WALKING IN MEXICO CITY: SOCIODEMOGRAPHIC CHARACTERISTICS OF THE PEDESTRIAN

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Abstract
This study seeks to describe the sociodemographic characteristics of pedestrians and trip variables that affect walking as a transportation mode. The analysis brought together five Origin-Destination Survey 2017 databases that contained data on housing, vehicles per home, persons, transportation mode, and lengths of trips (n=890,740). The data were analyzed through hypothesis testing to examine the association and difference of proportions and averages, and the logistic regression model to identify what variables determine the characteristics of persons who walk. 60.6% (n=322,173) of the walking was carried out on a section of the overall trip; and it was found that, proportionately, the persons who walk the least are male subjects, who have vehicles, who are older, who have a higher sociodemographic and educational level, who travel early in the morning or at night, and when the purpose of the trip is to go to work. The variables that have the strongest influence on the number of times it is likely that a person walks are the location of the home—in which it is up to 2.76 times more likely in rural zones and 2.20 times more likely in city center areas—those who are of a low socioeconomic level (Odds Ratio, OR=2.02), and those who have no formal education (OR=2.19). Therefore, walking as a transportation mode in Mexico City is directly related to low income sociodemographic levels; and for these individuals, it is not a modal option, but rather an imposition, because the zones coincide with the greatest risks of violence and road safety.
Keywords: Walking; pedestrian; transportation; Origin-Destination Survey; Socioeconomic status.

1. INTRODUCTION

The National Institute of Statistics and Geography (INEGI, 2017) through the Origin-Destination Survey 2017 indicates that of the 19.38 million inhabitants over six years of age living in the Metropolitan Zone of the Valley of Mexico (MZVM), 15.63 millions of people make at least one trip during the week; and since it is known that the number of inhabitants influences mobility -since they are the ones that generate daily commuting, they shape the demand and are the main reason for trading (Inglada i Renau & Teixidio Medina, 2010)- mobility in Mexico City is one of the most important challenges to improve the quality of life of its inhabitants.

Also, with an average time of 43 minutes, in the MZVM, 34.56 million trips are made on a weekday, 45.1% on public transport, 21.1% on private transport and 32.3% on foot. Although, in the MZVM 77% of households have at least one car and, this type of transport, represents 90.6% of private transport trips; exclusively walking trips have an important percentage (32.3%) of trips made in the MZVM (INEGI, 2017).

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The Origin-Destination Survey (EOD 2017), considers for the first time in Mexico, walking as a mode of transport, and refers to travel walking exclusively; that is, those where it is not combined with another mode of transport, since in the previous survey of the year 2007 it was combined with another mode when it was only a travel section. Thus, the 2017 EOD indicates that, on average, 1.9 trips are made in each home, that is, about 11.15 million trips per day walked, without having used any other mode of transport (INEGI, 2017).

Thus, although walking is a daily activity of the human being, defined as an aerobic, rhythmic and dynamic activity of the large skeletal muscles that confers multiple benefits for health, since it improves the physical state, generates greater physiological activity and increases energy consumption (Morris & Hardman, 1997). Walking is an activity that has not been much studied in Mexico, and that is of great interest because the sociodemographic characteristics serve to create initiatives to educate people about the benefits of walking, such as the Step It Up! in the United States, Walking for Health in England and Canada Walks (Segar et al., 2017).

However, to date, in Mexico the socio-demographic characteristics of the walker (age, gender, income, culture), the environmental attributes (vehicular traffic, crime rates, and air quality, among others) and the characteristics of the urban form (availability, comfort and quality of the infrastructure for walking, connectivity to different destinations) are unknown. Thus, questions about what are the characteristics of people who use walking as a mode of transport, what are the variables of travel that determine the use of this mode of transport, and what are the geographical contexts (urban or suburban) arise.

In this sense, this study emerges in which data from the Origin-Destination Survey are used in households in the Metropolitan Zone of the Valley of Mexico, to establish, through an analysis with multivariate statistics -specifically, binary regression-, the main variables that determine the people who use walking as a mode of transport. This can be useful to know the needs of travelers, improve travel conditions and promote this mode of transport which is the most common and cheap physical activity.

2. LITERATURE REVIEW

According to Morris and Hardman (1997) walking is the most natural way of movement, it is accessible to most people, it is low risk, low cost and of particular interest for the health of the population. In addition, Mulley (2017) indicates that walking has positive effects on the physical and mental health of the population; helps with body composition, cardiovascular health, blood pressure, vascular function, blood lipids, hemostatic, inflammatory and immunological markers, glucose metabolism, increases skeletal muscle health and promotes good mental health as it generates the effect of feeling good; it helps self-esteem, cognitive functioning, positive mood and, in general, quality of life. In addition, there is a growing

evidence base on which walking prevents and is used in the treatment of poor mental health, such as depression, stress, and anxiety, through regular physical activity.

