

# THE EFFECT OF METRO ON THE MOBILITY OF CAPTIVE PUBLIC TRANSPORT RIDER WOMEN

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## Abstract

Majority of public transport investments in the world are justified on the grounds that they will help improve travel conditions, accessibility and mobility of citizens, and particularly those with limited access or inferior conditions of transport. Of public transport systems, rail-based ones, such as metro and light rail transit, with their high-capacity, high-quality and fast services, as well as their positive images in terms of safety, are often considered as effective tools in increasing mobility and quality of life. Particularly from the point of view of women, urban rail systems are discussed to have significant mobility benefits due to being a safe, secure, easily perceivable and reliable mode. There is an understanding that a good-quality rail transit system can increase women's mobility resources and help them travel to more destinations covering larger urban geographies. This paper summarizes a study that aimed at testing whether mobility levels, that is frequency of tripmaking and variety of destinations traveled to, increase for women who use the metro system in Ankara, Turkey. The analysis, derived from a comprehensive questionnaire, focused on the mobility of women living along the metro corridor, but only women with no access to a private car, hence those with a significant reliance on public transport. The questionnaire also covered perceptions of women regarding the metro and other modes of transport, the outcomes of which need to be considered and addressed in order to enhance the mobility of women users.

## 1. Introduction

The impact of any transport investment on mobility means more than just its effect on physical movement. An investment into transport can improve accessibility, increase mobility and remove barriers to social inclusion. Having the means of mobility can permit people to construct and reconstruct their social relations (Nielsen, 2005); it can help people access more job opportunities, and health and education services (Gannon et al., 2001; World Bank, 2002). Mobility can make people's life better (Freudental-Pederson, 2005): if a transport investment can help increase the mobility levels of citizens, then it can also improve their quality of life by allowing them access to a variety of workplaces, shopping places, services and leisure activities (UITP, 2002).

Mobility means personal independence, and therefore people with low mobility levels, such as those on low income and senior citizens, need and expect more affordable and higher quality urban transport (CEC, 2007). Without good quality public transport, low-income citizens are restricted to using whatever services can be accessed within walking distance, making them 'accessibility poor'; and in most cases they opt for more affordable but slower modes that are time-consuming, resulting in them becoming 'time poor' (World Bank 2002, p. 27). In addition, among the captive public transport users it is women, children and the elderly in particular that often put off making a journey due to their vulnerability to traffic accidents and personal violence, making them 'safety poor' (World Bank 2002, p. 27). It is possible that improvements in the service quality and affordability in public transport can

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eliminate these restrictions and vulnerabilities, and hence increase mobility levels and quality of life. Of public transport modes, rail-based systems are generally seen as effective tools in helping increase the mobility of disadvantaged people, i.e. mobility-vulnerable groups. Particularly from the point of view of women, urban rail systems are considered to offer significant benefits to mobility due to them being safe, secure, easily perceivable and reliable modes of transport.

This paper presents a study that aimed to analyse the effects of the metro system in Ankara, a 16 km line that opened in 1997, on the mobility of women by examining whether frequency of tripmaking and diversity of trip destinations increase for women who use the metro system. The metro serves a corridor that includes middle- to low-income neighbourhoods; and the analysis focused on the mobility of women living along this corridor with no access to a private car, hence captive public transport riders. In the rest of the paper, first the methodology of the study is presented; secondly, the analysis regarding the frequency of tripmaking by women is described and the effects of metro usage presented; thirdly, diversity of destinations for shopping and leisure trips are examined; and finally, women's perceptions regarding the metro and other public transport modes are presented with a view to test whether the metro helped eliminate barriers to tripmaking for mobility-vulnerable women.

## **2. Methodology**

The data for this study was obtained from a questionnaire prepared by the authors and applied to some 300 women living along the metro corridor in Ankara. 200 of the women were selected from areas within walking distance of the metro stations, ensuring that equal numbers of sample were included from each station area. The remaining respondents came from areas outside walking distance from the metro, but still with access to easy links to the metro system. The questionnaire was applied only to female captive public transport riders.

The questionnaire intended to measure mobility in two ways:

- In terms of trip frequency: this analysis was designed to reveal the mobility of women in four categories: women who made almost no trips at all in a day; women who made one or two trips a day using a transport vehicle/mode; women who made three to four trips a day; and women who made five or more trips a day. The trip frequency data were based on the respondents' reply to a question of how many trips they make separately on weekdays and weekends; in which they were asked to detail trips made by any transport mode other than walking. While walking trips may also be important in other mobility researches, in this study they were excluded, since the aim was to observe the effect of the metro on women's perceptions and the choice of trips made using a vehicle. In addition, they were asked not to count transfers between modes as separate trips.
- In terms of the variety in number and location of places in the city visited by each interviewee. While it was intended to analyse working trips, shopping trips and leisure trips, the analysis focused on the latter two, eliminating the first one, i.w. working trips, because the majority in the sample were non-working women. Nevertheless, the high rate of non-working women was considered as a good indication of the representation of the sample, since the area that the metro serves accommodates lower income and more traditional households. Furthermore, it helps the analysis to cover an important percentage of women with lower levels of mobility, since the majority do not have to make work trips. For the shopping and leisure trips,

the interviewees were asked to name all destinations, so as to allow a calculation of the average number of different locations visited, as well as the coverage of the urban area by each respondent.

