Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 25 (2017) 2297–2308

Transportation Research Procedia

www.elsevier.com/locate/procedia

World Conference on Transport Research - WCTR 2016 Shanghai. 10-15 July 2016

Effective factors in walking mode choice of different age groups for school trips

Yaser Hatamzadeh[a], Meeghat Habibian[b*], Ali Khodaii[c]

[a] PhD candidate, Amirkabir University of Technology, Tehran 15875-4413, Iran
[b] Assistant professor of transportation planning, Amirkabir University of Technology, Tehran 15875-4413, Iran
[c] Associate professor, Amirkabir University of Technology, Tehran 15875-4413, Iran

Abstract

Due to an increase in motorized trips and a decline in individuals' physical activity, studying factors that increase active transportation modes in school trips have captured significant attention in recent years. However, research on walking mode choice behavior across different age groups remains limited. The main objective in this study was to understand reasons behind differences in choosing walking as a mode of transportation in trips to school across different age groups and inside the urban areas of Rasht. Three separate behavioral choice models were developed for elementary, middle and high school students in trips to school using a range of explanatory variables including individual; household; travel; and environmental variables. Results show that the effect of different factors on walking behaviors in trips to school is different across age and gender groups. For example girls are less motivated to walk relative to boys in all age groups. Results show that regardless of age, individual who has a car in his/her household is less motivates to walk to school. Time of day only motivates elementary and middle aged students' to choose walking for transportation. Another significant factor is the travel distance which diversely affects walking in all models. More explanations for differences between age groups in choosing walking in trips to school are discussed in the article; and some issues are suggested for future research.

Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.

Keywords: Walking; Transportation; School Trips; Age Group Analysis; Binary Choice Model

* Meeghat Habibian. Tel.: +98-216-454-3042; fax: +98-216-641-4213.
E-mail address: habibian@aut.ac.ir

2352-1465
Peer-review under responsibility of WORLD CONFERENCE ON TRANSPORT RESEARCH SOCIETY.
10.1016/j.trpro.2017.05.441

1. Introduction

In recent years, studying factors that encourage active transportation modes in school trips have captured significant attention in both public and academic viewpoints due to importance placed on health-related reasons connected to active transportation and an emphasis on enacting public policy. Especially over the last two decades, there has been growing concern over childhood obesity. For example, it was reported in 2009–2010 that 17% of US children and adolescents aged 2–19 years were obese (Ogden et al. (2012)). Based on new evidences, active transportation to school reduces risk of childhood obesity (Sahlqvist et al. (2012); Cooper et al. (2012); Roth et al. (2012)). Promoting active transportation to school has other advantages in terms of health, economic, environment, transportation and even social justice. Despite the mentioned advantages, there have been well-documented declines in walking to school across the globe in recent years (McDonald (2007)). Hence, understanding factors that influence active transportation may support interventions that increase rates of walking to school, and in turn might promote children's physical activity.

Numerous studies have investigated the effect of a wide range of factors on children's mode choice for the school trip and suggested a range of policies to be considered by the policy-makers. Overall, previous studies are usually focused on specific population groups of students and research on walking mode choice behavior of different age groups in one study remains limited. It seems likely, however, that the walking behavior varies between different age groups, suggesting the need to develop models of walking travel behavior that are segmented by age. This research investigates and compares walking behaviors in three different age groups (stages) including elementary (aged between 7 to 11 years), middle (aged between 12 to 15 years) and high school students (aged between 16 to 18 years). A comparison between covariates that are expected to influence walking mode choice tendencies across different age groups could be interesting and beneficial in evaluating candidate policies for promoting walking as a mode of transportation. No enough attention has been paid to this comparison in Iran. This research is an attempt to fill a gap in Iran. The study is focused on the city of Rasht in Guilan province, in which students should cover three mentioned periods of study to be graduated from school

2. Literature review

Walking to school has been found to be affected by a wide range of factors including (1) individual characteristics, (2) household characteristics, (3) trip characteristics, and (4) environmental factors. Previous studies have not all led to consistent results due to different sources of used data as well as different adopted methodologies. Results of previous studies on the effect of different factors on walking behavior of children are discussed in more detail in this section.

2.1. Demographic and socioeconomic characteristics

Age and gender are found to be the most correlated characteristics with walking travel behavior. Some prior researches on the effect of age have found a negative sign for the age variable (McDonald (2008); Wilson et al. (2010)), but some others found that with an increase in age (as children get older), the propensity for choosing active modes of transportation increases (Yeung et al. (2008); Pabayo et al. (2011); Su et al. (2013)). There are also some studies which found no significant relation between age and choosing active modes in trips to school (Ermagun and Samimi (2012). In another study, it was indicated that the likelihood of walking declines during high school but with insignificant effect (McDonald (2008)). This study shows that the effect of age was only significant for children between 5 and 14 years (elementary and middle school).

