presence in conventionally bypassed and ignored neighborhoods can open the door for an altogether different relationship between communities and the state.

The above suggests that including perceptions in infrastructure evaluations could be an important insight to identify the actual effects beyond the traditional quantitative indicators. However, when the perceptions are used, is necessary to control heterogeneity. We consider that the proposed framework could be applied to complement other evaluations of different types of infrastructure and built environment interventions driven to improve people's SWB. The use of Campbell's model (1976) to structure the effects on SWB is key for a better understanding of the way by which different perceived and objective measures affect life satisfaction.

Deploying structural equation modeling for the analysis of objective and subjective metrics of travel satisfaction and SWB served as a reliable mechanism to mathematically test theoretical constructs often hard to communicate to non-specialized audiences and decision-makers, and to create bridges with the language used in international development agendas. The quasi-experimental approach also enables the addition of rigor to the evidence and facilitates a conversation about impacts that can be incorporated into evaluation methods for transport interventions. Our methodology and findings, highlight the need for a more nuanced understanding of the specificity of travel needs, perceptions, and attitudes, the unique interpretations of SWB, the role of public transport in its definition for low-income communities, and the relevance of transport for sustainable development. The traditional measure of travel time savings and accessibility gains are important, but there are multiple additional dimensions (domains) that could be affected by urban projects. In this case, we were able to go further and estimate the impact on various domains that positively influence the SWB. This is a unique contribution to the current debate on SWB and transport. The analysis of SWB provides a solid bedrock to broaden the scope of comprehensive transport policy and investment and the recognition of their contributions to urban development beyond the often-reductionist approach of improving mobility and efficiency.

Among the research limitations, we are considering transport indicators affecting perception in one direction. However, the relationships examined could go in both directions (e.g., perceiving a better infrastructure and high security can make residents have higher activity participation). Having higher activity participation could also change residents' perceptions of their environment. Furthermore, poor security or infrastructure perceptions and travel satisfaction could lead residents to choose more expensive modes of transport or to travel longer routes. However, analyzing these and other similar dynamics would imply the use of non-recursive models which are beyond our scope. Additionally, the effect of some variables could be underestimated because other satisfaction domains were not considered. Another common concern among researchers using perception variables is that people more satisfied

Table A1
SEM-MIMIC results – direct effects.

Dependent variable	Independent variable	Estimate	Z
SWB	Leisure activity participation	0.179	9.66
SWB	Neighborhood satisfaction	0.209	9.32
SWB	Travel satisfaction	0.103	4.61
SWB	Female	−0.124	−6.77
SWB	Older than 57 years	−0.045	−2.13
SWB	Employed	0.080	4.04
SWB	Medium education level	0.134	6.30
SWB	High education level	0.171	7.42
SWB	Married	0.042	1.97
SWB	Divorced	−0.044	−1.94
SWB	Medium-low income	0.136	6.90
SWB	Low income	0.075	3.51
SWB	CB	0.094	4.51
SWB	CB-T1	0.116	5.97
Travel satisfaction	Leisure activity participation	0.078	3.78
Travel satisfaction	Travel time	−0.144	−6.42
Travel satisfaction	Affordability	−0.009*	−0.36
Travel satisfaction	Security perception	0.343	15.26
Travel satisfaction	Infrastructure perception	0.323	16.67
Travel satisfaction	Social capital: Institutional trust	0.147	6.00
Travel satisfaction	Social capital: Interpersonal trust	0.073	2.40
Travel satisfaction	Married	−0.047	−2.07
Travel satisfaction	Medium-low income	0.039	1.84
Travel satisfaction	Low income	0.058	2.78
Travel satisfaction	CB	0.197	8.69
Travel satisfaction	CB-T1	0.129	5.56
Neighborhood satisfaction	Travel time	−0.099	−3.61
Neighborhood satisfaction	Security perception	0.459	17.17
Neighborhood satisfaction	Infrastructure perception	0.323	13.46
Neighborhood satisfaction	Social capital: Institutional trust	0.013*	0.43
Neighborhood satisfaction	Social capital: Interpersonal trust	0.065	1.96
Neighborhood satisfaction	Medium education level	−0.114	−4.59
Neighborhood satisfaction	High education level	−0.111	−4.15
Neighborhood satisfaction	Married	0.062	2.39
Neighborhood satisfaction	Divorced	0.057	2.18
Neighborhood satisfaction	Employed	0.066	2.78
Neighborhood satisfaction	CB	0.047	1.86
Neighborhood satisfaction	CB-T1	−0.030*	−1.21
Social capital: Interpersonal trust	Leisure activity participation	0.171	6.15
Social capital: Interpersonal trust	Older than 57 years	−0.111	−3.87
Social capital: Interpersonal trust	Married	−0.101	−2.87
Social capital: Interpersonal trust	Divorced	−0.062	−1.83
Social capital: Interpersonal trust	CB	−0.076	−2.21
Social capital: Interpersonal trust	CB-T1	0.220	3.32
Social capital: Institutional trust	Travel time	−0.012*	−0.40
Social capital: Institutional trust	Affordability	−0.077	−2.62
Social capital: Institutional trust	Security perception	0.287	11.90
Social capital: Institutional trust	Infrastructure perception	0.144	5.97
Social capital: Institutional trust	Older than 57 years	0.151	6.43
Social capital: Institutional trust	Medium education level	−0.082	−3.12
Social capital: Institutional trust	Divorced	−0.063	−2.31
Social capital: Institutional trust	CB	−0.131	−5.12
Social capital: Institutional trust	CB-T1	−0.002*	−0.10
Security perception	High education level	−0.114	−3.98
Security perception	Female	−0.054	−2.47
Security perception	Married	−0.063	−2.40
Security perception	CB	−0.141	−5.38
Security perception	CB-T1	0.084	3.32
Infrastructure perception	Married	−0.055	−2.35
Infrastructure perception	Older than 57 years	0.073	3.11
Infrastructure perception	Low income	0.035*	1.54
Infrastructure perception	CB	−0.188	−7.91
Infrastructure perception	CB-T1	0.044	1.86
RMSEA		**0.038**	
CFI		**0.921**	
SRMR		**0.066**	

* Not statistically significant variables at the 90% confidence level.

with their life can report better environmental perceptions. The analysis with panel data could control to some extent this bias.

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CRediT authorship contribution statement

Luis A. Guzman: Conceptualization, Supervision, Methodology, Writing – original draft, Writing – review & editing. **Julian Arellana:** Conceptualization, Methodology, Conceptualization, Writing – original draft, Formal analysis, Writing – original draft, Writing – review & editing. **Daniel Oviedo:** Writing – original draft, Investigation, Data curation, Validation. **Daniela Castaño Herrera:** Writing – original draft. **Olga L. Sarmiento:** Writing – original draft, Investigation, Validation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix

(See Table A1).

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