Despite all the benefits of walking, walking as a mode of transport is an activity that is little promoted and that is discouraged by public policies that promote the use and development of automobile infrastructure. In Latin America values and beliefs have been imposed around private transport; the automobile is not only considered as a mode of transport, but also as an indicator of the stratum or social class of individuals (Bull, 2003), which together with the poor quality of public transport service, crime, the urban structure -which generates long distances- and the lack of pedestrian infrastructure, create a vicious circle that discourages walking and proliferates the use of the automobile, which comfort, that is changed by health -physical and mental- and other social costs -such as pollution and injuries in transit-, causes problems to continue growing along with the number of cars.

The analysis of the ability to walk has grown in popularity in recent years (Nigro et al., 2018) and, as for the characteristics of people who walk, there is research indicating that people with better socioeconomic conditions have higher rates of walking and physical activity than the more disadvantaged (Adkins et al., 2017). Living in "more walkable" neighborhoods is associated with greater walking and, in turn, with a positive impact on health and certain behaviors (Badland et al., 2017). In this sense, a positive relationship has been documented between built environments that are passable and walking (Clarke et al., 2017); and it is known that people in the most passable neighborhoods are 4.90 more likely to walk to work than people in less passable neighborhoods (Kelly et al., 2015).

Although empirical studies show that people who live in highly transitable areas walk more and are more physically active (Reyer et al., 2014), people from lower income sociodemographic strata walk less than double than the most favored, despite having supportive built environments for walking, due to social and individual characteristics and other environmental factors not built that challenge disadvantaged groups, including the fear of crime and the lack of social support (Adkins et al., 2017). Consequently, men living in neighborhoods with connectivity in the main streets (Odds Ratio, OR=1.47) and greater safety in traffic and crime (OR=1.28) and women who live in neighborhoods with high proximity (OR=1.36) and the high esthetics of the neighborhood (OR=1.36) are more likely to walk (Pelclová et al., 2013). While low-income people have lower rates of physical activity than the general population and, especially, female sex (Segar et al., 2017).

On the other hand, walking is different for each of the age groups. For example, in children of a low socioeconomic status the ease of walking is positively related to walking during leisure time; whereas, in neighborhoods of high socioeconomic status, the ease of walking is not related to the physical activity of children (D'Haese et al., 2014). For its part, in older adults, the environment built by the neighborhood

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can support and encourage walking outdoors, so that inequalities in certain intensity of land use (i.e. green spaces, recreation centers, schools and industries) influence the disparities in outdoor walking levels of older adults (Zandieh et al., 2017). For its part, in Mexico, pedestrian studies are very scarce and focus mainly on injuries and traffic accidents. Híjar et al. (2001) point out that, a couple of decades ago, 57% of deaths due to traffic accidents in Mexico were pedestrian injuries, with mortality rates of 10.6 per 100,000 inhabitants for men and 4.0 / 100,000 for women.

Subsequently, Cervantes et al. (2018) indicated the dangers of pedestrian mobility and showing that the chances of fatal accidents are greater for men compared to women (OR=3.6) and highlight the mortality rates between male adults 60 to 74 years of age and 75 years and older with 13.9 and 24.2 deaths per 100,000 inhabitants, respectively. In this same sense, another study indicates that the highest concentration of deaths in pedestrians was observed in ten neighborhoods with specific types of street environments (Híjar et al., 2003); here, it is pointed out that high-risk environments have wide avenues with abundant vehicular traffic, where cars and vendors invade spaces supposedly reserved for pedestrians; in addition, many pedestrians have never driven a motor vehicle, few know the traffic signals and almost all the events were "hit and run" cases. Walkability and the built environment have also been studied through the validation of the Neighborhood Environmental Availability Scale (NEWS) for urban areas in Mexico (Martínez-Martínez & Ramírez-López, 2018). This study concludes that the perception of the environment and its implications in aspects such as physical activity, the quality of life of the population and public insecurity can be assessed through indicators that include infrastructure for access to services, image of the environment and proximity to stores and services. This study coincides with that of Hidalgo et al. (2010) in which the reasons for the use and non-use of pedestrian bridges were analyzed, and they conclude that public insecurity is the main reason for not using pedestrian bridges.