Individual's gender has also been reported as an effective factor on walking behavior of school students. Many studies on trips to school have found that girls are less likely to walk than boys (McDonald (2008); McMillan et al. (2006); Marten and Olds (2004); Johnson et al. (2010)). In a study it was suggested that gender played an important role in the likelihood that youth would walk to school, with boys being more likely to walk to school and also engage in physical activity after school (Cooper et al. (2003)). In another study it was found that rates of walking were generally higher for older boys (in high school) who were non-white, had a lower body mass index, and had parents that were infrequently home after school (Evenson et al. (2003)). There are some studies which do not confirm that

boys are more likely to walk to school than girls (Wilson et al. (2010); Ermagun and Samimi (2012); Bopp et al. (2012)). Also in some studies, no association was found between gender and children's walking to school (Su et al. (2013); Carlin et al. (1997)). These studies are usually on children's which are quite young (at elementary school level). It has been insisted that gender differences at this age may not yet be large enough to be significant in influencing children's walking to school rates (Su et al. (2013)).

Previous studies indicate that household characteristics including household structure influence the travel behavior. It has been reported in some studies that household interactions are important in the decision to walk to school (McDonald (2008); Park et al. (2013); Yarlagadda and Srinivasan (2007)). The relationship between walking or bicycling to school and the walking habits of parents or caregivers was examined in a study. It was found that the more frequently parents engage in walking activity, the more likely a child engages in active travel for the school trip (Park et al. (2013)). McDonald found that the probability of younger children walking or bicycling to school decreases when their mother commuted to work in the morning. However, this had no statistically significant effect on high school students' likelihood to use active modes (McDonald (2008)).

The effects of opportunities or constraints on household transportation options and household income on walking mode choice of students have also been investigated previously. Previous studies mostly indicate that children of parents with lower income level are more likely to choose walking and bicycling in school trips than those with higher income (Ermagun and Samimi (2012); McMillan (2007); Spallek et al. (2006); Pabayo et al. (2011). The effect of transportation options have also been studied previously. While in many studies households access to private cars has been reported with a negative effect on walking and bicycling to school (Wilson et al. (2010); Copperman and Bhat (2007); Park et al. (2013); Mackett (2011)), there are also studies which found that the number of cars per driver in the household had no effect on the travel mode choice to school (McMillan (2007)).

2.2. Environment and travel characteristics

There are many environmental factors which could influence non-motorized travel such as mixed uses of land, street connectivity, residential density, sidewalk continuity, sidewalk width, presence of cycling and walking paths, and local topography. For example, in a study positive correlation was found between higher population density, greater school size, higher number of intersections (a measure of street network connectivity), and rates of walking or bicycling to school (Braza et al. (2004)). Walking to school is also associated with urban form and land-use planning (Voorhees et al. (2010); Pucher et al. (2010)). Mixed land use in a neighborhood positively affected the likelihood of walking and bicycling to school, while controlling other variables of influence (McMillan (2007)). Frank et.al incorporated three factors including mixed uses of land, street connectivity and residential density into a single 'walkability index' and examined its relation with individual's physical activity (Frank et al. (2005)). Manaugh and El-Geneidy examined the correlation of different indices of walkability (including the walkability index (Frank et al. (2005), the walk opportunities index (Kuzmyak et al. (2005)) and a measure using the pedshed method (Porta and Renne (2005)) with travel behavior for two trip purposes including trips to school and shopping trips. They suggested that different walkability indices should be used to understand the level to which the built environment encourages walking to various destinations. The simple pedshed method was found to be the best walkability index when it comes to explaining the odds of walking to school (Manaugh and El-Geneidy (2011)). Lack of sidewalks and unsafe road crossings has been identified as barriers for increasing non-motorized travel to school (Ewing et al. (2004)). Construction of sidewalks and street-crossings, and the installation of traffic control devices can also increase the proportion of children walking to school in areas where these changes are made (Boarnet et al. (2005)).

