Identification of Pedestrian Preference Pattern for Central Area of Goiânia City in Brazil

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Abstract

The need for establishing urban mobility policies that favor pedestrians, which are the most vulnerable elements in the transit system, is known. In this sense, the study aimed to identify the pattern of pedestrian preferences on sidewalks, using the Walkability Index and Stated Preference technique. The methodology developed to achieve the objective is composed of the following steps: (i) definition of the study area, (ii) Decription of the study area, (iii) definition of variables, (iv) data collection, (v) calculation of the Walkability Index, (vi) data processing of the stated preference survey, (vii) analysis of results and definition of guidelines. A case study was carried out in the central sector of Goiânia (GO) in order to validate the presented methodology. Thus, the study proposes to investigate pedestrian preferences on sidewalks in order to provide subsidies to assist the planning of pedestrian-oriented mobility systems..

Keywords: Pedestrian, mobility, stated preference technique, sidewalks.

Introduction

The recent and fast growth of the urban population, coupled with a model of thin expansion of the low density urban territory, reflects unsustainable frameworks for people's mobility performance. This implies extensive travel distances and lack of access to quality public transport, stimulating individual vehicle use. This reality increases the number of vehicles traveling and causes saturation of the road system in the central areas, causing immobility. According to Brazil's National Traffic Department (2018), the country's car fleet in December 2018 was approximately 58 million individual vehicles. Considering the negative impacts caused by the excessive use of individual motorized transport, it is necessary to adopt actions that stimulate and favor walking.

According to the Brazilian National Association of Public Transportation (2018), in 2016, cities with more than 60,000 inhabitants made 65.3 billion trips, corresponding to 218 million trips per day. Of this total, about 41% have done on foot, 28% by public transport, 25% by car and 2% by bicycle. Despite having significant participation in the modal split, non-motorized modes have not received the deserved attention from decision makers, even when the National Urban Mobility Policy (Federal Law No. 12.587/2012) states that active modes of travel are a priority on the government's public agenda, followed by investments in public transport over cars and other motorized modes of individual travel.

The quality of life in cities has been strongly affected by mobility issues, mainly due to the prioritization of private transport over public transport, non-motorized modes and walking. This is one of the factors that make spaces unattractive to pedestrians. Walking is considered the healthiest, most sustainable, economical and accessible transport mode, and it is a key element for an efficient transportation system (CARRENO et al., 2002). However, as it is a basic human activity, it is underrated or even ignored in the transportation planning process. Pedestrians are the most vulnerable components of the traffic system, which need attention in traffic planning and management, as they have distinct characteristics that influence their preferences, behaviors and consequently the way to walk.

Thus, the study aims to identify, through user preferences, the urban physical aspects that influence pedestrian mobility and to examine the variables that affect individual decisions to make walking trips, having the central region of the Goiânia city as the study area. As understanding user preferences provides elements to help plan pedestrian mobility, a methodology for identifying the pattern of pedestrian sidewalk preferences has been proposed to support planners' decision-making and to direct investments to non-motorized transport.

The pedestrian and walking as transport mode

The most vulnerable element of the transport system, pedestrians are anyone who travels on public roads using their own force as a form of propulsion (MELO, 2005), which is the most direct form of individual transport mode (VASCONCELLOS, 1998). According to Gondim (2010), pedestrians are people who move on foot, may have permanent or temporary physical limitations.

Despite the advantages that walking offers and the significant percentage of trips by this mode, users find many obstacles, once there are few investments in mobility infrastructure for non-motorized transportation in Brazil. Pedestrians, especially the elderly, the disabled and children, find it difficult to move around the city, and are exposed to high risks of accidents.

Walking is an indispensable mode of transport for the majority of the population, either as a primary way of commuting or complementing travel by car or public transport. The particularities of pedestrian movements and the conditions of the urban space that facilitate walking have attracted the attention of a large number of researchers in recent decades, and these have been gaining momentum in the debates on mobility, planning and urban design (ITDP, 2016).

Understanding the importance of the mode of transportation by foot for access to local activities, the general improvement of the public transport system through walking could be included in urban projects. According to Institute for Transport and Development Policy (ITDP, 2016), sustainable cities start with pedestrian friendly places and a good walking environment should prioritize pedestrians and protect them from motor vehicles. Walking through the places should be a pleasant act and the designed spaces should allow fluency in the movements, allowing people to move with pleasure.

Wide freedom of movement is a significant feature of pedestrian movements, as they can change direction instantly and move side to side as well. Such displacements involve physical effort and direct contact with the surroundings, and the low speed - 1.2 m/s on average - with which they are performed, reinforces the interaction with the surrounding urban space and makes details imperceptible to cyclists or users have a significant impact on pedestrians , for instance (ITDP, 2016).