3. METHOD

Data from the Home Origin-Destination Survey in the Metropolitan Zone of the Valley of Mexico 2017, which the National Institute of Statistics and Geography (INEGI, 2017) collected during the period between January 23 and March 3 of the year 2017 was used, and which aimed to obtain information to know the current mobility of the inhabitants of the Metropolitan Area of the Valley of Mexico, with respect to its characteristics, motive, duration, modes of transport and time of travel, among other aspects of the trips they are making. The survey had a sample design that was characterized as probabilistic. The database includes five files with the results of the questionnaire that were obtained through direct interview and supported by a travel card, so that the informants could record the information of each of the trips made (INEGI, 2018). The five databases that are included are described below:

1. TVIVIENDA: This database includes the records of 54,593 inhabited private homes, which include identification data -as a district, entity, municipality or delegation- and data on residents and households -such as the number of people per household and the way in which the expense is distributed-.
2. THOGAR: With 56,685 records, this section includes the quantity, type and characteristics of vehicles available per household.
3. TSDEM: Includes 200,117 records with sociodemographic characteristics such as kinship among members of households, sex, age and educational level; it also includes the identification of the people who traveled, and the number of trips made between the week and Saturday.
4. TVIAJE: This database, with 531,594 records, contains information on the origin and destination, schedules, purposes and modes of transport used in each of the trips made.
5. TTRANSPORTE: This database contains the records of the sub-tranches of trips or journeys by mode of transport, including the time and expense of transportation of a total of 890,748 records.

3.1. Data analysis

The databases were organized and linked through an identification variable (or key, also known as Id) and analyzed through the R software version 4.1.1. In a first analysis, all the trips and characteristics of the subjects who indicated having walked in some stretch of the trips they made. The INEGI (2018) on its methodological document indicates that to walk on the street are included full trips which were made by foot, as to all those sections of the trip in which despite having been able to use a way of transportation, the person decided to walk (this person's vehicle can't operate due to car-free-days laws, the transportation didn't arrive, or the person does not own a car); the distances by foot from the starting location up to the place where the first way of transportation is boarded and those from where the last taken transportation point up to the destination point are included. Descriptive statistics were obtained and hypothesis tests were developed to examine the independence and association between different groups of variables and people who walk or not (chi-square, χ^2). In addition, hypothesis tests of difference of proportions (table 1) and difference of means (table 2) were developed with the purpose of finding superiority between the variables corresponding to the characteristics of people who walk and those who do not.

Subsequently, using the logistic regression model, a multivariate data analysis was performed to identify which variables determine the characteristics of the people who walk (dependent variable) and the number of times that the event is more likely to occur according to the values of the variables, known as

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Odds Ratio (OR). Thus, the logistic regression model was executed twice in the R statistical software; the first with all the variables and the second to create a parsimony model, only with those that were significant at a confidence level with α=0.05.

4. RESULTS

The trips were classified in those that in some of their stretches reported having walked and those that did not at any time. Thus, there were 322,173 trips (60.6% of the total) in which it was affirmative to use walking as a mode of transport. Regarding the total of the travel segments, of the 890,748 records, it was obtained that 161,322 trips segments were made walking, without using any other mode of transport and for an average of 15 minutes of travel; while the travel segments associated with walking and the use of other modes of transport were 482,060 records, with an average of 8.8 minutes of walking and 34 minutes of travel in another mode of transport.

Figure 1 shows, on a map of Mexico City and part of its metropolitan area, the city halls or municipalities where the trips were made that included some stretch in walking. It can be seen that in the city hall of Cuauhtémoc -corresponding to the center of the city- Iztapalapa, Gustavo Adolfo Madero (GAM) and the municipalities of Ecatepec and Nezahualcóyotl -in the northeast- are the main origins and destinations of the people who walked.

The characteristics of the people and the results of the hypothesis tests that contrast the independence and association (chi-square, χ^2) between some dichotomous and polytomous variables (qualitative) and those that reported having walked and those that did not, are found in Table 1. There, it can be observed that for all the analyzed variables, walking or not are related to the different categories of the variables analyzed. In addition, in the same Table 1, the results of the proportions difference hypothesis tests are shown; which compares, for all categories, if the proportion of people who walk is greater, or vice versa, than the proportion of people who do not walk. Thus, it was found that the proportions of people who walk are greater among those who are between six and 20 years of age, for those who have lower educational level (up to secondary level), for those who live in the entities of Mexico City and Hidalgo, in the localities of up to less than one hundred thousand inhabitants, those who are not family heads, those who do not have vehicles, those who are in the lower socio-demographic strata and those who travel during the morning.