Trip distance has been reported as the most important factor in the probability of choosing active transportation. Many studies on travel to school showed that the probability of choosing active transportation decreased by the increase in trip distance (Ermagun and Samimi (2012); McDonald (2008); McMillan (2007); Cervero and Duncan (2003)). In general, research on walking behavior for different trip purposes show that a distance of 400 m (0.25 miles) which is about five-minute walk is often used as an acceptable walking distance (Krizek (2003); McCormack et al. (2008)). It has been found in other studies that students who live less than 1.6 kilometers from their school have a much higher probability of choosing active modes of transportation than those who live farther than 1.6 km from school (McMillan (2007)). A study has shown that in the U.S. state of Oregon, 52% of those who live less than 1.6

kilometers from their school walk to school. This number drops to 36% when the distance between home and school increases to 2.4 kilometers (Schlossberg et al. (2006)). Another study in Belgium reported that 83.5% of students walk to and from school when they live less than 2 kilometers from school (Dyck et al. (2010)). Due to lack of access to actual distance, a proxy has been considered for distance in some studies. For example, , public school density (the number of public schools per square mile) was used as a proxy for distance which showed that school children are more likely to walk to school where this variable increases (Park et al. (2013)).

3. Data

The research objective was to assess the travel behavior of students travelling to school inside the urban areas of Rasht. Rasht is the largest city on Iran's Caspian Sea coast (Figure 1) with a population of more than 550,000 according to the 2006 census. Automobile, taxi, motorcycle, mini-bus, bus, bicycle, and walking are the major modes of transportation and no mass transit system has been provided yet. The increasing rate of vehicle ownership during the last decade and a poor transit system has made the automobile and taxi as the most favorable modes of transportation in daily trips.

Unplanned settlements with disordered pathways, low quality and condensed houses and weak infrastructure constitute a major part of spatial structure of Rasht. Radiating streets from the city center in conjunction with ring roads shapes the main structure of street layout which gives a significant role to the city center where traditional bazaar is situated (Figure 2). Situation of the bazaar, as the main retail center in the core of the city, causes a heavy congestion. Over the past decades, there has been a change in the spatial pattern of activities in Rasht. By development of the city and also the limited space of old bazaar, part of the commercial activities has moved out from the city center and the traditional bazaar (Azimi (2005)).

Data for the analysis comes from Rasht comprehensive transportation planning study in 2007. As a part of that study, a questionnaire was designed and distributed among more than 5000 households who reside in 112 traffic analysis zones, TAZs (Figure 2). Some TAZs are identified as main areas of business. The aim of the survey was to collect detailed information about every trip taken by all members of each participating household. Each person was asked to fill out a trip diary for a specific day including the mode of travel, starting and ending time of the trip and the trip purpose. In addition, household information including number of vehicles owned and household size, as well as individual socio-demographic information such as age, gender and job status were also collected.

Fig. 1. Location of study area in north of Iran

Of all the trips made, 15.6% were for the purpose of study including trips to school and university. As the research objective was to assess the travel behavior of individuals to school, trips made from home to school were selected for the analysis. For the purpose of this study, trips which had origin-destination (O-D) outside the municipal boundaries of Rasht were excluded.

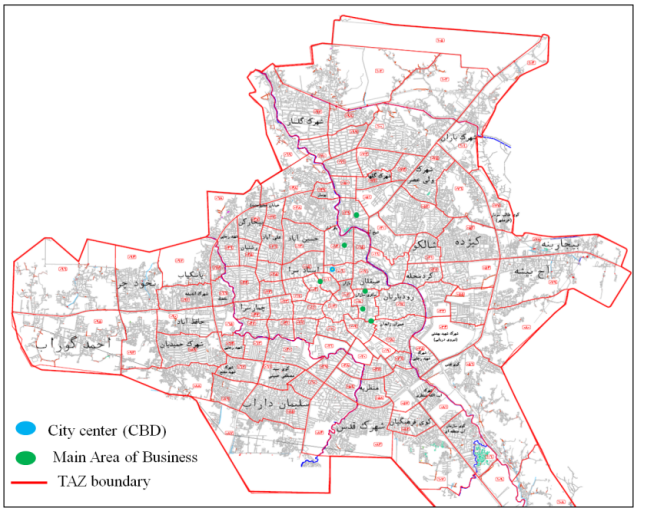

Fig. 2. City of Rasht containing 112 TAZs

Finally, the data contain 4236 trips to school in which 1411 trips are related to elementary, 1416 trips are related to middle school and 1409 trips are related to high school students. In the sample studied it was found that by increase in the level of education, walking rate decreases. Results show that on the way to school 49.26 % of elementary, 40.82 % of middle aged students, and 32.67 % of high school students choose walking to school. This finding shows that school children in Rasht choose an active mode of transportation, on average according to our sample, more than school children in the U.S. states California at 21% (Copperman and Bhat (2007)) and Georgia at 14.1% (Kerr et al. (2007)), but less than the Portuguese at 52.6% (Mota et al. (2007)) and Chinese at 87.7% (Shi et al. (2006)) which could be due to differences in various factors including demographics, socioeconomics, culture, infrastructure.