Finally the respondents were also asked a set of questions to reveal their perceptions regarding safety and convenience of the metro system as opposed to other transport modes. This part of the questionnaire was designed to provide a better understanding of whether the rail-based systems help eliminate cognitive barriers to making motorised trips by captive public transport rider women.

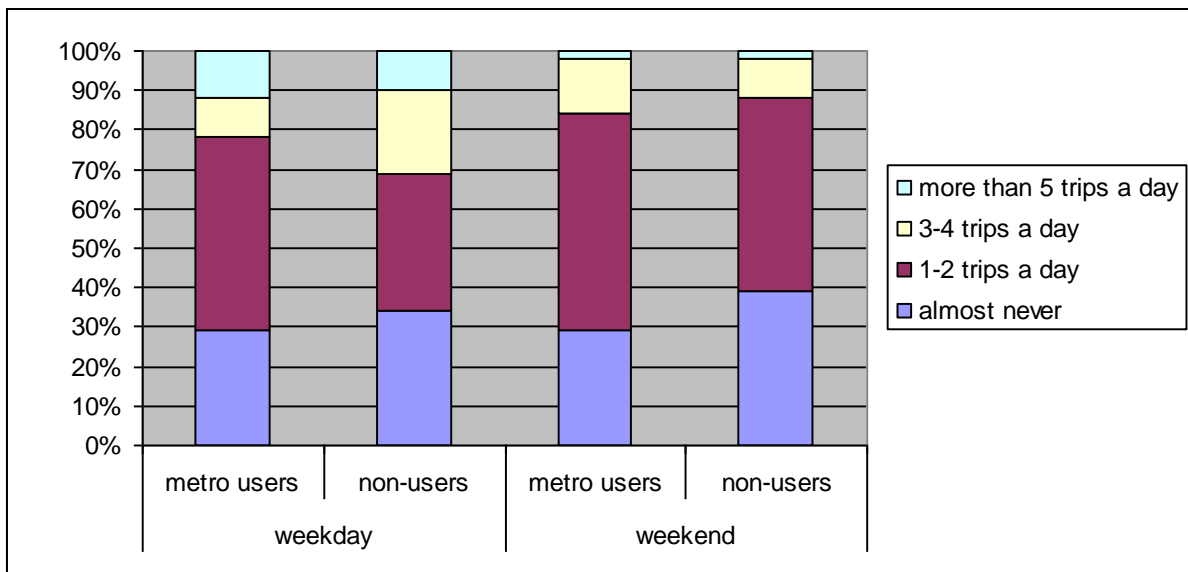
### **3. Results of the analysis**

#### **3.1. Metro usage and trip frequency**

The analysis showed that 63% of the women in the sample used the metro system while 37% did not. It seems that being within walking distance of a metro station was a significant determining factor in metro usage: 83% of the women living within walking distance of a metro station used the metro; compared to only 23% of those living outside walking distance. The analysis results presented here cover both groups, and consequently the comparison of metro users and non-users can also be seen, to a certain extent, as a comparison of those who have good access to a metro station and those who have indirect access.

For the weekdays, 31% of the women in the sample made almost no trips at all in a day; 43% made one or two trips a day; 14% made three to four trips; and 11% made five or more trips. In the weekends, 33% made no trips at all; 51% made one or two trips a day; 12% made three to four trips; and 2 % made five or more trips. It can be said that roughly about one third of the women make no motorised trips at all while half of them make one or two trips a day.

This finding that one third of the women made no motorised trips is important and from the point of view of this study it was important to see whether this rate was smaller for metro users since it would allow an observation of the effect of the metro on general mobility levels. As seen in Figure 1, the analysis showed that among the metro users, 29% declared that they almost never made trips during the week, whereas this rate was 34% for those who did not use the metro. This difference was slightly higher for weekend mobility: among the metro users, again 29% declared that they almost never made trips at the weekend, while this rate was 38% for non-users. It is also seen in the figure that the rate of women who make three to four trips a day at the weekend is higher in the metro-user groups when compared to non-users. It is surprising that this is not the case for the weekdays, and that non-user women make more numbers of trips on weekdays. The metro system does not seem to have a positive impact on weekday mobility of women who use the system; however, it does seem to increase their mobility at the weekend. It would be fair to suggest that the metro provides increased opportunities for leisure trips at the weekend, hence increasing the mobility of metro users at leisure times.