Preference and behavior of pedestrian

The term pedestrian encompasses a diversity of people with different preferences and behaviors, so it is relevant to this study to explore such concepts. It's possible to say the preference for certain alternatives, products or services over their competitors represents the behavior towards the various options available. The probability of a person makes a certain choice is directly linked to the greater advantage offered by the option when compared to the others (ORTUZAR; WILLUMSEN, 1994).

The preference is related with ideia of comparative and hypothetical evaluation, i.e., preference clarifies how an element would like to be seen or preferred and conveys the opportunity to exchange one thing for another. The concept of preference encompasses judgments that change under a semantic differential, that is, among several options the individual opts for the alternative he considers to have higher quality. It may also be related to placing alternatives in ascending or descending order preferably using, for example, a numerical classification (LAY; REIS, 1995).

According to Larrañaga and Cybis (2007), behavior is affected by psychological, biological, sociological, anthropological, economic and political aspects. It is determined by knowledge, skills and values. The appropriation of the space of the walk and the interpretation of the path derive from the pedestrians' understanding of the space and the elements that compose it, added to the various stimuli generated along the way, which can be mentioned: the visuals (luminous, signs , shop windows); audible (voices, horns, brakes); kinetic (speed of cars and other pedestrians) and psychological (humor, fear, haste) (MALATESTA, 2007).

In modal choice, users seek to meet their travel needs according to their budgetary, temporal and technological constraints. Users select by examining the peculiarities of each mode and the intervening variables such as travel time, motive, speed, cost of travel, comfort, accessibility, road infrastructure condition, car availability, individual's physical and financial condition, and relative subjective attributes to every mode. From these references, users develop the possible options that meet the set of needs based on their knowledge and skills (LARRAÑAGA, 2008).

Stated preference methods

Declared Preference Methods consist of a set of techniques that considere individual answers regarding your preferences, in a set of alternatives with intention of estimating utility functions. These functions mathematically express consumer preferences. Alternatives can be described from real situations or contexts conceived by the researcher. Declared Preference Methods estimate a consumer's preference structure by giving overall assessment of a cluster of alternatives chosen from attributes of different levels. Attributes are the characteristics that each product or service has and levels are the values that each attribute can accept (KROES and SHELDON, 1988).

Individual preferences can be achieved through the compositional or decompositional approach. In the compositional approach the individual gives a value to each attribute, and in the decompositional approach he puts the alternatives in order without assigning values to each one. The values are relative among the attributes. Therefore, the decompositional approach has shown greater efficiency since it is very difficult to assign values to each attribute and the preference of one alternative over another is the way to ensure greater reliability (Bastos, 1994).

Considering the transport field, the Declared Preference Methods have received greater attention in the United Kingdom since 1979 (KROES; SHELDON, 1988). Examples of transportation applications include: choice of transport mode, influence of time, comfort and cost factors on a trip, definition of travel routes and influence of fare value on parking lots (LUZ, 1997).

The preparation of Declared Preference surveys should contain the following steps (KROES; SHELDON, 1988): (i) determining the interview method and the context in which it will be applied; (ii) sample selection; (iii) definition of the most relevant factors in decision making; (iv) proposal of alternatives to be presented to respondents; (v) development of the method for presentation and data collection of the experiment; (vi) model estimation; (vii) data analysis; and (viii) validity test.

Data collection for research can be done in three different ways (BATES, 1988 apud FREITAS, 1995):

Choice: a cluster of options is exposed to the respondent and simply asked to choose the one option that most suits them;

Ordering: some options are pointed at the same time to the interviewee and asked to position them in the order of their preference;

Evaluation: respondents assign individual answers to each option.

In data analysis of Declared Preference, respondents' preferences are decomposed into part utilities in order to disassociate the attributes included in the survey, i.e., determining the relative value of each attribute in total utility. It is possible to deduce a mathematical formulation by investigating how respondents combine the utility for each attribute in a global utility function (Luz, 1997). It is often to assumes compensatory additive linear models according to equation (1).

$$U = \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

(1)

Where U is the total utility; X _1 aX _n are attribute values; □ _1 a□ _n are coefficients of the model. The coefficients of the model reflect the relative values of the attributes accordingly to the total utility of the product. The model is compensatory, since once the values of two attributes are changed, it is possible to maintain the same total utility (LUZ, 1997). The coefficients of the Declared Preference Model can be used to stipulate the relative importance of the attributes included in the experiment; determine time values; indicate monetary values of attributes; specify utility functions employed in forecasting models; and generate disaggregated demand models for alternatives that do not yet exist (LUZ, 1997).

