# FACTORS AFFECTING ACCESS TRIPS IN TWO LOW INCOME NEIGHBORHOODS IN RIO DE JANEIRO

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**RESUMO**
Com o crescente processo de urbanização, os indivíduos de baixa renda têm sido empurrados para áreas distantes da área central. A oferta de transporte público (TP) em algumas dessas áreas suburbanas é escassa e o acesso ao TP pode ser um fardo. O esforço para se chegar ao sistema de TP pode afetar negativamente as viagens realizadas por TP. Apesar da importância das viagens de acesso, pouca atenção tem sido dada a esta parte da viagem de TP. O objetivo do presente trabalho é analisar as viagens de acesso ao transporte público em dois bairros de baixa renda do Rio de Janeiro, focando na relação entre a escolha do modo de acesso e características socioeconômicas, a distância da viagem de acesso e as preferências dos usuários em relação ao modo de acesso.

**ABSTRACT**
As a consequence of the urbanization process, low income people tend to be moved away from central areas. The public transport (PT) provision in some of these suburban areas can be scarce and to access public transport can be a burden. The effort required to access PT can affect negatively the use of this type of transport. Despite the importance of the access trip in a PT journey, little attention has been paid to it. This paper aims to analyze the characteristics of access trips in two low income areas in Rio de Janeiro and identify which are the most important factors underlying the choice of access mode, with particular attention to the relation between access mode choice and socioeconomic characteristics, trips distance and users' preferences.

## 1. INTRODUCTION

The urbanization process, faced intensively specially in developing countries, tend to move most of the low income individuals away from the centre, and where they live, many times, is scarcely provided by public transport (PT) and the distance is too long to be covered by non-motorized modes. Since some of these low income areas are not well provided by public and private services and part of the local population cannot afford public transport fares frequently, they can have their mobility restricted or even, in some cases, be spatially segregated.

In Rio de Janeiro for example, job opportunities are concentrated in two or three areas in the city, whereas low income households are located far from these opportunities, while travel options (in terms of fare and availability) are lacking, creating a transport deprivation for these low income groups.

For these groups the use of PT is not an alternative it is the only option, they are PT captives. Given the magnitude of the territory of Rio de Janeiro, it is not rare that access trips to PT are long trips, which stresses the importance of the access trip in this city.

The importance of the access trip is highlighted by Krygsman et al. (2004) when they state that "much of the effort associated with public transport trips is performed to simply reach the system and the final destination".

As most of the studies regarding access trips, or multimodal trips are based on developed countries context, mainly European context, it is crucial to understand access trips and the factors affecting this part of a multimodal trip in a developing country context, especially in a big city as Rio de Janeiro.

The aim of this paper is to analyze the characteristics of access trips in two different areas in Rio de Janeiro and identify which are the most important factors underlying the choice of access mode. The main questions to be answered by this study are:

- What is the influence of socioeconomic characteristics on access mode choice?
- How distance affects access mode choice?
- Which are the preferences of public transport users in relation to access mode choice?

## 2. LITERATURE REVIEW

Even though access trips have not been extensively investigated, there are yet some studies which approach this part of the trip (Keijer and Rietveld, 2000; Rietveld, 2000; Rietveld, 2000a; Krygsman et al., 2004; Martens, 2004; Ribeiro, 2005; Givone and Rietveld, 2007; Martens, 2007). Looking at the most important features affecting access trips, distance and time seem to play an important role. Population density plays a role as well. Socio-demographic characteristics seem to have less influence. However, studies on access trips in different context of Europe are still lacking.

As Krygsman et al. (2004) observe, socio-demographic variables are not significant for access and egress trips. Males seem to have shorter egress trips and individuals with children have shorter access time, probably because of the burden to have to accompany kids, they seem to choose the closer transport option.

With respect to access trips time, Krygsman et al. (2004) state that it should be considered not only the absolute access time but the relative share of the total trip time. In this sense they come up with the interconnectivity ratio which is “the proportion of access and egress time to total trip travel time”.

Distance is also relevant for access trips and it is strongly related to travel time. The longer the trip, the lesser is the negative effect of access and egress trips (Krygsman et al., 2004; Rietveld, 2000). This is reasonable, taking into account the interconnectivity ratio. The smaller influence of distance in longer trip is also confirmed by the minor effect of access and egress trips in inter-urban trips, which tend to be longer (Krygsman et al. 2004).