Conversely, in the proportion of those who least walk are male subjects, those who own vehicles, those who are older, have a higher sociodemographic or educational level, those who travel during the early hours or at night, and when the purpose of traveling is to go to work or to go to receive medical services.

The quantitative data and the difference of means, between people who walk and those who do not, are shown in Table 2. Here, it is observed that people who do not walk on any travel stretch, are older or have a greater number of vehicles than people who walk. In addition, it was found that, on average, people who do not walk on any stretch of travel use more time on their trips and, although they have higher transportation costs, spend less time stationed, so they have lower spending on parking of their vehicles.

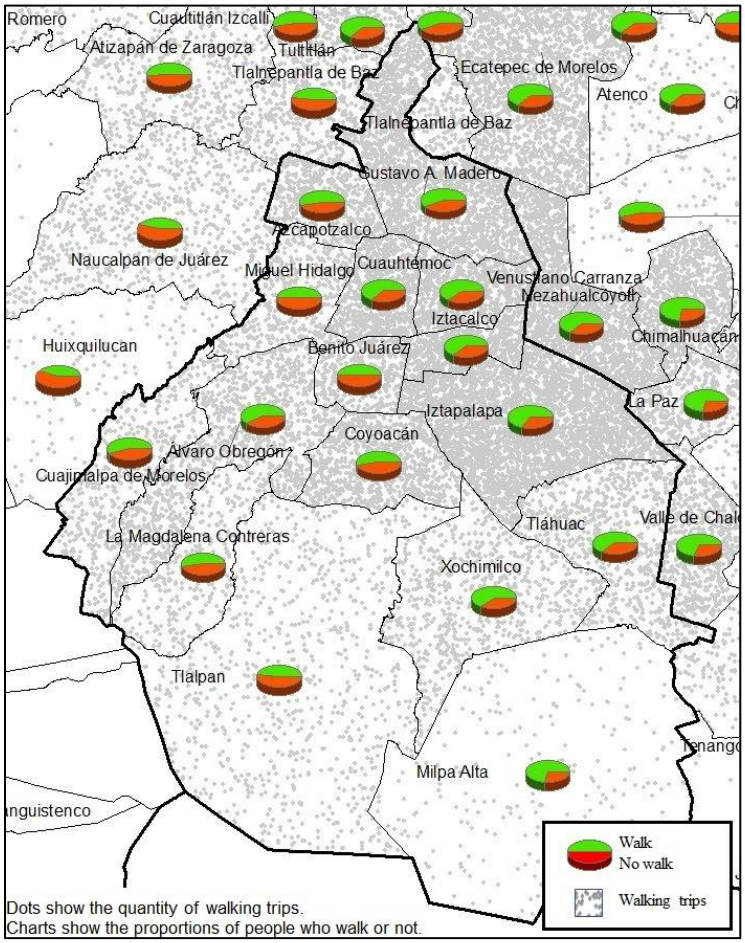

FIGURE 1 - TRIPS THAT INCLUDED OR NOT THE WALKING AS A MODE OF TRANSPORT CLASSIFIED BY MUNICIPALITY
Source: Own elaboration with data from the Origin-Destination Survey 2017

Finally, with the characteristics of the trips that were made walking and to establish the dependence of walking or not (walking, Y=1, or not walking Y=0) with the variables of the trips and their different categories, a logistic regression analysis was carried out. In the first execution, in which all the variables were included, only were found to be significant (p<.05) the variables: Housing municipality, Socioeconomic stratum, Size of the locality, Relationship, Sex, Educational level, Travel day, Origin of travel, Start time, Destination place, Purpose of travel, Possession of cars in the home, Possession of motorcycles, Possession of bicycles and Number of people living in the home; and since they did not show evidence of independence, they were included in the final model.

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TABLE 1 - VARIABLES OF THE TRIPS OF THE PEOPLE CLASSIFIED BY THOSE WHO WALKED AND THOSE WHO DID NOT, AND THE RESULTS OF THE TESTS OF INDEPENDENCE AND DIFFERENCE OF PROPORTIONS