Methodology to identify the pedestrian preference pattern

The sidewalk is the part of the segregated and different level road intended for pedestrian traffic (BRAZIL, 1997). Therefore, in the proposed methodology, it has been decided to study trips that occur in sidewalks, seeking to present the service level offered in certain sidewalks as well as to understand the preferences of pedestrians when using them. The Walkability Index developed by ITDP Brasil (2016) has been used in order to analyze the level of service offered by sidewalks, which enables the assessment of urban space conditions and monitoring of the impact of public space qualification actions, indicating where such actions favor walking or not.

The developed methodology sought data through physical surveys and interviews, which provide quantitative results that were later qualitatively analyzed (subjective judgments and interpretations). The Declared Preference Technique has been used in order to determine users' desires regarding the sidewalks. Thus, the methodology presented in this section consists of five steps, which constitute a tool that seeks to assist technicians in the process of implementing urban projects linked to pedestrian mobility, considering their preferences (displacement, comfort, safety). The steps are:

- **Step I**: delimitation and description of the study area.
- **Step II:** definition of physical variables chosen through the indicators and analysis categories proposed by the ITDP Walkability Index.
- **Step III:** collecting data of sidewalk infrastructure in the study region and applying the Walkability Index.
- **Step IV:** application of the Declared Preference Method questionnaire and treatment of the data obtained in the interviews.
- **Step V:** analysis of results and definition of guidelines.

Identification of pedestrian preference pattern: the case of the central area of Goiânia city in Brazil

A case study has been developed in the city center of Goiânia in order to validate the methodology presented. Moreover, the data have been obtained through a questionnaire and observation of pedestrians on established days and times and identification of the service level offered by certain sidewalks.

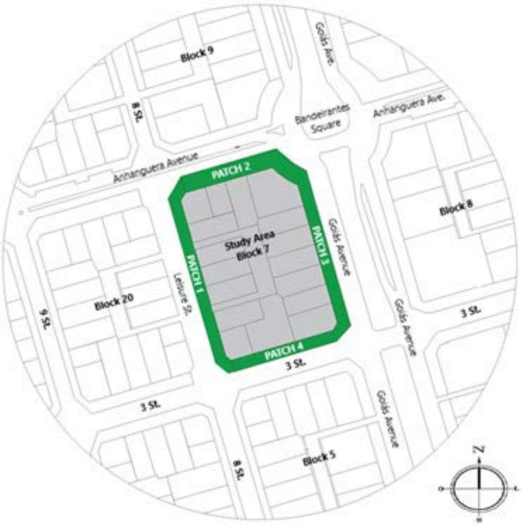
Step I: definition and description of the study area

Goiânia was founded in 1937. The original urban plan was did to accommodate 50,000 inhabitants. However, currently Goiânia has an estimated population of 1,495,705 inhabitants; which corresponds to half of the population of the Metropolitan Region, which is composed of 20 municipalities (IBGE, 2018). These numbers caused the great growth of trips in the city and metropolitan region that conflict with the offered conditions of mobility.

Accordingly to origin-destination survey did in Goiânia Metropolitan Region in 2000, motorised individual transport was the most widely used mode of transport (36%), followed by public transport (30%), walking (26%) and bicycles (6%). Goiânia has the highest motorization rates: motorised individual transport accounted for 42.8% of trips, followed by public transport (28%) and walking trips (24%) (CMTC, 2007). Thus, pedestrians represent an important amount of the share of each mode of transport in the capital.

The region selected for the case study is the central area of Goiânia. This place was chosen due to the great diversity of attraction points, such as shops and residences, but mainly because it reflects the dynamics of the movement of people in the city. The case study was done at the intersection of two important avenues of the city center, Goiás and Anhanguera avenues (Figure 1). Such avenues are busy during the day. No flow of people is noticed on the most segregated streets, such as in the alleys and inner squares, and during the night.

Figura 1 - Definition of the study area.



Fonte: the authors.

The place chosen for the case study was the block 7 of the central area of Goiânia. The block has been divided into four parts (see the block in green in Figure 1) namely:

- **Segment 1:** it is located on the 8th Street between Anhanguera Avenue and 3rd Street, also known as "Leisure Street". It is an exclusive street for pedestrians and it was once a venue for scenic shows. The place is busy during the day and at night there are no pedestrians.
- **Segment 2:** it is located on Anhanguera Avenue, the most important axis of the urban transport system of Goiânia. The avenue is constituted of shops, hotels, popular shops, offices and several other types of trades. In it is part of the main bus corridor that connects the east to west of Goiânia, also called the Anhanguera Axis.
- **Segment 3:** it is located on Goiás Avenue, one of the largest and busiest thoroughfares in central Goiânia, this part is predominantly commercial. Pedestrians who walk along the sidewalks of the avenue need to avoid severals obstacles belonging to stores that invade the space for walkers with their products.
- **Segment 4:** it is located at 3rd Street, which has a large number of commercial establishments, contributing to the increase of pedestrian flow. The 3rd Street is an arterial road that has traffic lights, intersections and high flow of vehicles.