In the Netherlands, data on mode used for access trips to train station shows that walking is the most mode used for distances up to 1,5km. From this distance till 3km, bicycle is the preferred mode, and from 3km PT seems to be the most used mode in access trips. Referring to egress trips, walking is the most relevant mode for distances up to 2km and from this distance on PT is the main mode for egress trips (Keijer and Rietveld, 2000).

There are not many studies available regarding to access and egress trips to/from other modes other than train. One exception is Krygsman et al. (2004) who find out that for bus/metro/tram bicycle is not a significant mode in access and egress trips, in the case of The Netherlands, and this is probably due to the dense network of these modes enabling shorter access and egress trips, making the bicycle not the best option. Another possible reason could be the lack

of proper parking facilities at stops, making it difficult if not possible to use bicycle as access mode. Martens (2004) also find some differences between slow (trams and local buses) and fast modes (inter-city buses and trains), as seen above, confirming this. For instance, slower modes attract fewer bicycles as feeder modes than faster modes. In addition people to cycle shorter distance to access slower modes and cycle longer to access fast modes.

Density has influence as well in access trips. Krygsman et al. (2004) find out that for access trips, as density increases, time decreases up to an inflection point, when density reach a certain level that causes pedestrian and cyclist congestion as people converge to a single station, resulting in longer times.

The presence of transfer in the transport chain also affects access distances. People tend to have shorter access trips to get to a mode which involves transfer than have a longer access trip and take a more direct option. For egress trips it seems to have no impact on it, and it is likely that the reason is that people are less informed about more alternatives at destination (Krygsman et al., 2004).

Facilities provided in the stations are found to be relevant for access modes, since improved facilities, such as car parking facilities, bicycle parking (both guarded and unguarded) tend to attract more people, increasing the modal share of the mode (Givoni and Rietveld, 2007).

There are lower barriers for changing travel behaviour in access trip than overall mode change (Martens, 2007) and this could be a target. Instead of trying to stimulate people to change the whole trip mode, it would be more feasible to tackle specifically on the feeder modes, especially in large cities, where the main modes usually cover long distances and access motorized trip tend to be not that long.

Research conducted in Europe indicates that distance, density, presence of transfer and the main mode are important factors when it comes to access mode choice. In the present study, some of these aspects such as socioeconomic characteristics, density, main mode and distance of access trips are regarded, and it will provide an overview of the access mode choice in a different context: a Brazilian large city.

## 3. STUDY DESIGN

### 3.1. Study areas

This study reflects the travel patterns of data collected in two neighborhoods of Rio de Janeiro: Colégio and Santa Cruz (Figure 1). These two neighborhoods share one characteristic: both are low income areas. Nevertheless, Colégio has an average *per capita* income higher than Santa Cruz (R$262 as compared to R$206).

However, regarding other relevant characteristics related to the use of PT, they differ significantly. Santa Cruz is located in the western part of the city, it presents one of the lowest population densities of Rio, and the formal public transport provision is scarce, with areas being not served by bus lines. Land use is highly mixed, with both commercial and residential buildings, especially in the center of the neighborhood. In addition, Santa Cruz attracts residents from longer distances, including of adjacent neighborhoods, as it has a train station and final bus stops of many lines which leads to the city center and other areas of the city. The distance from Santa Cruz center to the CBD is nearly 63km (shown by the arrow in Figure 1).

On the other hand, Colégio is located in the northern part of the city, presents a high population density and it counts on a good PT supply, with plenty of bus lines available and a metro station. The land use mix is low, being mainly a residential neighborhood. The distance from Colégio metro station to CBD is approximately 25km (shown by the arrow in Figure 1).

### 3.2. Data collection methodology

The data collection methodology applied in this study is composed of several steps, including qualitative methods (expert group, focus group and in-depth interviews) and subsequently quantitative methods (selection of frequent PT users and telephone interviews). Firstly an expert group and a focus group with PT users were conducted to bring the main variables affecting multimodal trips to the picture. The experts' group was composed by representatives of diverse modes operators as well as a representative from the academia. The focus group was conducted with both train and bus users from Santa Cruz. As it was not possible to arrange a focus group with metro users in the other study area, in depth interviews with these users were conducted instead.