**Figure 1: Weekday and weekend trip frequency of metro-users and non-users**

The finding indicates that weekend mobility of those who use the metro is slightly higher; but more importantly this initial analysis shows that metro usage is not sufficient to explain why about one-third of the sample never made trips, either on weekdays or weekends. Socio-economic and demographic factors help explain the low mobility of women:

- The lowest income families were the least mobile, as half of them declared they almost never made trips on weekdays or weekends.
- Women older than 55 were also found to be less mobile, with 42% declaring that they almost never travel in the weekdays and 50% declaring that they did not travel at the weekend.
- Women with no education, or those with only the minimum basic education, also had very low mobility levels, slightly more than 50% indicating that they almost never travel on weekdays or at weekends.

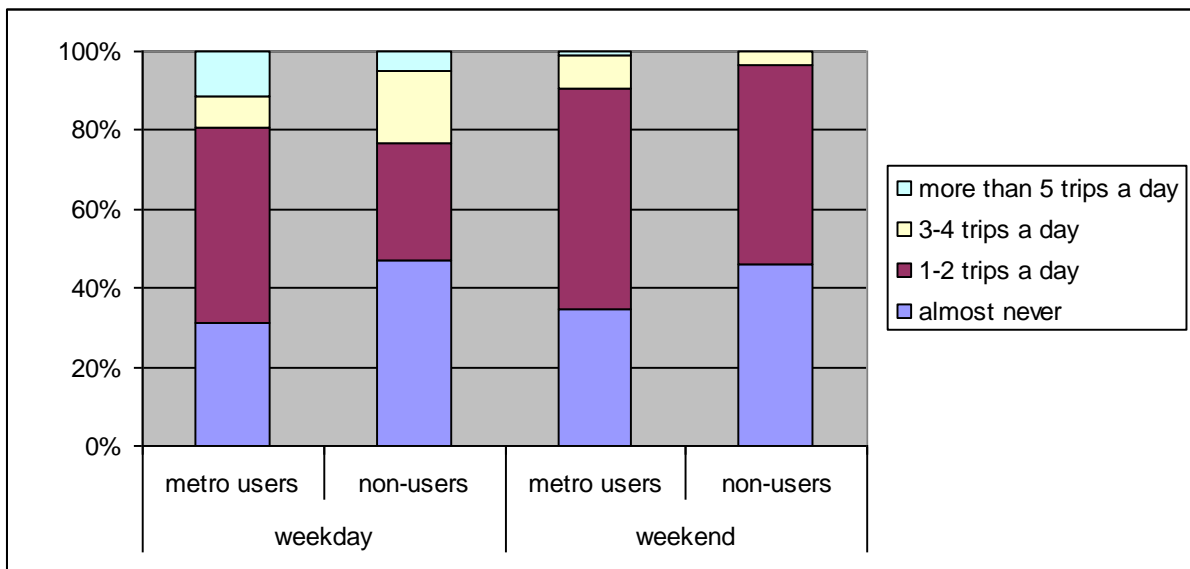
While it was expected that married women and women with children would also be among the vulnerable groups, this does not seem to be the case: in both groups, around 35% of women indicated that they never travelled on weekdays or at weekends, which is quite similar to the average of the whole sample. Although the mobility of single women and of those without children was much higher, with at least one trip per day for more than 80%, it was decided that married women and those with children are not as immobile as the other vulnerable groups. In addition, it was expected that young women, particularly those younger than 18, would be less mobile; however, this was not the case either. As a result, the initial analysis revealed that low income women, those older than 55, and those with the lowest/minimum education level were less mobile; and hence were identified as vulnerable women groups in terms of mobility.

The ratio of women who use the metro in these more vulnerable groups indicates that they consider the metro as an important mode of transport: 62% of women older than 55, and 60% of those with the lowest education levels regularly use the system. While metro usage rates decrease as income levels decrease, it can be seen that 78% of the lowest income women used the metro, which is a fairly high rate.