Variable	Walk		Not walk		X^2-Test
	n	(%)[a]	n	(%)[a]	P-value
Gender					
Male	140,961	(43.8%)	114,606	(54.7%) [b]	.000[c]
Female	181,212	(56.2%) [b]	94,815	(45.3%)	
Age groups (years)					
6 to 20	80,982	(25.1%) [b]	38,460	(18.4%)	.000[c]
21 to 40	119,057	(37.0%)	80,502	(38.4%) [b]	
41 to 60	88,810	(27.6%)	68,054	(32.5%) [b]	
61 to 99	33,324	(10.3%)	22,405	(10.7%) [b]	
Years of education					
0 - 6	91,324	(28.4%) [b]	39,788	(19.0%)	.000[c]
7 - 9	102,500	(31.8%) [b]	52,310	(25.0%)	
10 - 12	80,480	(25.0%)	52,567	(25.1%)	
13 - 17	45,012	(14.0%)	58,063	(27.8%) [b]	
≥ 18	2,577	(0.8%)	6,491	(3.1%) [b]	
Entities (administrative division)					
Mexico City	148,142	(46.0%) [b]	94,683	(45.2%)	.000[c]
Hidalgo	2,088	(0.6%) [b]	961	(0.5%)	
State of Mexico	171,943	(53.4%)	113,777	(54.3%) [b]	
All share the same expense					
Yes	302,672	(93.9%)	199,443	(95.2%) [b]	.000[c]
No	19,501	(6.1%) [b]	9,978	(4.8%)	
Sociodemographic stratum					
Lower	3,544	(1.1%) [b]	1,228	(0.6%)	.000[c]
Lower middle	199,330	(61.9%) [b]	102,496	(48.9%)	
Upper middle	96,507	(30.0%)	65,763	(31.4%) [b]	
Upper	22,792	(7.1%)	39,934	(19.1%) [b]	
Trip purposes					
Back home	151,678	(47.1%) [b]	97,260	(46.5%)	.000[c]
Work	61,350	(19.1%)	47,837	(22.9%) [b]	
School	29,505	(9.2%) [b]	13,219	(6.3%)	
Shopping	36,714	(11.4%) [b]	13,961	(6.7%)	
Social	18,818	(5.8%)	21,786	(10.4%) [b]	
Transport someone	16,192	(5.0%) [b]	8,699	(4.2%)	
Procedure	2,098	(0.7%)	1,448	(0.7%)	
Medical care or health	2,769	(0.9%)	3,124	(1.5%) [b]	
Religion	1,125	(0.3%)	686	(0.3%)	
Others	1,757	(0.5%)	1,274	(0.6%) [b]	
Cars available at home					
Yes	100,366	(31.2%)	132,827	(63.4%) [b]	.000[c]
No	221,807	(68.8%) [b]	76,594	(36.6%)	
Motorcycles available at home					
Yes	15,600	(4.8%)	17,058	(8.1%) [b]	.000[c]
No	306,573	(95.2%) [b]	192,363	(91.9%)	
Bikes available at home					
Yes	71,164	(22.1%)	50,012	(23.9%) [b]	.000[c]
No	251,009	(77.9%) [b]	159,409	(76.1%)	
Size of locality (inhabitants)					
≥ 100,000	272,453	(84.6%)	183,766	(87.7%) [b]	.000[c]
15,000 - 99,999	27,906	(8.7%) [b]	13,415	(6.4%)	
2,500 - 14,999	20,792	(6.5%) [b]	11,885	(5.7%)	
< 2,500	1,022	(0.3%) [b]	355	(0.2%)	
Family relationships					
Head	93,021	(28.9%)	79,853	(38.1%) [b]	.000[c]
Spouse	72,334	(22.5%) [b]	40,270	(19.2%)	
Child	116,060	(36.0%) [b]	68,437	(32.7%)	
Grandchild	15,788	(4.9%) [b]	6,991	(3.3%)	
Other relationship	23,166	(7.2%) [b]	12,853	(6.1%)	
No relationship	1,804	(0.6%) [b]	1,017	(0.5%)	
Trip start time (time of day)					
00:01 - 06:00	29,476	(9.2%)	22,308	(10.7%) [b]	.000[c]
06:01 - 12:00	139,585	(43.4%) [b]	76,736	(36.7%)	
12:01 - 18:00	120,065	(37.3%)	77,804	(37.2%)	
18:01 - 24:00	32,846	(10.2%)	32,392	(15.5%) [b]	
TOTAL	**322,173**	**(100%)**	**209,421**	**(100%)**	

n= number of trips. [a]Column proportions.

[b]Greater proportion by row in two-proportion z-test, taking as the null hypothesis (Ho: Pw ≥Pnw) that the proportion who walked (Pw) is greater or equal to the proportion that did not walk (Pnw).

[c]The variables are independent. There is not relationship between walking trips and variables in the chi-Square Test for Association.

Full trips (origin-destination) including sub-tranches are considered. (n=531,594).