4. Methodology

This research investigates and compares walking behaviors in three different stages (age groups). Therefore, separate models were developed for elementary, middle and high school students' trips to school. The decision to make a trip by foot to school was modeled as a dichotomous variable in a binary logistic model. Explanatory variables are divided into two main categories including socioeconomic and demographic characteristics beside environment and travel characteristics. Explanatory variables used in this study are introduced in Table 1. Age and gender beside some household factors such as household size, number of children and vehicle ownership were used as socioeconomic and demographic characteristics. Also, four variables were defined as environmental and travel characteristics. In order to examine the effect of travel distance, the distance between the TAZ centroids of origin and destination of the trip was taken as the trip distance. It is worth noting that the average radius of the TAZs was about 0.26 mile which seems that the distance considered is an appropriate proxy for the travel distance. About the intra-zonal trips which are the shortest trips in the data set, the equivalent radius of each TAZ was considered as the travel distance which was in the range of 0.12-0.84 miles. To find out the relative amount of disutility of distance intervals in different school stages, seven categories were defined for trip distance taking trips less than 0.25 miles as the reference level (Table 1). A variable was defined to see if there is any relation between time of travel and walking behavior of different stages in school trips. Some schools in Rasht have two distinct periods (usually one period in the morning and another period in the afternoon) which could affect the walking mode choice behavior. To examine the possible relationships between environmental features and walking mode choice of students, some variables were created using the existing data. A variable is the population density of trips origin zone. Also, a variable is created for trips made to TAZs which are identified as main areas of business (as shown in Figure 2).

Coding definitions, specifically developed for each of the variables are given in Table 1. Variables were included in the final model if they were significant at the 10% level or if there was a strong theoretical reason for keeping them in the model. The best specifications for the three models were obtained after systematically excluding the statistically insignificant variables.

Table 1. Description of examined variables.

Category Name	Variable Name	Definition	
Individual Characteristics			
	Age	Students' age	0: otherwise
	Gender	1:if student is female;	0: otherwise
Household Characteristics			
Structure	HHSize	Number of persons in household	0: otherwise
	Child_U7	1:if there is a child under 7 years in household;	0: otherwise
	Child_711	1:if there is a 7-11 years child in household;	0: otherwise
	Child_1218	1:if there is a 12-18 years child in household;	0: otherwise
Vehicle Ownership	Veh1_Auto	1:if there is at least one automobile in household;	0: otherwise
	Veh2_Motor	Number of motorcycles in household	0: otherwise
Trip Characteristics			
Travel distance	Dist_r (ref. level)	1:if trip distance is less than 0.25 miles ;	0: otherwise
	Dist_0.25-0.50	1:if trip distance is between 0.25 to 0.5 miles ;	0: otherwise
	Dist_0.50-0.75	1:if trip distance is between 0.5 to 0.75 miles ;	0: otherwise
	Dist_0.75-1.00	1:if trip distance is between 0.75 to 1.0 miles ;	0: otherwise
	Dist_1.00-1.50	1:if trip distance is between 1.0 to 1.50 miles ;	0: otherwise
	Dist_1.50-2.00	1:if trip distance is between 1.50 to 2.0 miles ;	0: otherwise
	Dist_Ov2.00	1:if trip distance is over 2.0 miles;	0: otherwise
Time of travel	Time	1:if trip is made in the afternoon;	0: otherwise
Environmental Characteristics			
Population density	PopDen	Population per square kilometer of residential area	
Area of business	CBD (Bazaar)	1:if trip destination is a main area of business;	0: otherwise

5. Results

As discussed in the previous section, separate binary logit models were developed for different age groups in trips to school. Average and standard deviation of the variables used in final models are reported in Table 2. Results show that beside some similarities, walking behaviors across age groups are different in trips to school. Final models are summarized in Table 3. The rest of this section is devoted to the discussion of the findings.

5.1. Demographic and socioeconomic characteristic

Results show that gender has a significant and negative effect on walking mode choice in all models which means that girls are less likely to walk to school than boys in all of the studied groups. The reason behind this finding may be due to socio-cultural factors in Rahst. For example, parents may have more concerns about girls' security in walking alone to school than boys. Therefore, despite of girls' possible interests, parents may prefer other modes of transportation and limit chances of walking for them, especially at younger ages. However, this should be more investigated in future studies. In comparison with previous studies, our finding is in line with some of them which found that girls are less likely to walk than boys (McDonald (2008); McMillan et al. (2006); Marten and Olds (2004); Johnson et al. (2010)) but also in contrast with some other studies which found opposite results (Wilson et al. (2010); Ermagun and Samimi (2012); Bopp et al. (2012)). In a previous study, it was mentioned that gender differences at

elementary school level may not yet be significant enough to influence children's walking to school rates (Su et al. (2013)), which is not confirmed in the current study.