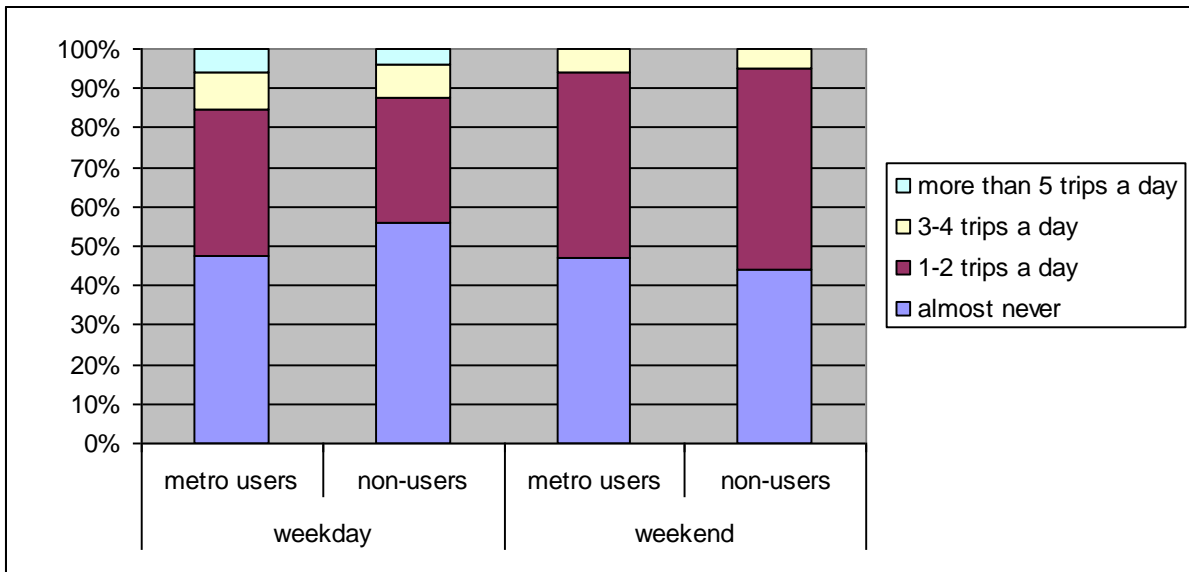
When the effect of metro usage is analysed for these more vulnerable groups, the differences between metro users and non-users were found to be as follows:

- Within the lowest income group (with monthly household income below 1,000 TL – corresponding to slightly less than 500 Euro), more than 45% of women who do not use the metro said that they almost never travelled on weekdays or weekends, while this rate was below 35% for metro users (Figure 2).
- Metro usage is not a strong factor in the mobility of women with a low level of education: 56% of non-users make no trips in weekdays while this rate is 47% for metro users. Hence, metro users in this group are slightly more mobile on weekdays; however, the difference is not as stark as in the low income group. The difference is even smaller for weekend mobility (Figure 3).
- Similarly, metro usage does not seem to have a significant effect on either the weekend or the weekday mobility of women in the 55+ age range. 42% of elderly users make no trips in weekdays while this rate is 42% for non-users. The rates are the same for weekend travels. (Figure 4)

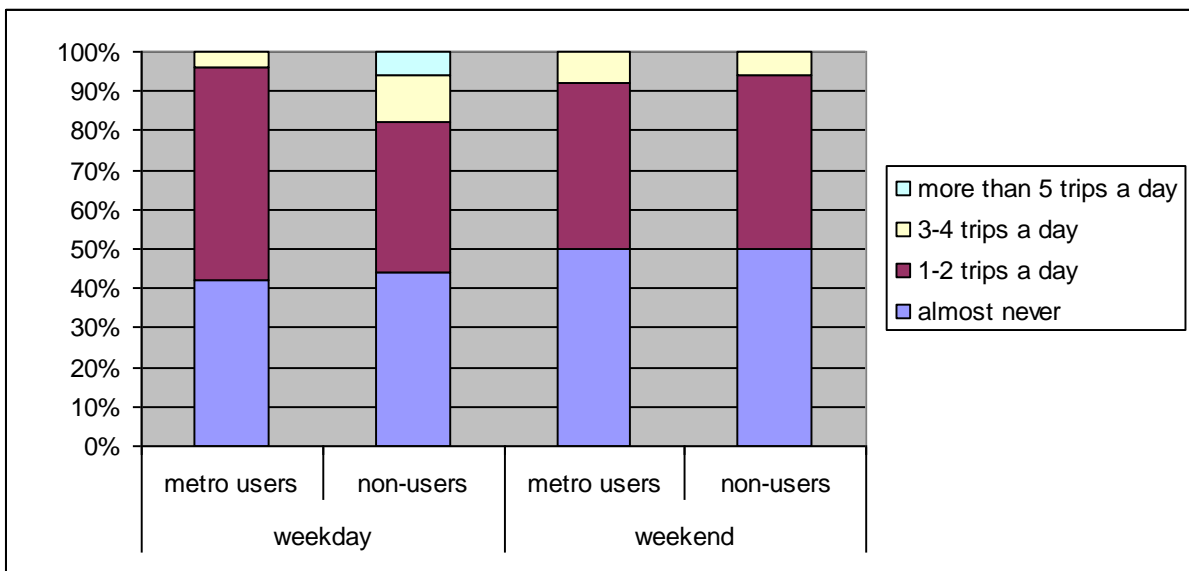
The effect of metro usage was found to be the most significant among low income women, when compared to its effect on other vulnerable groups. It is also seen in Figures 2 to 4 that the ratio of women who make more than two trips at the weekend is extremely low; however, this rate is higher on weekdays. This may be related to the fact that women tend to carry out household chores, such as taking children to school or daily shopping, during the week rather than at the weekend. In other words, they are required to make trips on weekdays, whereas there is no similar requirement at the weekend. As a result, their mobility levels are significantly low at the weekends, with only one or two trips, if any. The analysis showed that using the metro did not alter this situation significantly, except for among low income women metro users, who travel slightly more frequently at the weekends when compared to non-users.