Step II: variables definition

The use of the Declared Preference method was used to quantify and prioritize the physical description variables of the selected sidewalks. This has been done through users' opinions regarding the infrastructure assessment of possible scenarios composed by combining these variables. The physical description variables has been chosen through the indicators and analysis categories proposed by the ITPD (2016) Walkability Index, which are: floor condition, useful width, longitudinal slope and floor material.

Once the variables were defined, it was necessary to decide the control levels of these variables to complete the composition of the experiment. The fixation at two levels of control considered relevant factors. First, it is believed that setting a range ranging from a maximum (+) to a minimum (-) effectively meets the options for physical description variables of the selected sidewalks. Since the complexity of the interviewees' task stems from the number of alternatives, too many choices can make the experiment unworkable. Table 1 presents the physical description variables of the sidewalks and the control levels used in the study.

Table 1 - Description variables of physical aspects of sidewalks and control levels.

Description variables of Physical Aspects	Control levels
Floor conditions	Good (+) Bad (-)
Useful width	Good (+) Narrow (-)
Longitudinal slope	Good (+) Large (-)
Floor material	Good (+) Bad (-)

Fonte: th authors.

Thus, the proposal seeks for pedestrians to examine the service offered through the analysis of quality attributes, conceived by combining several levels of control of the physical description variables of sidewalks that make it possible to generate alternatives. The total number of alternatives was elaborated based on the "complete factorial" experiment and it is the result of the number of variables, which for this study are four, and the levels, which are two. By combining all possible alternatives they originate (2)4 = 16 alternatives.

As the number of alternatives was large, a fractional factorial experiment was used. The sixteen alternatives of the full factorial were reduced to eight alternatives by applying appropriate statistical design to the fractional factorial design techniques. The reduction was performed by employing the "half" fraction of a 2k factorial experiment, which has "k" variables controlled by two levels. The resulting fractional planning matrix after statistical processing is presented in table 2.

According to Carpinetti (2003), when using the "half" fraction of a 2k factorial experiment, there is the possibility of performing half of the experiment, i.e, half of the possible combinations, subtracting part of the so-called "confused" combinations. The effects of the highest order and the lowest order are not relevant and can generally be overlooked, as respondents tend to opt for the most positive effects and neglect the most negative effects.

Table 2 - Fractional planning matrix

Combinations	Variables Levels - Scenarios			
	Variable 1	Variable 2	Variable 3	Variable 4
1ª	-	-	-	-
2ª	+	-	-	+
3ª	-	+	-	+
4ª	+	+	-	-
5ª	-	-	+	+
6ª	+	-	+	-
7ª	-	+	+	-
8ª	+	+	+	+

Fonte: the authors.

The questionnaire presents six (6) alternatives that form the cards. Such cards represent six (6) different scenarios that can be assembled depicting hypothetical situations conceived by combining experiment variables. Table 3 shows the options of six (6) scenarios as result of combining the variables and levels of quality aspects according to the final experiment.

Table 3 - Possible choices for description of the physical aspect of sidewalks.

Choices / Scenarios	Variables			
	Floor condition	Useful width	Longitudinal slope	Material of the floor
1ª	Good	Narrow	Large	Good
2ª	Bad	Good	Large	Good
3ª	Good	Good	Large	Bad
4ª	Bad	Narrow	Good	Good
5ª	Good	Narrow	Good	Bad
6ª	Bad	Good	Good	Bad

Fonte: the authors.

Step III: on-site data collection of sidewalk infrastructure and application of the Walkability Index

According to ITDP (2016), the sidewalk segment is the basic unit of data collection and indicator evaluation for the final calculation of the Walkability Index because the sidewalk segment accurately reflects the pedestrian's walking experience. This research considered the "sidewalk" category, which is composed of four indicators described in table 4.

Table 4 - Walkability Index parameters.