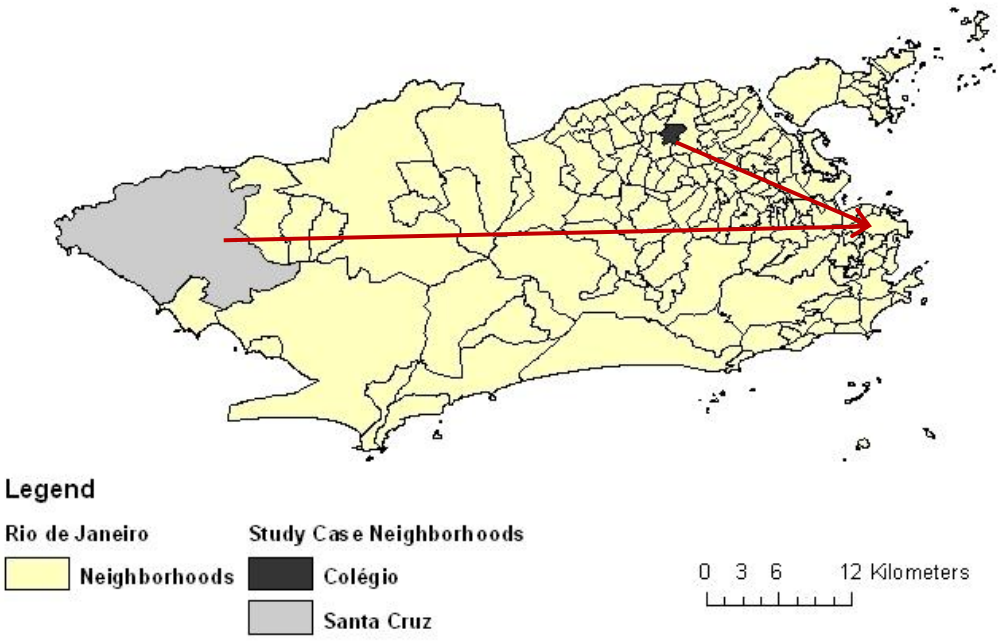


**Figure 1**: Study Case Neighborhoods, Rio de Janeiro

The results of the qualitative data collection together with an extensive literature review on the topic were the basis for the questionnaire form design. The final questionnaire was imported to handheld computers using the freeware CyberTracker, in order to have an electronic data collection. The use of such electronic device is of great help not only for the ease to treat the data, but also for saving time and minimizing errors both in digitizing the data and also in carrying out the interview itself. On the other hand, unexpected problems with the electronic devices can affect the data collection, and therefore it is crucial to have paper questionnaires available as a backup during the data collection.

For the next stage of data collection handheld computers were used and the PT users were approached in the main mode boarding points. PT users were approached in bus stops and the train station in Santa Cruz and in the metro station of Colégio. The sample used in this survey, therefore, is composed by PT users who enter the public transport system through those boarding points. Filter questions were asked to check whether the user fits the desired profile.

The desired profile consisted in people living within the city of Rio de Janeiro borders and having the destination also within these borders; people making trips to work or study (compulsory trips) and people who use the same transport mode(s) in daily basis. If the person matched these conditions, the surveyors invited the interviewee to take part in a longer interview to be performed by telephone and the call would be made in an appropriate time and date indicated by the person. The filter interview takes a maximum 1 minute.

The final step of the survey was the telephone interviews and again handheld computers were used. The telephone interview took, on average 5 minutes. The questions were related to four main categories and captured the following information:

- Transport data: access mode (bus line when applicable), main mode (bus line when applied), complementary mode (bus line when applied), extra complementary mode (bus line when applied)
- Spatial data: origin and destination locations, as well as transfer locations
- Behavioral data: attributes of choice related to all individual components of the multimodal trip
- Socioeconomic data: gender, age, income, car availability

A total of 620 valid interviews are used for the present study, with 444 respondents in Santa Cruz and 176 respondents in Colégio.