**Figure 2: Weekday and weekend trip frequency of low-income women: metro-users and non-users**



**Figure 3: Weekday and weekend trip frequency of women with low education levels: metro-users and non-users**



**Figure 4: Weekday and weekend trip frequency of 55+ women: metro-users and non-users**

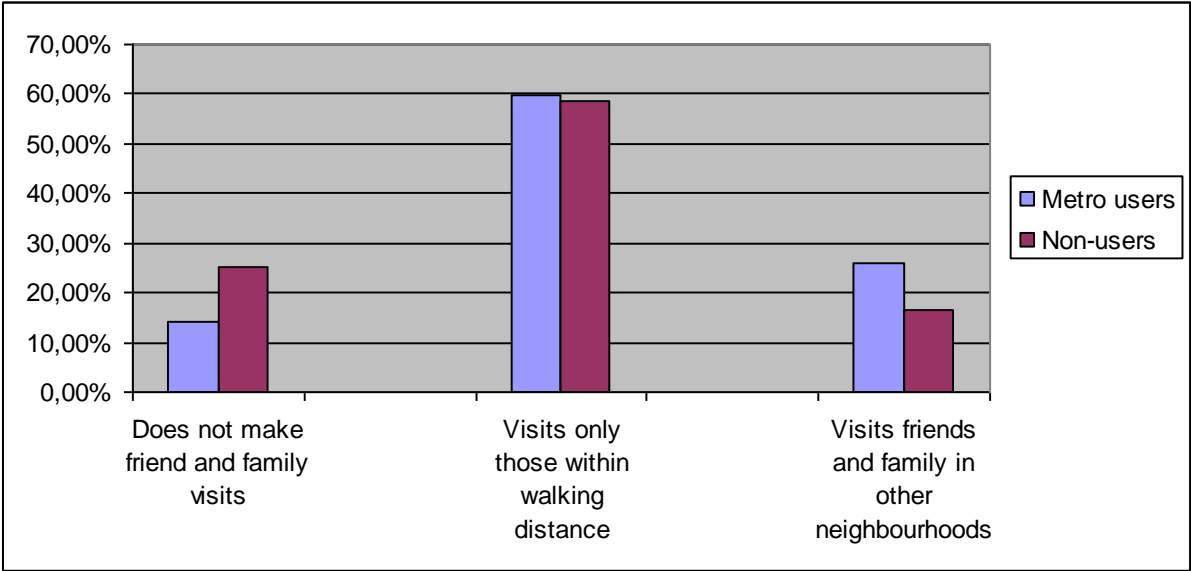
The respondents were also asked whether they would travel as often as they had if there was no metro system. 46% of the total sample declared that they would travel less if there was no metro system. This rate was:

- 57% for the lowest income women,
- 70% for those older than 55, and
- 38% for the least educated group.

When compared with the average, the figures reveal that the presence of the metro is particularly valued by the lowest income women and those older than 55.

A final analysis regarding mobility was related to visits made by the respondents to friends and family. In quality of life analysis, visits to friends and family are regarded as crucial activities, since they can improve an individual's social life and psychological health (Metz,

2000; Banister and Bowling, 2004; Cass et al., 2005). As seen in Figure 5, only 14% metro users stated that they did not make visits to friends and family, while this rate was 25%, one quarter, for non-users. In addition, more than a quarter of metro users stated that they travelled by various vehicles to areas beyond walking distance for visits to family and friends. This rate was lower for non-users, at only 17%. When asked what vehicle/mode they used when travelling beyond walking distance for visits to friends and family, 92% stated that they used the metro.