Indicator	Score 3	Score 2	Score 1	Score 0
Longitudinal slope	Streets for pedestrian only	Segregated walkways for pedestrian use only	Streets shared safely by different modes with speed limits of 15km/h	Streets with unsuitable typology / No sidewalk
Material of the floor	High quality material and high level deployment	High quality material and regular deployment	High quality material and unsuitable deployment	Unsuitable material and unsuitable deployment
Floor condition	No holes, 100% of surface is suitable	1 hole every 100 meters	2 holes every 100 meters	More than 2 holes every 100 meters
Useful width	Width is suitable along all segment of the sidewalk	-	-	Width is not suitable along all segment of the sidewalk

Fonte: ITDP (2016).

Exploratory visits were made during March 2018 and data were collected for each sidewalk segment through the field descriptive form and photographic record. The data, once digitized, were used to calculate the Walkability Index, indicating the situation of the sidewalks and the intervention priority. The results were summarized in Table 5 after the Index application.

Analyzing the results it can be concluded the categories that received the lowest averages were "floor condition" and "useful width". Both categories received zero as score in some segments. Thus, according to the recommendations of the Walkability Index, priority intervention and immediate action is required. Other categories that achieved the highest scores should receive short and medium term actions, in addition to maintaining and improving existing infrastructure.

Table 5 - WSummary of results for Indicators of Walkability Index.

Indicator "longitudinal slope" - scores for segment			
Segment 1	Segment 2	Segment 3	Segment 4
3	2	2	2
Indicator "material of the floor" - scores for segment			
Segment 1	Segment 2	Segment 3	Segment 4
3	1	1,3	1,85
Indicator "floor condition" - scores for segment			
Segment 1	Segment 2	Segment 3	Segment 4
0	0	0	0
Indicator "useful width" - scores for segment			
Segment 1	Segment 2	Segment 3	Segment 4
3	0	0	3

Fonte: the authors.

Step IV: questionnaire application and data processing of the stated preference survey

This part of the research was separated into three phases. Initially, information about the interviewee's profile (gender, age group, reason for walking and frequency of walking) was noted on the form. After that, a second questionnaire was given to each respondent with questions regarding opinions and preferences about the sidewalk infrastructure through which users were passing during the interviews. Finally, a set of six cards were given to respondents, where each card represented a specific scenario with the combinations of levels of the physical description variables of the sidewalks, the respondents sorted the cards according to their preferences. The set of cards was delivered individually to the respondents and the order of cards prepared by the respondents was noted on the form using a sequential code known only to the researcher.

Sample size calculation

The universe of this research was defined through the finite population formula, which is widely used in social research that does not exceed 100,000 elements (GIL, 1999). People were counted in each segment of the study area, at peak hours and on a typical day. Thus, in segments 1, 2, 3 and 4 were found, respectively, the flow of 8, 15, 12 and 9 pedestrians per minute. Therefore, considering that throughout the day the flow remains the same as during peak hours (which is not the case, since between peak hours and at night the observed flow was lower compared to peak hours), we found if the following population in the study area:

- Segment 1: 8 x 60 min x 24 h = 11,520 people - dia
- Segment 2: 15 x 60 min x 24 h = 21,600 people - dia
- Segment 3: 12 x 60 min x 24 h = 17,280 people - dia
- Segment 4: 9 x 60 min x 24 h = 12,960 people - dia

Thus, in the worst case scenario, where it is considered that during the 24 hours of the day the flow remains the same as the peak hour, the total population would be 63,360 people per day in the four segments of the study area, which is the result of the sum of the four segments. In this research the definition of the sample size (n) was made through the expression of finite populations (equation 2), as recommended by Gil (1999).

$$n = \frac{\sigma^2 \cdot p \cdot q \cdot N}{e^2 \cdot (N-1) + \sigma^2 \cdot p \cdot q} \qquad (2)$$

Where n is sample size; σ is the confidence level adopted; p is the percentage with which the phenomenon occurs; q is the complementary percentage; e is the maximum error allowed; N is the population size. Thus, the following values have been used in this study:

σ = 95% = 1.96.

p = 50 (is the proportion expected to find, and when you have no idea what to expect the most prudent option is to use the worst case scenario: the population is evenly distributed, so p = 50%).

q = 50 (complementary percentage of p).

e = 10% (may range from 3% to 10%).

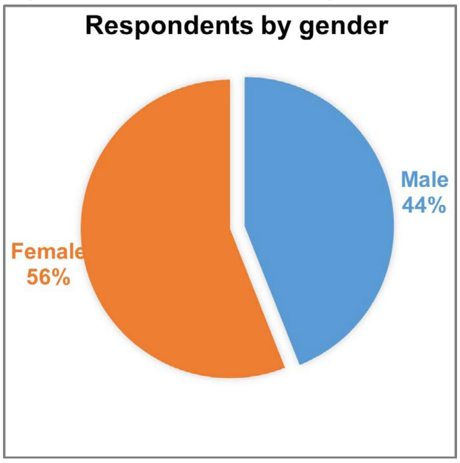
N = 63,360.