Table 2. Averages and variance of variables used in final model.

	Elementary school		Middle school		High School	
Variable	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
Age	-	-	-	-	16.1583	1.01693
Gender	.440113	.496577	.310028	.462668	.443652	.496992
HHSize	-	-	4.10664	.889236	4.22040	.940369
Veh1_Auto	.541460	.498455	.518362	.499839	.577746	.494095
Dist_0.25-0.50	.358611	.479763	.258475	.437951	.167618	.373660
Dist_0.50-0.75	.189227	.391828	.159605	.366368	.136947	.343914
Dist_0.75-1.00	.127569	.333728	.106638	.308762	.105563	.307388
Dist_1.00-1.50	.129695	.336087	.218927	.413665	.217546	.412724
Dist_1.50-2.00	.772502E-01	.267083	.960452E-01	.294757	.142653	.349844
Dist_Ov2.00	.708717E-01	.256701	.112288	.315832	.199001	.399392
Time	.140326	.347448	.127119	.333224	-	-
PopDen	134.804	77.2324	-	-	-	-
BD (Bazaar)	-	-	.153955	.361033	-	-

Table 3. Binary logit models for school trips.

	Elementary School		Middle School		High School	
Variable	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Constant	2.099***	5.81	1.424***	3.15	5.566***	4.51
Age	-	-	-	-	-.225***	-3.18
Gender	-.265**	-2.04	-.359**	-2.50	-.724***	-5.16
HHSize	-	-	.143*	1.89	.122*	1.7
Veh1_Auto	-.256**	-1.98	-.354***	-2.64	-.321**	-2.35
Dist_0.25-0.50	-.316	-.96	-.689*	-1.95	-1.281***	-2.73
Dist_0.50-0.75	-1.33***	-3.93	-1.367***	-3.8	-1.898***	-4.02
Dist_0.75-1.00	-2.128***	-6.00	-2.560***	-6.85	-2.422***	-5.04
Dist_1.00-1.50	-3.444***	-8.98	-3.084***	-8.49	-3.283***	-6.98
Dist_1.50-2.00	-4.051***	-8.54	-4.395***	-8.87	-3.888***	-7.83
Dist_Ov2.00	-4.178***	-8.23	-4.576***	-9.28	-4.852***	-9.27
Time	.463**	2.51	.350*	1.78	-	-
PopDen	-.003***	-3.16	-	-	-	-
BD (Bazaar)	-	-	-.592***	-2.79	-	-
Number of observations	1411		1416		1402	
Log likelihood at zero	-733.66112		-693.40496		-666.40277	
Log likelihood at convergence	-977.87439		-957.49038		-885.78322	
McFadden Pseudo R-squared	.2497		.2758		.2477	

Note: *** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

Results show that the effect of age is only significant in models developed for high school students. With an increase in age between high school students, the likelihood to walk to school decreases. Age has no significant effect on walking mode choice of elementary and middle school student. This finding is in contrast with a previous study which

found that the effect of age was only significant for children between 5 and 14 years (elementary and middle school) but not for high school students (McDonald (2008)).

As discussed before, previous studies indicate that household characteristics such as household structure, opportunities or constraints on household transportation options and household income influence the travel behavior. Our analysis suggests that the presence of other children in family has no significant effect on the likelihood of walking in none of the models; which is consistent with a previous study (Ermagun and Samimi (2012)) but is also in contrast with another study which found positive correlation between the number of children in a household and the propensity of students to utilize active modes of transportation (Yelavich et al. (2008)). However, the variable used in the mentioned studies was the number of children in a household while the variable used in our study was the presence of other school age children in household. Furthermore, results show that household size has no significant effect on walking mode choice of elementary students but it is a significant factor in increasing the propensity to walk across middle aged and high school students. The reason behind this finding may be due to families more concerns about younger children in the way walking to school (for example, about street crossings). This could make more sense of responsibility to accompany them in their way to school, especially by car. In this case, older children will less likely to be accompanied to school by car; giving them more chance of walking. However, there is no fact to proof the mentioned reason because such information was not available in the data collected.

As indicated in Table 3, results show that regardless of age, student who has a car in his/her household is less motivated to walk to school. It is worth noting that none of the studied groups have reached their legal age limit (+18) to take driving licenses. Our finding is consistent with results found in previous studies (Wilson et al. (2010); Copperman and Bhat (2007); Park et al. (2013); Mackett (2011)). A reason behind this could be the interactions between children's trip to school and their parent's trip to workplace which probably leads families to choose motorized transportation modes (usually driving) for accompanying students and then attainment to their workplaces. The mentioned reason has also been addressed in the literature (McDonald (2008); Yarlagadda and Srinivasan (2007)). The variable defined for the number of motorcycles in household was found statistically insignificant in all models and was excluded from the final model presented. In another study, no association was found between the number of motorcycles in household and individual's tendency to walk for the purpose of study including trips to school and university (Hatamzadeh et al. (2014)).