**Figure 5: Visits to family and friends: metro-users and non-users**

When vulnerable women groups were analysed, it was seen that metro usage had an effect in visits to friends and family made by women in the 55+ age group. Among this group, only 19% of metro users stated that they did not visit friends and family; while this rate was 34% for non-users. A more striking result was that 24% of elderly metro users travelled to neighbourhoods beyond walking distance in order to visit friends and family, while none of the elderly who did not use the metro made trips to neighbourhoods beyond walking distance for friend and family visits. These figures show that the metro can help captive women public transport users, particularly the elderly, to travel more often and further for visits to friends and family.

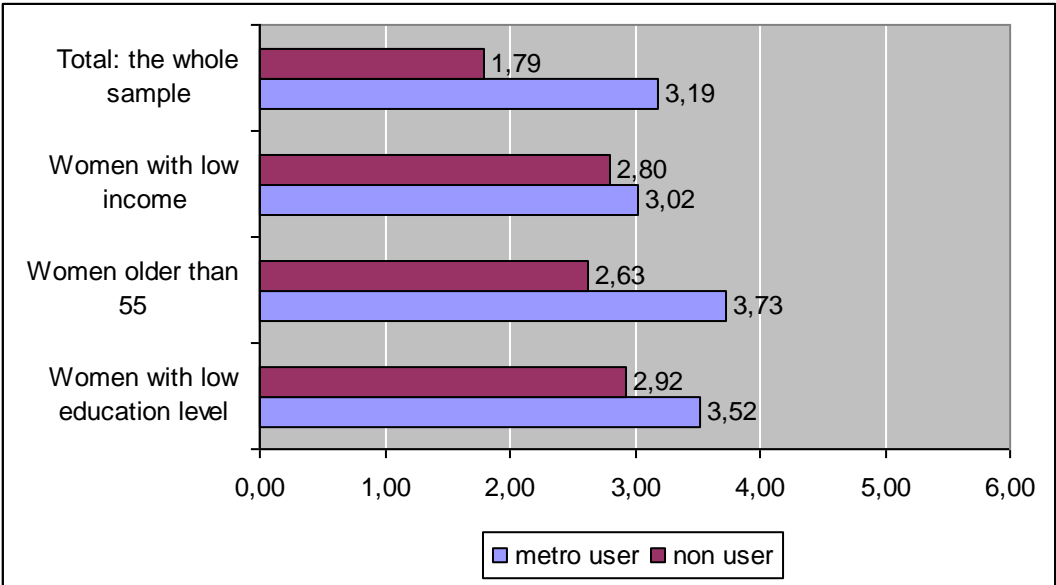
**3.2. Metro usage and diversity of travel destinations**

As stated before, the questionnaire included a questions regarding destinations for working, shopping and leisure trips of women residing along the metro corridor; however, because the ratio of women who were working was very low in the sample, and because working destinations were few in number, given that workplace locations are concentrated mostly in the city centre, only the results of the shopping and leisure trip analysis are presented here.

Among the 300 women interviewed, 188 used the metro, while 112 did not use it at all. The results of the questionnaire revealed that the 188 users listed a total of 600 preferred places for non-food shopping; while the 112 non-users listed only 200 places. This shows that on

average, women who use the metro travel to 3.19 different shopping locations, in contrast to the average of 1.79 destinations for women who do not use the metro.

When trips made by the three vulnerable groups (low-income, elderly, and women with low education levels) are analysed, it was seen that in all vulnerable groups, metro users travel to more shopping places on average when compared to those who do not use the metro (Figure 6). The effect of metro usage is particularly significant for women older than 55. Nevertheless, it should be noted that when compared with the averages of the whole sample, the difference between metro users and non-users in the vulnerable groups are not particularly striking.