Source: own elaboration with data from the Origin-Destination Survey 2017

TABLE 2 - DESCRIPTIVE STATISTICS OF VARIABLES CORRESPONDING TO TRAVEL STRETCHES, CLASSIFIED BY THOSE WHO WALKED DURING THE TRIP AND THOSE WHO DID NOT

Variable		n	Mean	StDev	P-value[a] Ho: $\sigma^2_1=\sigma^2_2$	P-value[b] Ho: $\mu_1-\mu_2>=0$
Age (years)						
	Walk	322,173	35.45	18.34	.000	.000 **
	Not walk	209,421	37.96	17.50		
Number of people per household						
	Walk	322,173	4.58	2.13	.000	1.000
	Not walk	209,421	4.30	1.97		
Number of cars per household						
	Walk	322,173	0.36	0.59	.000	.000 **
	Not walk	209,421	0.87	0.86		
Number of motorcycles per household						
	Walk	322,173	0.05	0.25	.000	.000 **
	Not walk	209,421	0.09	0.36		
Number of bicycles per household						
	Walk	322,173	0.31	0.69	.000	.000 **
	Not walk	209,421	0.36	0.76		
Number of trips made on a weekday						
	Walk	322,173	2.43	1.07	1.000 *	.500
	Not walk	209,421	2.43	1.07		
Number of trips made on saturday						
	Walk	322,173	2.16	0.69	.000	.000 **
	Not walk	209,421	2.23	0.82		
Number of separate expenses per household						
	Walk	322,173	2.30	0.57	.000	.000 **
	Not walk	209,421	2.31	0.58		
Homes per dwelling						
	Walk	322,173	1.04	0.22	.000	1.000
	Not walk	209,421	1.03	0.19		
At the beginning of the trip how many people were in the vehicle						
	Walk	322,173	1.62	0.88	.000	.000 **
	Not walk	209,421	1.64	1.01		
Time parked per trip (hours)						
	Walk	322,173	5.57	5.08	.000	1.000
	Not walk	209,421	5.40	4.68		
Cost of parking						
	Walk	322,173	81.71	173.32	.000	1.000
	Not walk	209,421	67.10	182.32		
Stops less than 10 minutes						
	Walk	322,173	0.08	0.31	.000	.000 **
	Not walk	209,421	0.10	0.39		
Transportation expenses ($MXN)						
	Walk	170,746	9.81	13.24	.000	.000 **
	Not walk	92,959	18.12	31.82		
Travel time						
	Walk	635,873	20.40	18.80	.000	.000 **
	Not walk	244,962	36.51	30.31		

n= number of trips. StDev = Standard deviation.

[a]F-test of equality of variances. Determine whether the variances or the standard deviations of two groups differ. σ^2_1: for walked and σ^2_2 for not walked.

*The null hypothesis is not rejected (Ho: $\sigma^2_1=\sigma^2_{2)}$. Equal variances are assumed (homocedasticity).

[b]Two-Sample t-Test. 2. Determine whether the mean differs significantly between two groups. μ_1 for walked and μ_2 for not walked

**The null hypothesis is rejected. The mean of the people who walked is less than those who did not.
The sub-tranches of trips may not add up to the total (n=890,748) due to missing or not applicable values.

Source: own elaboration with data from the Origin-Destination Survey 2017

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To evaluate the model, Omnibus tests were performed on the coefficients, and it was obtained that the increase of the Napierian logarithm of less than twice the logarithm of the verisimilitude function and the results of the chi-square test that evaluates the null hypothesis that all the coefficients included in the model are zero, given that $p<0.01$, it is considered globally that the model is statistically significant. In addition, there is a low specificity (24.1%) and a high sensitivity (94.3%), so that the model generated through logistic regression offers a global sample accuracy of 74.8% in the prediction of the Walking event, Y=1.

The results of the model show that the variables that most influence the number of times a person is more likely to walk are: Housing municipality, Socioeconomic stratum and Educational level. In the case of the place of housing, the rural municipalities Temascalapa (OR=2.76, 95% CI=[1.93, 3.93]) and Tepetixtla (OR=2.42, 95% CI=[1.81, 3.22]); the suburban municipalities Chalco (OR=1.34, 95% CI=[1.23, 1.46]) and Ixtapaluca (OR=1.26, 95% CI=[1.16, 1.37]); and, in Mexico City, the Mayoralties Cuauhtémoc (OR=2.20, 95% CI=[2.02, 2.40]) in the downtown area, Miguel Hidalgo (OR=1.46, 95% CI=[1.34, 1.59]), Venustiano Carranza (OR=1.45, 95% CI=[1.33, 1.57]) and Iztapalapa (OR=1.30, 95% CI=[1.20, 1.41]) stand out.