In order to enable spatial analysis, it was necessary to geo-reference the locations involved in this study (residence locations and PT boarding points). The first step was to divide the city of Rio de Janeiro into square grid cells measuring 800m x 800m. Using this grid cell size as the unit of analysis means that the average intra-grid cell trip distance is of approximately 450m which is reasonable considering the proposed analysis and the scales of the trip and the areas. Each grid cell has one centroid. The next step was to use the information about location collected with the questionnaires and use it to populate the centroids with the residence locations of the interviews, as well the boarding points. As the base map is geo-referenced, all the information derived from this map are, consequently, also geo-referenced.

### 3.3. Analysis methodology

In order to answer the questions proposed above and tackle the aim of the current study, the analysis of the results will be conducted as follows: firstly the access mode choice to different main modes will be identified and then associated to socioeconomic characteristics, based on frequencies analysis. A comparison across neighborhoods will be presented. Differences and similarities will be highlighted. Subsequently the distance traversed per mode is analyzed and also compared across the two different areas. Next the reasons why individuals choose the access mode are presented and associated to socioeconomic characteristics, home location and finally contrasted between neighborhoods. Lastly the PT alternatives available for access trips will be examined and an analysis of current mode versus alternatives will be presented and compared across study areas.

## 4. RIO DE JANEIRO: AN OVERVIEW

Before analyzing the results from the survey, it is important to provide an overview of the main characteristics of Rio de Janeiro, the study case city, regarding population and transport infrastructure.

The city of Rio de Janeiro has approximately 6 million inhabitants, and a 52.3 inhabitant/ha average density, though significant differences can be found, with the highest density found in Rocinha (446,8 inhab/ha) and the lowest in Guaratiba (8,5 inhab/ha) (PDTU, 2005).

The railway system in the city of Rio de Janeiro is composed by 35.7km of metro railways (divided in 2 lines, with 33 stations), and 149.9km of urban trains (divided in 5 corridors with 71 stations). Regarding the road network, 3.357km of roads connect different areas of the city, and 2.420km out of this total accommodate public transport.

According to an Origin Destination (OD) survey conducted in 2002-2003 (PDTU, 2005), approximately 11 million trips are made per day in the city of Rio de Janeiro. From all these trips, 67.1% are made by motorized mode whereas the remaining is made by non-motorized modes. The modal split indicates a higher share of PT among the motorized modes and a concentration of walk trips among the non-motorized modes. The PT share is divided among the different public modes, with a strong dominance of urban bus followed by informal transport. Metro, train and other modes (tram, boat and charter transport) play a minor role.

## 5. ANALYSIS OF RESULTS

In this section the main surveys' results regarding the access trip are presented. Firstly the access mode choice is analyzed in association with socioeconomic characteristics. Then the characteristics of the trip are presented, with special attention to the relation of access leg distance and access mode, neighborhood and socioeconomic characteristics. Subsequently the reasons for choosing the access mode are shown and also the relation with socioeconomic characteristics and residence location. Finally the PT alternatives for access trips in the two areas are examined.

### 5.1. Access mode choice

When asked about the mode used to access the bus stop in Santa Cruz, more than half of the interviewees answered the bus, followed by informal transport and "walk". The same order of access mode is used to access the train station. On the other hand, in Colégio, almost two thirds of the metro users get to the station by walking and the bus is the second access mode, with close to one third of the answers. The other access modes, such as car and bicycle, correspond to less than 5% of the total access mode choice and therefore will not be considered in further analysis.

Regarding socioeconomic characteristics, the informal transport users' are in its majority women (more than 70%), and its higher use is amongst people from 25 to 34 years (almost 40%) and close to half of the total users belong to the 1 minimum wage (MW) to 2MW income range (the value for the minimum wage in Rio de Janeiro for the year of 2011 is R$608). Most of the individuals do not own a car and do own a bicycle.

Bus users are mainly women as well, but with a smaller proportion (less than 60%), the most frequent age range is from 25 to 34 years, and 45% of the individuals earn from 1MW to 2MW. Three fifths of the bus users do not have a car and two thirds do have a bicycle.