5.2. Environment and travel characteristics

Some environment and travel characteristics were examined in this study. Results show that making trips to school on afternoon has different effects on walking behavior of different age groups. As mentioned earlier, some schools in Rasht have one period in the morning and another period in the afternoon. It was found that making trips to school on afternoon has no statistically significant effect on high school students' tendency towards walking; but it has a significant and positive effect on the walking mode choice of elementary and middle aged students. The unwillingness to walk in morning could be due to the sensitivity on getting to school on time, and the fact that the children's school may be on the way to their parent's workplace in the morning as mentioned earlier. It has been mentioned in another study that having a school within walking distance did not reduce demand for escorting in the morning although it did in the afternoon (Vovsha and Petersen (2005)).

Another significant factor is the travel distance which was categorized in six levels (increasing by 0.25 miles) relative to a base category (i.e., distances less than 0.25 miles) to show the variation of distance effect across studied groups. Results show that the travel distance has negative signs in all models and diversely affects walking tendency which is consistent with other studies showing that an increase in trip distance decreases the likelihood of walking (Ermagun and Samimi (2012); McDonald (2008); McMillan (2007); Cervero and Duncan (2003)). All distance categories are also significantly different with respect to the reference level (i.e., under 0.25 mile) except the first category (i.e., 0.25-0.5 mile) in models developed for elementary students. This issue implies that the acceptable walking distance of elementary students in trips to school is 0.5 mile. In other words, one can conclude that elementary students do not mind walking up to 0.5 mile (800 meter) but middle and high school students are sensitive to trips longer than 0.25 mile in choosing walking to school.

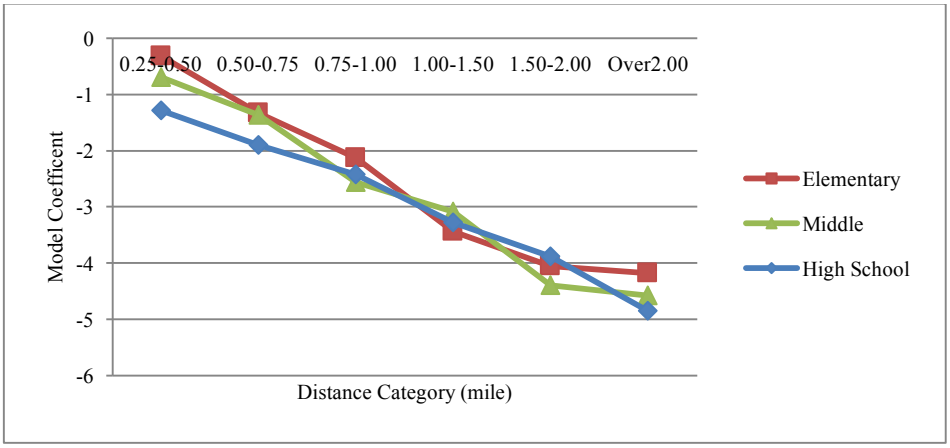

Fig. 3. Effects of distance on propensity to walk across different stages in school trips.

As shown in Table 3, different coefficient values are determined for the assumed distance intervals. This issue confirms the appropriateness of assuming the distance variable in several intervals. Estimated coefficients are plotted in Figure 3 to show the variation of distance effect across different studied groups in school trips. As it can be seen in Figure 3, the effect of an increase in distance is different between school levels. More variation in walking behavior of elementary and middle aged students can be seen as the trip distance increases.

As mentioned in section 4, access to environmental information was limited in this study. Therefore, only two variables were created to examine their relation with walking behaviour across different studied groups in school trips. Results show that population density has no significant effect on walking behaviour of middle and high school students but it has a significant and negative relation with walking mode choice of elementary students. Results also show that making a trip to a zone which is identified as main area of business (i.e., school is located in a main area of business as shown in Figure 2), decreases the likelihood of walking for middle aged students but has no significant effect on walking mode choice of other students.

6. Summary and conclusion

Previous studies have investigated the effect of a wide range of factors on children's mode choice for the school trip but a significant portion of the literature is made up of studies that are focused on a single age group. Therefore, this research investigated and compared walking behaviors in three different age groups (stages), including elementary, middle and high school students. The main objective was to understand reasons behind differences in choosing walking as a mode of transportation in trips to school across age groups. The study focused on the city of Rasht, the regional capital of Guilan province in which adequate attention has not been paid to this issue. Despite limitations to this study, many variables were created and examined in multiple behavioral models. Separate models were developed for each group and comparisons were presented to provide useful insights about traveler's behavior.