In the socioeconomic stratum, people in the "Low" category have an OR=2.02 (95% CI=[1.90, 2.15]); while, for the educational level stand out, with OR=2.19 95% CI=[2.06, 2.32], the people who indicated that they do not have any school instruction. The rest of the odd ratio (OR=$e\beta$), the confidence intervals and the estimated coefficients of regression β_i can be observed in the table of variables of the equation in the supplementary material (Variables in the equation and coding table).

5. DISCUSSIONS

The results indicate that, in the Metropolitan Area of the Valley of Mexico, the least socioeconomically disadvantaged people are the ones that most use walking as a mode of transportation. Understandably, the people of this stratum are those who have fewer cars or prefer to avoid the daily use of vehicles, to reduce fuel costs and parking, which, compared to public transport, are more expensive. Thus, 63.4% of the people who indicated having a car did not take any trip on foot; so that people with lower incomes use public transport more and, therefore, walking is the way to connect the different sections of travel; so, walking is not a decision but a necessity for access to public transport.

These assertions are in contrast to the results of studies in other countries that indicate that people with better socioeconomic conditions have higher rates of walking, compared to the less disadvantaged (Adkins et al., 2017; Segar et al., 2017). In addition, these studies indicate that people who walk the most walk-through streets that are built with adequate environments for pedestrians, have social support and are exposed to less crime.

Contradictorily, although it should be investigated, it is common that in the colonies and popular neighborhoods of Mexico City and conurbation areas of the State of Mexico the streets, sidewalks and pedestrian areas do not have adequate spaces to transit as a pedestrian and, on the contrary, the sidewalks are very narrow, they are obstructed by trees, modifications to the ramps for the access of the cars to the garages, itinerant shops and even religious altars that obstruct the entire sidewalk. In this way, in addition to the fact that people of lower socioeconomic status do not have adequate environments for walking, it can be inferred that they have a higher risk of being run over; since, in these zones, the sidewalks are not passable and people walk by the vehicle stream.

In the logistic regression model, the results indicate that people living in the municipalities Cuauhtémoc (OR=2.2), Miguel Hidalgo (OR=1.46), Venustiano Carranza (OR=1.45) and Iztapalapa (OR=1.30), and in the municipalities of Chalco (OR=1.34) and Ixtapaluca (OR=1.26) have the highest odds ratios in terms of the possibility of walking. The municipal governments of Cuauhtémoc and Miguel Hidalgo have very high income and very low income areas. In addition, some of the old colonies and commercial zones, of these demarcations, have parklets, pedestrian areas and infrastructure that seek to be homologated to the zero accident vision project; therefore, the disparity of these zones does not clearly allow us to identify how this relates to the socioeconomic stratum and, in order to make blunt conclusions, it is necessary to carry out analysis with smaller geographical divisions. However, it is understandable that these municipalities -because they are part of the city center, and because they have good accessibility in terms of public transport, metro, fast transit buses and shared bicycles- are part of the group of variables that have the most influence for a person to walk.

Nonetheless, according to Hernández (2018), road killings are more common in the municipalities of Cuauhtémoc, Iztapalapa, Miguel Hidalgo and Gustavo A. Madero; with the exception of the last one, the mayoral offices with the most records of run over are the same as in the results. Given that Hernández (2018) is only based on absolute values, it is possible that, in terms of probability, these mayoralties are not the most risky and that, this indicator, only reflects directly the amount of daily commuting, which is why it is necessary to formulate statistical hypothesis tests to evaluate the proportions of run over by number of travelers. In any case, the number of road accidents in the city (6.9 pedestrians per day) makes it necessary to reduce the number of incidents through actions such as promoting road culture, providing safe infrastructure for pedestrians and being strict in complying with regulations, both for the construction and modification of sidewalks, and the traffic regulations, which are not fully followed (Berrones Sanz, 2018).

Regarding public safety, Jimena et al. (2018) point out that critical zones in matters of violence -which are associated with a high population density and lack of formal education- are also in the municipalities of

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Cuauhtémoc, Iztapalapa, Miguel Hidalgo, Gustavo A. Madero and in the zones that they are close to the Mexico-Puebla highway corridor, as is the case of the municipalities of Chalco and Ixtapaluca. Also, they indicate that only in the mayoralties of Cuauhtémoc and Iztapalapa about 40% of the violence events in the city, 17% and 23% respectively, are obtained. So, the people who walk the most, have their homes in areas where there are more hit and where there is a higher rate of violence. Thus, as opposed to other studies where, with greater security in traffic and crime, the possibility increases in 1.28 (OR) of a person walking (Pelclová et al., 2013), in Mexico, violence and road safety show that walking as a mode of transport rather than a decision derived from the preferences of people is due to the interaction of socioeconomic factors; as the condition of low income (OR=2.02, 95% CI=[1.90, 2.15]) or of any educational level (OR=2.19 95% CI=[2.06, 2.32]) that more than double the possibility of walking. Thus, people who are in these categories walk more due to the lack of resources to use other modes of transport, such as a private vehicle, and because walking represents savings for not using taxis or other public transport systems that generate an economic cost in some small stretch of the trips.