People who walk to access public transport system are most frequently female. In terms of age range, there is an almost equal distribution of individual across the first three ranges (up to 24 years, from 25 to 34 years and from 35 to 44 years). Regarding to income it is also more equally distributed across income levels. Most of the people do not have a car and less than

half of the respondents do have a bicycle, but the share of bicycle ownership amongst walkers is the lowest (38%) as compared to informal transport and bus users (48% for both modes). This can be explained by the high share of walkers in Colégio and the lower level of bicycle ownership in this area, where the bicycle use is much lower than in Santa Cruz. Walkers who are bicycle owners in Santa Cruz correspond to almost 80%, whereas in Colégio this share drops to less than half of total walkers.

### 5.2. Access trips characteristics

In order to analyze the influence of the distance in access modes' choice the access trip distance is measured by using Euclidean distance from the origin (centroid of a grid cell) to the PT boarding point.

For the analysis of access trips characteristics, firstly, the relations between mode and distance are presented. The figure below (figure 2) illustrates the share of each mode per distance traveled. As expected, in distance up to 1 km the most used mode is walk, accounting for almost 90% of the access trips. For distances between 1km and 2km, the proportion of walking is still significant, but also bus presents similar percentage. Informal transport still plays a minor role in this distance range. When it comes to distances between 2km and 5km, walking trips share drops dramatically and bus is the most used transport mode although informal transport is also a relevant mode. For distances longer than 5km bus is the dominant mode but informal transport is still an important alternative.

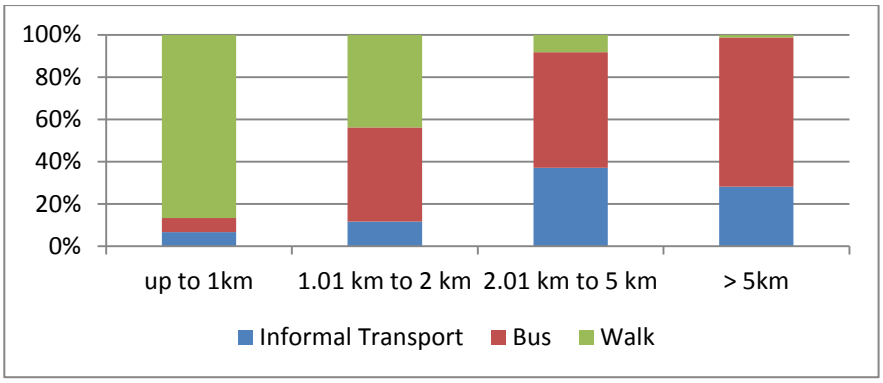


**Figure 2:** Access leg distance per access mode

This distribution of access distance per mode confirms that the choice of the access mode is strongly related to the distance traveled. Up to 2km walk is the main mode and for longer distances the motorized mode is preferred, being it bus or informal transport.

Comparing the distances traveled by bus and informal transport in Santa Cruz no significant difference can be noticed. It is likely that the main factor related to the choice between these two modes is the location of residence which is directly linked to the transport provision available in the area.

Since walking and bus are common access modes in both neighborhoods, it is possible to compare the distance traveled by each mode across areas. However, as informal transport is not present as access mode in the Colégio area, only bus and walk are taken into account for this analysis.

The main difference when comparing the differences of distances per mode across neighborhoods is in the range from 1km to 2km (Figure 3). In Colégio 70% of the residents of this area take the bus whereas approximately the same share in Santa Cruz walks within the same distance. One possible explanation for this dramatic difference can be the income level. In Santa Cruz the income level is lower than in Colégio, and it is likely that people accept to walk for longer distances in Santa Cruz in order to save the bus fare. This practice of replacing a bus leg by walking in order to save money is a common one in Rio de Janeiro (FETRANSPOR, 2007).