Adopting the values presented previously, a minimum sample of 97 questionnaires to be applied has been defined. Thus, 100 face-to-face interviews were done and the questionnaires were completed. The researcher handed the questionnaires to the respondents and after all questions were marked, the researcher offered the cards and requested to the respondents to sort the cards in order of preference according to the evaluation of the quality of the physical characteristics of the sidewalks. The data collected during the interview applied to the pedestrians are presented following. Initially, general features are presented after that, results achieved are detached.

User overview

There is a predominance of women who transit in the study area (Figure 2). According to the 2010 IBGE census the Goiânia city with its metropolitan region present the female population (51.54%) slightly higher than the male population (48.46%).

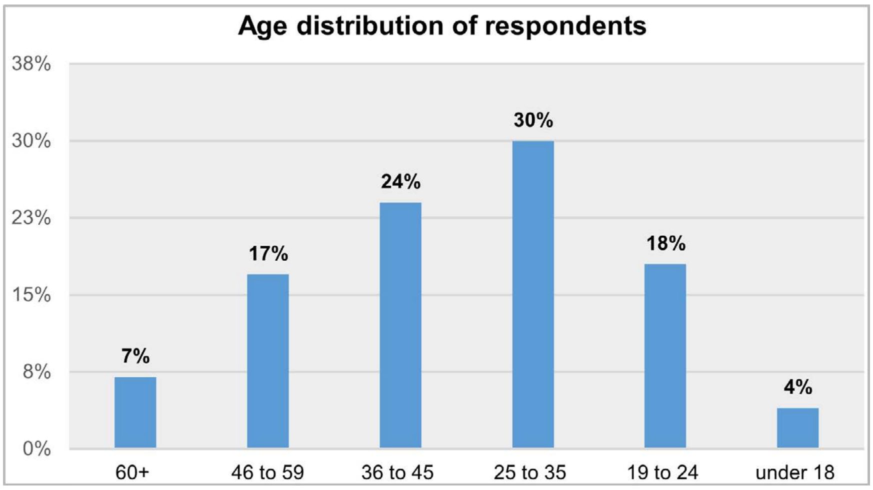
Figura 2 - Gender of respondents



Fonte: the authors.

The people interviewed were predominantly in the 25 to 35 and 36 to 45 age groups, representing more than half of the sample (Figure 3). The age groups 19 to 24 and 46 to 59 also constitute a large part of the population studied.

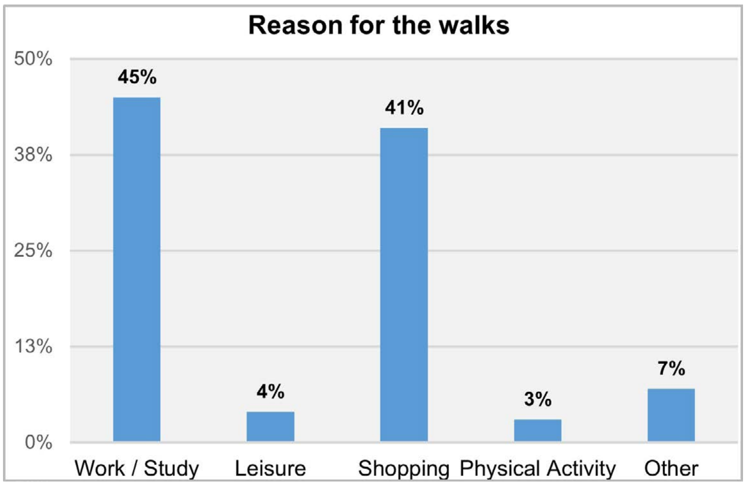
Figura 3 - Age range of respondents.



Fonte: the authors.

The results presented in Figure 4 show that the main reasons for the interviewees' walks were for working and shopping. The study area is mainly commercial, which corroborates with the answer of the majority of respondents. The few pedestrians interviewed who declared leisure as a reason for walking were elderly, who go to Rua do Lazer as a pastime.