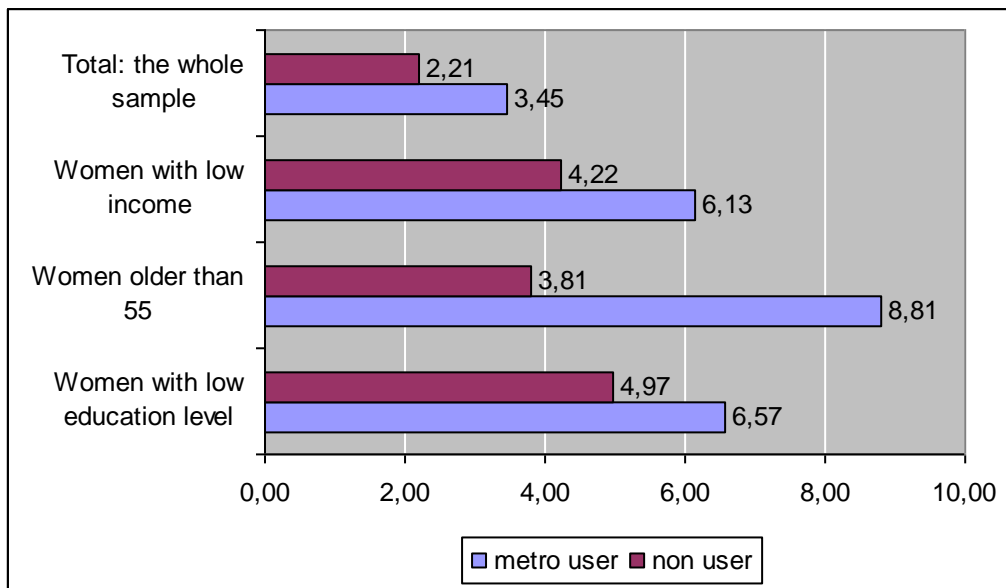


**Figure 6: Average number of destinations for shopping trips: metro-users and non-users**

As for leisure trips, of the 300 interviewed women, 188 metro users listed 648 places as leisure destinations, while the 112 non-users listed only 248. Hence, metro users, on average, travel to 3.45 places per person, while non-metro users on average travel to only 2.21 places. The analysis of leisure trip destinations for metro users and non-users in the vulnerable women groups (Figure 7) reveals more significant differences for women older than 55. Metro users in this age group travel to 8.81 different places on average, for their leisure trips; however this average is only 3.81 for those who do not use the metro.

Comparing shopping and leisure trips, it can be suggested that metro access and metro usage has a particularly positive effect on leisure trips, given that the difference between the average number of trip destinations of women who use the metro and of those who do not is striking in this category. This is particularly true for women older than 55. It appears that metro use enables captive women public transport riders (and among them particularly the more vulnerable elderly women groups) to travel to a higher variety of leisure activity locations in the city, and hence experience more places in the urban area.





**Figure 7: Average number of destinations for leisure trips: metro-users and non-users**

Based on the travel destination information, a high number of mps were produced to compare the extent of urban areas that are travelled to, and hence experienced, by the women. The comparison of the maps of metro users and non-users for the overall samples as well as the vulnerable groups revealed that metro users in the low-income women group, and particularly in the elderly women group, make leisure travels within a larger urban geography, and not necessarily along the metro route, but to all parts of the city. This finding indicates that women who use the metro have a larger urban geography when it comes to travelling for leisure activities. Since the locations frequently visited by metro users are dispersed over the urban area, and are not only limited to areas accessed by the metro, it is possible to suggest that using the metro makes women more likely to travel to various locations, even to those that require using modes other than the metro. Hence, using the metro may have an impact on eliminating negative perceptions or thresholds regarding the usage of other public transport modes too. This is further analysed in the following section.

### 3.3. Perceptions regarding the metro

Respondents were asked to state the urban transport mode that they felt most secure when using. 58% stated metro as the most secure. 16% placed private car and 11% placed walking in the first place as the form of transport that they felt most secure when using. 10% said buses and minibuses were the most secure modes from their point of view. When this analysis was made to compare the perceptions of metro users and non-users, 68% of metro users placed the metro and 15% placed the private car in the first place. Of the non-users, 40% stated the metro, 16% stated the private car and 15% stated walking as the most secure forms of transport. The analysis shows that the metro is seen as the most secure form of transport by the majority of metro users; and while an important proportion of non-users also see metro as a secure form, they also consider non-transit modes, i.e. private car and walking, as secure modes.

The respondents were also asked to list the reasons for their not choosing to use the system (if they did not choose to use the system) in shopping and leisure trips. Of those who do not use

the metro for shopping trips, 44% stated that they do not use the system because they do their shopping within walking distance; 15% said they use buses because otherwise it would require a transfer of vehicles. For leisure trips, 29 % of those who stated that they do not use the metro system said that they do so because they choose to go to leisure places within walking distance. 21% stated that they found the metro too crowded and therefore did not use the system for leisure trips. Of course, choosing places within walking distance is not necessarily the main reason, but possibly an outcome, or a symptom, of some other factors regarding the usage of the metro o travel to further distances.

A variety of features of the metro system, including security issues as well as information and convenience, were listed in the questionnaire and the respondents were asked to state whether such features were a reason, *or could become a reason*, for them not choosing to use the metro. The results in terms of metro users and non-users are as follows:

For the metro-users:

- 58% stated that they have fears of terrorist attacks on the metro which may become a factor in using the metro.
- 58% stated that they have fears of violence or personal attacks on the metro.
- 56% stated that the metro system's being crowded was the most important negative feature of the system.
- 39% stated that when using the system they felt anxious about being on their own in an empty metro car.
- 38% stated that they felt unsafe walking to a metro station when it was dark.