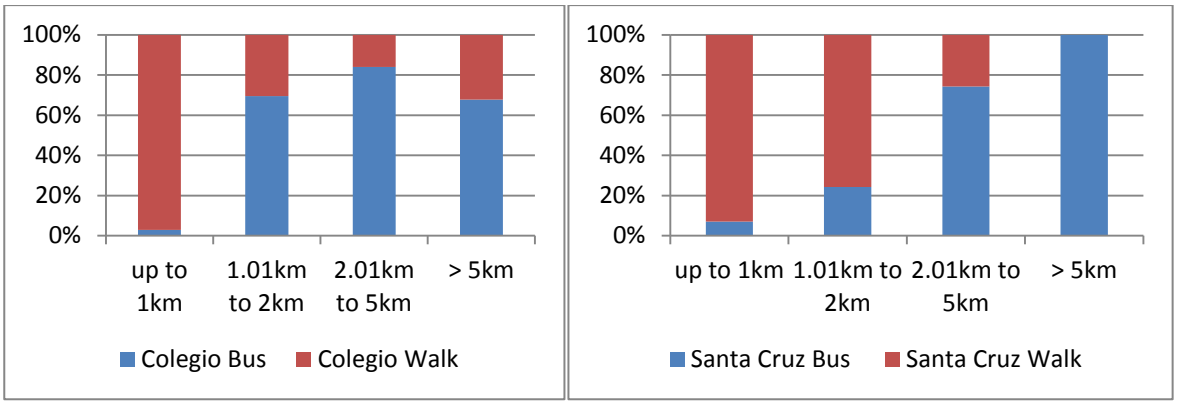


**Figure 3** - Access distance per mode in Colégio (a) and in Santa Cruz (b)

### 5.3. Why individuals choose an access mode?

In this section the reasons why individuals choose a given access mode are presented. The reasons for transport mode choice given by the respondents are: captivity, travel time, cost, comfort, health, relaxing, independence, no waiting time, no walking to the mode, proximity from home, frequency, ticket facilities and safety. However, many of these attributes account for a very small percentage and therefore are not considered here in the further analysis. The remaining factors account for 92% of the total responses.

The reason(s) for someone to choose a particular access mode varies considerably depending on the mode used. For informal transport users, the most important factor affecting its choice is the frequency of the mode. If “no waiting time” is also considered as way to express the frequency of the mode, the role that frequency plays increases considerably. Travel time is also very important for informal transport users, followed by captivity, meaning that this is the only option available.

For bus users captivity and frequency are equally important. They correspond to more than half of the responses. Travel time also plays a role when deciding to use the bus. Proximity from home in this case refers to the proximity of the bus stop from home, and is responsible for approximately 10% of the answers.

When it comes to walking, almost two thirds of the interviewees indicated “proximity from home” as the reason why they walk to the PT station/stop. This confirms the result presented above that more than 90% of the people who walk to the station lives within 1km from the PT boarding point. Cost accounts for almost 20% of the responses.

However, some distinctions can be made across neighborhoods. For instance, the importance of the cost when choosing walking in Santa Cruz (31%) is much higher than in Colégio (less than 10%). This can be explained by the higher income level of Colégio as compared to Santa

Cruz. Still in Colégio almost three quarters of the respondents walk because of the proximity from home whereas in Santa Cruz this share is less of half of the respondents. In Santa Cruz, a considerable part of the respondents walk due to the cost aspect, meaning to save the money of this leg of the trip, whereas in Colégio this is the case for only for small portion of the respondents. This confirms the above mentioned fact of the importance of the cost factor in Santa Cruz.

Regarding the use of bus, the reasons are also different depending on the location. The main attribute of choice in Colégio is travel time, followed by frequency and captivity. On the other hand, captivity is the main reason for taking the bus in Santa Cruz. This can confirm the above mentioned statement that in Santa Cruz the public transport provision is scarcer than in Colégio.

When it comes to socioeconomic characteristics associated to the choice of the mode, no relations can be made between mode choice and gender or age range. However, as expected, when it comes to income level, the importance of the attribute "cost" decreases as income level increases.

Individuals who do not own a car gives more importance to cost than those who do. On the other hand, respondents who have a car choose the mode based on the proximity from home more often than those who do not have a car. Car ownership is related to income, which in turn can be related to where people live. Usually the value of the land in the surrounding area of a train/metro/bus station is more valuable and this holds true for areas with higher provision of transport (Lentino, 2005). This can imply that individuals who can afford to have a car have higher income level and can afford to live in areas with higher provision of PT.