On the other hand, other factors such as that young people (between six and 20 years) or that women walk more in proportion, is similar to other researches (D'Haese et al., 2014; Segar et al., 2017). It is not surprising that children and young people walk more and mobilize in a recreational way and to socialize. As for women, given that the results indicate that people who least walk are those who have a car or who are not considered head of the family, it is possible to make some interpretations. On the one hand, it is known that women have lower incomes (Araújo Freitas, 2015), so the wage gap is a determining factor for the purchase of automobiles and the selection or spending on transportation. Also, the use of cars has a masculinity charge that encourages men to buy and use vehicles, despite being forced to acquire debts or restrict their expenses in other areas such as recreational, food or housing. On the other hand, in relation to family headship, when women lead single-parent households, they prioritize their income in food, housing, health and education of the family, so that private vehicles go into the background. In addition, in families formed by couples, where both works, the income is higher, making it easier to purchase a family car; however, in this scenario, generally, the family car, despite being acquired with both income, is administered and used in greater proportion by men.

Finally, since it was found that 63.4% of people who have a car did not make any trip on foot and that people who do not walk use more time and money on their trips, it can be assumed that walking as a mode of transportation, is given as a necessity by the interaction of socioeconomic factors, even though, in central and commercial areas, well connected in mobility issues, it can be given as an opportunity to reduce the generalized cost of transportation (which includes economic cost, time used and qualitative factors). Nevertheless, although using the car requires more time to move and find parking than walking,

in general, people who can decide -in terms of the economic factor- prefer the use of the car for the following possible causes: perceive greater road and public safety, greater comfort than in saturated and precarious public transport, long transfers and access to public transport. Therefore, the qualitative factors are decisive for the selection of modes of transport in people who do not belong to the low-income strata.

However, despite the differences found in Mexico with international literature, it is important to consider that different authors focus on the analysis of walking indicators in the structure of the road network (Nigro et al., 2018) and that they recommend to make additional efforts to study many other conditions that affect the propensity to walk, not only the shape of the network and the urban topology, but also the safety and attractiveness of the landscape, or the specific characteristics of the infrastructure, such as the size of the sidewalks, the values of accommodation of the automobile (parking of automobiles and motorcycles) and the difficulty of the pedestrian route (dead ends, slopes and the length of the roads).

6. CONCLUSIONS

Walking as a mode of transportation in Mexico City is directly related to the socio-demographic strata of lower income and, for these, it does not seem to be a modal option; but rather an imposition, because the zones coincide with the greater risks of violence and road safety. Nonetheless, to improve mobility, environmental conditions and reduce externalities in the city, it is necessary to promote walking as a mode of transport.

The required actions are a challenge for the city, among these are the urban planning with multifunctional zones that allow to diminish the displacements of the people; efficient and attractive public transport for people of different incomes; renovate the pedestrian infrastructure and use holistic approaches to improve walkability; promote road safety; strict application of regulation; and improve public safety. In sum, the authorities should direct their efforts and resources in promoting collective transport over the automobile.

Nonetheless, despite that this study can seem relevant in the sense that it could fill the gap of the general picture of the behaviors of walking in Mexico City -given that, up until now, no previous study has been realized- and which allows us to infer about the pedestrians' sociodemographic characteristics; it must be established that the inferences are based on the set of variables that are being modelled (and there are other variables not collected, hence not tested in this study, like satisfaction or other declared preferences). As a result, it cannot be categorically established which variables determine the characteristics of people who walk, although interesting relationships between walking and violence as well as road safety are suggested.

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In this sense, is proposed a research which allows to study the cause-effect the risks of violence and road safety as an imposition upon walking as a mode; given that the causation could well be more deep-seated. Indeed, it can be argued that associative relationships can be speculative. Besides, an interesting perspective, that could be approached in subsequent studies, is to changing the general description of the pedestrians' behavior for searching for a way to relate walking with the risk of violence and road safety, to something that has not been studied much in the literature.

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