Our findings show that beside some similarities, walking behaviors across studied groups are different in trips to school which suggests that age differences need to be addressed if policymakers hope to increase rates of walking in children's trips to school. Among demographic factors, gender was a significant variable in all models. Results show that girls are less likely to walk to school than boys in all studied groups. The effect of age is only significant in model developed for high school students in which an increase in age between high school students decreases the likelihood to walk to school. Age has no significant effect within the walking mode choice of elementary and middle aged students.

Analysis suggests that the presence of other children in family has no significant effect on the likelihood of walking in none of the models. Furthermore, results show that household size has no significant effect on walking mode choice of elementary students but it is a significant factor in increasing the propensity to walk across middle aged and high school students. Also, it was found that regardless of age, student who has a car in his/her household is

less motivated to walk to school. Due to lack of information in the data used in this study, more explanations about the effect of household characteristics on children's walking to school (for example, interactions between children's trip to school and parent's trip to workplace) were not possible and is proposed to be explored in future studies.

Another finding is that making trips to school on afternoon, only has a significant and positive effect on the walking mode choice of elementary and middle aged students. It is worth reminding that some schools in Rasht have one period in the morning and another period in the afternoon.

It was also found that travel distance diversely affects walking in all models. Due to lack of information about the actual distance travelled in this study, distance in zonal based form was considered as the travel distance. Seven categories were defined for trip distance taking trips less than 0.25 miles as the reference level. The aim was to find out the relative amount of disutility of distance intervals in different trip purposes. Different coefficient values were determined for the assumed distance intervals which confirms the appropriateness of assuming the distance variable in several intervals. The results showed that all distance categories are significantly different with respect to the reference level (i.e., under 0.25 mile) except the first category (i.e., 0.25-0.5 mile) in models developed for elementary students. It was concluded that elementary students do not mind walking up to 0.5 mile (800 meter) but others are sensitive to trips longer than 0.25 mile in choosing walking to school.

Access to environmental data was also limited in this study even though an emerging body of literature suggests that pedestrian and bicycle modes are sensitive to characteristics of the built environment. Also, some socioeconomic factors such as household's income which have been reported to influence the travel behavior in previous studies were not gathered in the data collection stage. Altogether, while some findings in this study are in line with previous studies, some others are not. Although these similarities and differences may suggest culture and social diversity, it should be noted that in previous studies the analysis were not on segments of age, as was in this study. Therefore, despite some reasons presented for differences between age groups (stages) in choosing walking in school trips, this subject is still interesting and open for future studies. In this regard, data collection specifically to explore walking behaviors across age groups in school trips is proposed.

References

Azimi, N., 2005. Restructuring Urban Morphology: A case study of Rasht, Iran, Researches in Geography 53, Fall.

Boarnet, M.G., Anderson, C.L., Day, K., McMillan, T.E. and Alfonzo, M., 2005. Evaluation of the California safe routes to school legislation: urban form change and children's active transportation to school. American Journal of Preventive Medicine 28 (2S2), 134–140.

Bopp, M., T.Kaczynski, A. and Besenyi, G., 2012. Active commuting influences among adults. Preventive Medicine 54 , 237–241.

Braza, M., Shoemaker, W. and Seeley, A., 2004. Neighborhood design and rates of walking and biking to elementary school in 34 California communities. American Journal of Health Promotion 19, 128–136.

Carlin, J.B., Stevenson, M.R., Roberts, I., Bennett, C.M., Gelman, A. and Nolan, T., 1997. Walking to school and traffic exposure in Australian children. Australian and New Zealand Journal of Public Health 21, 286–292.

Cervero, R. and Duncan, M., 2003. Walking, bicycling, and urban landscapes: Evidence from the San Francisco Bay Area. American Journal of Public Health 93, no. 9, 1478-1483.

Cooper, A.R., Jago, R., Southward, E.F. and Page, A.S., 2012. Active travel and physical activity across the school transition: the PEACH project. Medicine and Science in Sports and Exercise 44, 1890–1897.

Cooper, A.R., Page, A.S., Foster, L.J. and Qahwaji, D., 2003. Commuting to school—are children who walk more physically active?. American Journal of Preventive Medicine 25, 273–276.

Copperman, R. and Bhat, C., 2007. An analysis of the determinants of children's weekend physical activity participation. Transportation 34, 67–87.

Dyck, D., Bourdeaudhuij, I., Cardon, G. and Deforche, B., 2010. Criterion distances and correlates of active transportation to school in Belgian older adolescents. Journal of Behavioral Nutrition and Physical Activity.