Associating the attributes of access mode choice with residence location, no significant patterns can be detected. One exception, unsurprisingly, is those who choose a mode due to the proximity from home. Those people live in the vicinity of the station, and this is especially clear in Colégio. Figure 4 depicts this relation. In Santa Cruz the concentration of respondents in the surroundings of the station is not that evident. This is due to the characteristics of the area, where there are more commercial buildings than residential. Also it is possible to identify areas where respondents choose to the proximity from home, but they are located further from the main boarding station in Santa Cruz. Those individuals refer to the proximity to the bus stops they use as access mode.

Regarding the attribute "captivity", as mentioned above, it is clear that this is an issue in Santa Cruz but not much in Colégio. In Santa Cruz, the "captives" are distributed all over the PT boarding points catchment area. There are some areas with higher concentration of captives, and those grids correspond to some "conjuntos" or "favelas", where there is a higher concentration of residents than the average low density of Santa Cruz.

### 5.4. Access mode alternatives

In order to analyze the transport alternatives available, a selection of the bus lines which can be used from origin areas to the PT boarding point (bus stop and train station in Santa Cruz and metro station in Colégio) was made. Then the Euclidean distance from origins (residences) to the closest bus line was calculated.

The majority (nearly three quarters) of the residences have a bus line within 250m. If the distance considered is 500m, then more than 90% of the home locations are served by a bus line which can take the resident to the PT boarding point.

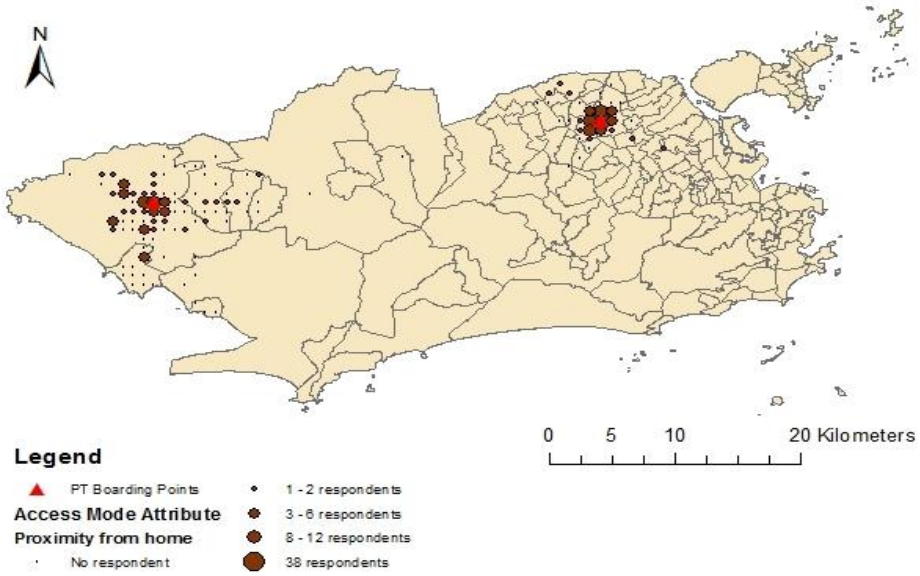


**Figure 4** - Attributes of access mode choice (proximity from home) per residence location

However, when the neighborhoods are taken into account, differences can be noticed. In Colégio almost 85% of the origins are served by a bus line within 250m and another 15% of the origins within 500m. This means that almost all households in this neighborhood have a bus line within 500m. For Santa Cruz, this picture is quite diverse. The share of residences distant 250m drops to two thirds, even though the proportion of respondents within 500m is higher than in Colégio (almost one quarter). Still in Santa Cruz, there is a significant percentage of interviewees who live further than 500m from a bus line. These results again confirm the better provision of public transport in Colégio, where the bus network seems to be denser than in Santa Cruz. However, most of the respondents still walk to the metro station due to its proximity from home locations.

When the distance from residence to the closest bus line is compared across access mode used, it is detected that for more than 80% of those who walk to the PT boarding point there is a bus route available within 250m (figure 5). As seen above, almost 90% of the people who walk to PT boarding points live within 1km from the boarding points. This can indicate that the bus provision is more abundant close to PT stations.

Figure 5 also shows that there is a slightly higher share of bus users who have a bus line within 250m as compared to informal transport users. Despite the low share, it is worthy to highlight that there are respondents who have to walk more than 1 km to take a bus to PT boarding points.