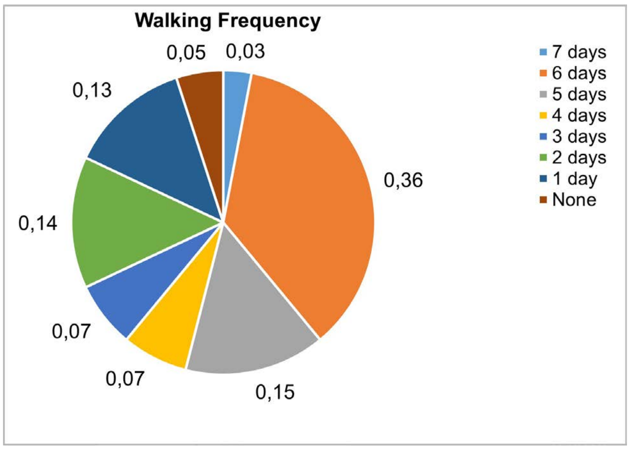
Figura 4 - Walking reasons of respondents.



Fonte: the authors.

Figure 5 shows that 36% of interviewed pedestrians walk six (6) times a week, and most of the study area shopping facilities are open Monday through Saturday. Fews people reported that most weeks do not walk once and that they perform the activity sporadically.

Figura 5 - Walking frequency.

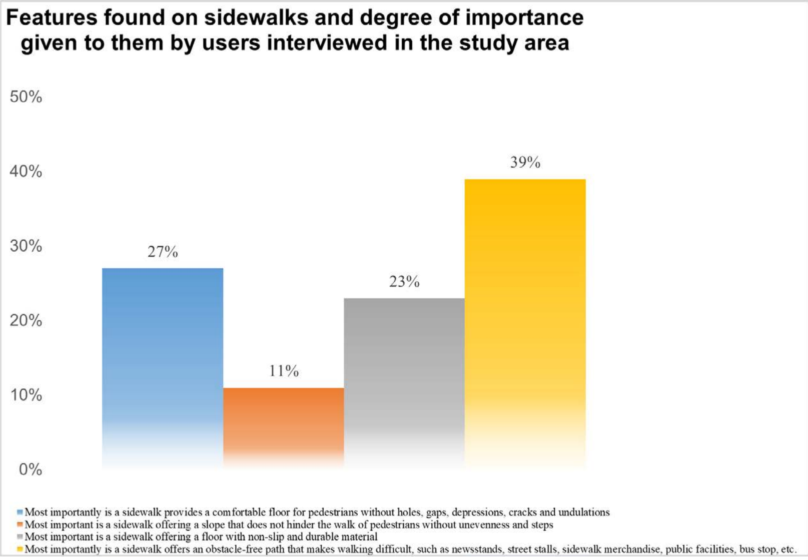


Fonte: the authors.

Results achieved from pedestrian opinion questionnaires

It has been asked to the respondents to indicate a characteristic, according to their preferences, that represents the highest degree of importance when walking along sidewalks shown in Figure 6.

Figura 6 - Features found on sidewalks and degree of importance given to them by users interviewed in the study area.



Fonte: the authors.

The four characteristics presented in Figure 6 concerning to the attributes selected for the Declared Preference Survey. The first characteristic corresponds to the attribute “floor condition”, the second to “longitudinal slope”, the third to “floor material” and the fourth to “useful width”. According to the according to respondents’ answers shown in figure 6 the most important characteristic is the useful width, followed by the condition of the floor, floor material and finally, longitudinal slope.

In a second moment of the research, pedestrians were asked to indicate five (5) characteristics related to the aspects of the sidewalks that, according to their opinion, most influence the quality of people’s walking on the sidewalks. One hundred (100) people were interviewed and each one of them marked five (5) characteristics, in total five hundred (500) answers (table 6).

Table 6 - Number of responses and percentage for each feature related to sidewalk aspects.

Feature	Nº of answers	%
Steps along the sidewalks	39	7.8
Number of pedestrians on sidewalks	17	3.4
Broken and hole sections	51	10.2
Sidewalk slope	25	5.0
Width available for use	75	15.0
Type of material used for sidewalk flooring (slippery, rough, etc.)	31	6.2
Arrangement of street facilities on sidewalks (public telephones, newsagents, fire hydrants, post office box, etc.)	29	5.8
Commercial advertisements on sidewalks	23	4.6
Number of sidewalk access ramps	32	6.4
Number of benches, electric post, dumpsters and boards	21	4.2
Condition of the floor	47	9.4
Store goods displayed on sidewalks	26	5.2
Location of sidewalk access ramps	19	3.8
Floor irregularities	29	5.8
Unpaved sections	36	7.2

Fonte: the authors.

Step V: analysis of the results

As results obtained by applying the opinion questionnaires, 39% of respondents reported that the most important is a sidewalk offering an unobstructed route, such feature is directly linked to the free usable walking width and without interference. 27% of respondents considered the comfortable floor (no holes, unevenness, cracks and undulations) for pedestrians as the most important aspect. These two characteristics (width and floor condition) obtained the highest values of importance in the opinion poll. In the application of the Walkability Index were the indicators that received the lowest scores.