These fears regarding the system are important and need to be addressed although it is important to note that these were stated by those who already use the metro. As for those who do not use the metro, such fears were marked to a lesser extent, and the most negative aspect of the system from the non-users' point of view was the route alignment and station locations of the system (52%), indicating that it is not cognitive barriers that are the major factors preventing them from using the system but simply the convenience of the route for their trip destinations. Nevertheless, such cognitive barriers regarding safety and security of the metro were also important, although to a lesser extent. Of those who do not use the metro:

- 52% stated that the route and station locations were not convenient when compared to the access provided by other public transport modes.
- 46% stated that they have fears of violence or personal attacks on the metro.
- 45% stated that when using the system they felt anxious about being on their own in an empty metro car.
- 36% stated that they have fears of terrorist attacks on the metro which may become a factor in using the metro.
- 40% stated that the lack of CCTV cameras throughout the metro system was the most important negative feature of the system.

There were many other features of the system listed as well as possible reasons or scenarios that may result in the respondents' not choosing to use the metro. Although they were not marked by as many respondents as those listed above, some of these are important:

- 27% of those who do not use the system stated that they did not know the metro, its route or location of stations and found it difficult to understand these features.
- 22% of both metro users and non-users felt that it was not convenient to ride the metro when they had many shopping bags.

- 19% of those who do not use the metro stated that they choose not to use the metro when they travel with children. This issue was marked by only 9% the metro users.
- 10% of metro users stated that buying a metro ticket was difficult and taking too long; only 2% of non-users saw this as an issue, perhaps because they are not aware of it.
- In addition, 14% of metro users found the system expensive while this was an issue for only 5% of non-users; again this may be related to non-users' awareness of fares.

To summarise, the analysis shows that safety and security issues are important for women users although it does not necessarily seem to affect their decision of using the system. In other words, while there are certain fears regarding the safety and security of the metro system, these do not seem to translate into cognitive barriers: such safety concerns are stressed mostly by those who already use the system. For those who do not use the system, the main reason for their not using the system is the convenience of the route and location of its stations. Nevertheless, safety concerns need to be addressed by improving the image and advertising of the system as a safe and secure mode. It appears that better information services need to be provided, and perhaps improvements need to be made to ease ticket purchasing or to inform the public better about purchasing methods. Similarly arrangements need to be made to allow special spaces for those with children, push-cars, and luggage; and information on such improvements needs to be announced.

#### **4. Concluding remarks**

It was stated at the beginning of the paper that most investments in new urban rail systems aim at improving the mobility of those with limited travel opportunities. The findings of this analysis on the Ankara metro support such expectations to a certain extent. When the captive public transport riders are considered, it appears that having a metro station within walking distance of one's home results in significantly higher metro usage. However, metro usage does not necessarily translate into increased mobility when the whole sample is taken into consideration: in both metro-user and non-user groups about one-third of the captive public transport rider women stated that they almost never made trips on weekdays. It was seen that socio-economic and demographic factors had a greater effect on general mobility levels, i.e. frequency of travel. Low-income women, the 55+ age group, and women with low education levels were the least mobile. Among these mobility-vulnerable women, those who used the metro were more mobile however. This was particularly the case for the lower income women: almost half of the lower income women who stated that they do not use the metro made no motorised trips at all. This was the case for only 30% of the metro-users in the low-income women group.

The metro system also appears to have a positive effect on visits to friends and family, which is considered to be an important activity in quality of life studies. Metro user women travel more often and further in distance to visit friends and family, while non-users, and especially non-users in the relatively older women groups, make such visits only within walking distance. Of those who travel beyond walking distance for friend and family visits, 92% use the metro system, indicating that the metro enables captive women public transport riders to travel more and further for such visits. Another important finding was that almost half of the women who used the metro declared that they would not travel as often as they did if there was no metro system. This ratio was even higher for women above 55 and for low-income women. It is clear that the presence of the metro in Ankara is valued by captive women public transport riders, and particularly by the more vulnerable.

Metro users also appear to be visiting a higher number of different shopping and leisure destinations in the city when compared to those who do not use the metro system. In fact, trips for leisure activities appear to be the strongest impact area for the metro system, as metro users in the vulnerable women groups, particularly the 55+ group, visit more leisure destinations in the city and therefore experience a wider geography when compared to non-users.

Women's assessment of the metro system in Ankara also shows that the system is regarded as the most secure form of transport in the city. In spite of this, there are concerns regarding their safety in stations and when accessing stations in night times. There are also concerns regarding terrorist attacks to the metro and violence and personal attacks. It is important that such safety concerns are addressed by improving the image of the system. More advertising of the system as a safe and secure mode may help. In addition, it appears that better information services need to be provided, regarding the system's route, station locations, accessibility it provides as well as methods of ticket purchasing.

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