It is interesting to notice that amongst informal transport users who mentioned that this is the only mode available (captives), more than three quarters have a bus line within 500m from their residence location. This can indicate that these users perceive that the informal transport is their only alternative, but in reality there is also the bus available. It would be necessary and worthwhile to investigate the reasons for such perception.

Unfortunately there is none data available about informal transport routes, and therefore it is not possible to examine if the opposite perception also takes place, that bus users feel that the bus is their only choice, but there are informal transport routes in the vicinity of their home locations.

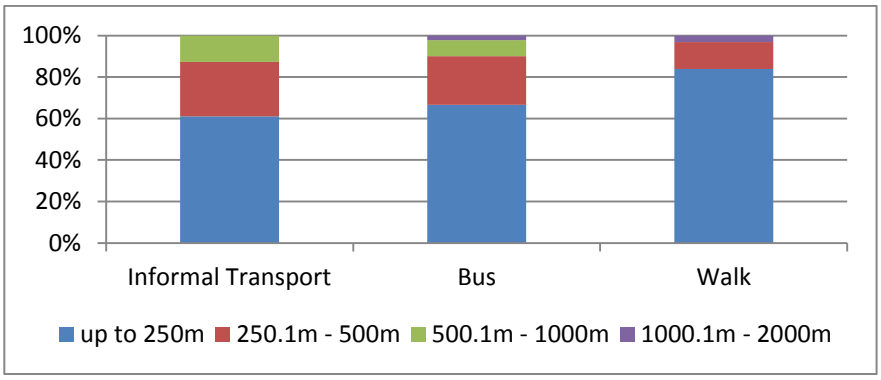


**Figure 5**: Nearest bus line per access mode

## 6. CONCLUSIONS AND RECOMMENDATIONS

This study draws attention to a commonly neglected part of a trip: the access leg. It gives an overview of the main aspects of these trips, such as the most used access modes, the reasons why people choose a mode, the relation between distance traveled and the mode used and finally the possible alternatives of access mode.

The comparative higher proportion of women as informal transport users' in relation to other mode users is unexpected, since due to the uncertainty related to the mode it would be expected women to feel more vulnerable to use it and tend to avoid this mode and prefer the bus, when possible. People who walk to the station/stop tend to be more homogeneous in terms of age and income ranges and what is more important for this group is the distance to the PT system.

Apart from the walking trips for young people in Santa Cruz, the differences noticed on the comparison of socioeconomic characteristics per mode across neighborhoods are more related to the profile of the people living in each specific area than to mode specific characteristics.

Regarding the choice of the access mode, it is possible to conclude that the main factors affecting this choice in these two areas are the transport options available and the distance to be traversed. Density also plays a role, as it influences directly the distance traveled. On the other hand, contrary to the studies conducted in Europe, the main mode has no influence on the choice of the access mode

In Colégio where the density is high and people live very close to the metro station, walking is the main access mode, even though there are plenty of bus lines available, suggesting that distance plays a major role in access mode choice. For individuals who live further from the station, the bus is the usual option, as the supply is sufficient and the coverage satisfactory. Captivity is not an issue in this area, firstly due to the concentration of residences in the surroundings of the station, enabling walking as access mode and secondly as a result of the good PT provision. On the other hand, in Santa Cruz, captivity is an issue to a large portion of the respondents. The catchment area of the PT boarding points analyzed in this study is much broader in Santa Cruz than in Colégio, due to its low density. The former attract individuals living up to 10km away from the station/stop whereas in Colégio this distance drops to 5km.

Some respondents perceive informal transport or bus, depending on the area, as their only choice. However, looking at the bus coverage in the area, it was possible to detect that even those who say that the informal transport is their only transport option, they can have a bus line in the vicinities of their residence. It is a matter of perception. Further studies are necessary to identify the reasons why have this perceptions. The opposite analysis, examining the coverage of informal transport, was not possible due to the informal and irregular nature of this service.

The relation between access mode and main mode observed in European studies could not be confirmed by the present study. In Santa Cruz, where the train and bus were considered as the main modes, no distinction in access mode modal split was detected.

It would be interesting to have further investigations in neighborhoods with higher income levels in Rio de Janeiro to look at the influence of income in access mode trips, as both areas considered in the current study are low income areas.

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