Analysis of the estimated utility functions for each aspect of sidewalk infrastructure reveals the scenario preferred by the interviewed users should, firstly, have an efficient useful width for walking without interference. The second most important aspect for pedestrians is the condition of the floor. Two variables that present the most deficiencies regarding to the result of the application of the Walkability Index are the most significant by pedestrians according to the results from Declared Preference Survey and opinion questionnaires.

In the applied questionnaires, pedestrians were asked to indicate the three characteristics they least liked when walking on the sidewalks of the study area. Such answers can be used to assist in taking actions that considere users' wishes. All answers were analyzed and the complaints regarding to the "width" were: "little walking space", "sidewalk obstacles", "flow impediments", "sidewalk vendors", "stalls hinder circulation", "informal commerce blocks flow", "store products scattered on sidewalks", "front-end shops disrupting traffic", "full sidewalks", "large amount of services and obstacles sidewalks". Other answers related to "sidewalk width" were issued, but they had the same meanings.

Answers show that user dissatisfaction is generated by obstacles in the sidewalks. During the on-site survey, it was found the widths are enough to support the flow of pedestrians. Therefore, the "full sidewalks" response is possibly due to the presence of various obstacles, causing problems in the movement of people and the feeling of smaller space.

All sidewalk segments received the lowest scores (zero) regarding the "floor condition" indicator. The Walkability Index considers the condition of the floor for pedestrians is associated with the existence of holes, cavities or depressions of varying depths caused by damage resulting from use or poor deploying. The existence of holes along the sidewalk interrupts the uniformity of the surface used by pedestrians and especially impairs the mobility of the elderly, children and people with disabilities.

Results obtained through the Declared Preference Survey and opinion questionnaires demonstrate the condition of the floor is the second most relevant feature for pedestrians, and the recoveries identified for this item were: "sidewalk holes", "sidewalk with many holes", "poor pavement", "broken pavement", "unpaved stretches", among other similar answers.

The "floor material" indicator concern to the suitability of the pavement floor material and the conditions of implementation. The aspects indicated by users for this item are: "unevenness of sidewalks", "poorly made floor", "bad paving", "too many unevenness". No criticism was made by pedestrians regarding to the "longitudinal slope". During the on-site data collection it was found the inclination of the study area sidewalks is efficient for pedestrian circulation.

The evaluation regarding to the "floor material" indicator was considered acceptable. Therefore, it is suggested by the Walkability Index that priority intervention and short-term actions need to be done. This indicator is composed by two attributes, namely "floor material" and "longitudinal slope". "Floor material" was ranked last one in importance in the Declared Preference Survey, and third one in the opinion questionnaires, while "longitudinal slope" was ranked third one in the Declared Preference Survey, and last one in the questionnaires.

Analyzing the results of the Walkability Index and Declared Preference Survey, it can be concluded the features considered most important by the pedestrians presented the worst levels of sidewalk service. The result of the research applied to the pedestrians in the central area of Goiânia city, although it was restricted to a group of people of the city, showed that pedestrians' desire concern to the spaces that offer comfort to walk.

Conclusions

Urban problems caused by transportation planning that prioritizes the use of vehicles over other modes of transportation indicate walking as a viable and sustainable alternative to urban transportation in Brazilian cities. In recent decades, most of the world's population has migrated to urban centers. This increase in urban population has generated the need for revision in urban planning policies. Some authors such as Jan Gehl and Jane Jacobs discuss aspects of sidewalks as quality generators in cities.

In this context, this work aims to develop a methodological procedure that contributes to the qualification of the infrastructure of systems aimed at walking mobility, aiming at effective actions to promote the practice of walking that are attractive to pedestrians, integrating the technical requirements of sidewalk evaluation through the Walkability Index, and considering user preferences through the Declared Preference Method.

The methodology allowed to evaluate the quality of sidewalks, identifying the most critical points regarding attributes related to urban infrastructure and where improvements are urgent. Through the methodology it was possible to know the pedestrians preferences regarding the sidewalks. Such information is important because it provides support to managers' decisions and actions regarding the quality of sidewalks.

Suggestions for future work to be developed on the subject are: application of the methodology considering other indicators of the Walkability Index, namely: mobility, attraction, public safety, road safety and environment. The proposed methodology was applied in an essentially commercial area. It is suggested to apply it also in areas with other types of use (residential, industrial, institutional, etc.) in order to identify the preferences of pedestrians due to the change in the type of use of these areas.

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NOTA

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