Ermagun, A. and Samimi, A., 2012. Active Transportation Mode Choice Behavior across Genders in School Trips. Annual Meeting of the Transportation Research Board, Washington, D.C..

Evenson, K.R., Huston, S.L., Mcmillen, B.J., Bors, P. and Ward, D.S., 2003. Statewide prevalence and correlates of walking and bicycling to school. Archives of Pediatrics & Adolescent Medicine 157, 887–892.

Ewing, R., Schroeer, W. and Greene, W., 2004. School location and student travel analysis of factors affecting mode choice. Transportation

Research Record: Journal of the Transportation Research Board 1895 (1), 55–63.

Frank, L.D., Schmid, T.L., Sallis, J.F., Chapman, J. and Saelens, B.E., 2005. Linking objectively measured physical activity with objectively measured urban form – findings from Smartraq. American Journal of Preventive Medicine 28, no. 2, 117– 125.

Hatamzadeh, Y., Habibian, M. and Khodaii, A., 2014. Walking Behaviors by Trip Purposes. Transportation Research Record: Journal of the Transportation Research Board 2464, p118-125.

Johnson, T.G., Brusseau, T.A., Darst, P.W., Kulinna, P.H. and White-Taylor, J., 2010. Step counts of non-white minority children and youth by gender, grade level, race/ethnicity, and mode of school transportation. Journal of Physical Activity & Health 7, p730-736.

Kerr, J., Frank, L., Sallis, J. and Chapman, J., 2007. Urban form correlates of pedestrian travel in youth: differences by gender, race-ethnicity and household attributes. Transportation Research Part D— Transport and Environment 12, 177–182.

Krizek, K., 2003. Neighborhood services, trip purpose, and tour-based travel. Transportation 30, no. 4, 387– 410.

Kuzmyak, J.R., Baber, C. and Savory, D., 2005. Use of walk opportunities index to quantify local accessibility. Transportation Research Record: Journal of the Transportation Research Board 1977, 145–153.

Mackett, R.L., 2011. Letting children be free to walk. WALK 21 12th Annual Conference, Vancouver, Canada.

Manaugh, K. and El-Geneidy, A., 2011. Validating walkability indices: how do different households respond to the walkability of their neighbourhood?. Transportation Research Part D 16, no. 4, 309–315.

Marten, N. and Olds, T., 2004. Physical activity: patterns of active transport in 11–12 year old Australian children. Australian and New Zealand Journal of Public Health 28, 167–172.

McCormack., G., Giles-Corti, B. and Bulsara, M., 2008. The relationship between destination proximity, destination mix and physical activity behaviors. Preventive Medicine 46, no. 1, 33– 40.

McDonald, N., 2007. Active transportation to school: Trends among U.S. schoolchildren. American Journal of Preventive Medicine 32, no. 6, 509–16.

McDonald, N., 2008. Critical factors for active transportation to school among low- income and minority students: evidence from the 2001 national household travel survey. American Journal of Preventive Medicine 34, 341–344.

McDonald, N.C., 2008. Household interactions and children's school travel: the effect of parental work patterns on walking and biking to school. Journal of Transport Geography 16, 324–331.

McMillan, T., 2007. The relative influence of urban form on a child's travel mode to school. Transportation Research Part A— Policy and Practice 41, 69–79.

McMillan, T., Day, K., Boarnet, M., Alfonzo, M. and Anderson, C., 2006. Johnny walk s to school—Does Jane? Sex differences in children's active travel to school. Children, Youth and Environments 16, 75–89.

Mota, J., Gomes, H., Almeida, M., Ribeiro, J., Carvalho, J. and Santos, M., 2007. Active versus passive transportation to school-differences in screen time, socio- economic position and perceived environmental characteristics in adolescent girls. Annals of Human Biology 34, 273–282.

Ogden, C.L., Carroll, M.D., Kit, B.K. and Flegal, K.M., 2012. Prevalence of Obesity in the United States, 2009–2010. NCHS Data Brief National Center for Health Statistics, Hyattsville, MD 82.

Pabayo, R., Gauvin, L. and Barnett, T.A., 2011. Longitudinal changes in active transportation to school in canadian youth aged 6 through 16 years. Pediatrics 128, E404–E413.

Park, H., Noland, R.B. and Lachapelle, U., 2013. Active school trips: associations with caregiver walking frequency. Transport Policy 29, September , p23-28.

Porta, S. and Renne, J.L., 2005. Linking urban design to sustainability: formal indicators of social urban sustainability field research in Perth, Western Australia, Urban Design International 10, 51–64.

Pucher, J., Dill, J. and Handy, S., 2010. Infrastructure, programs, and policies to increase bicycling: an international review. Preventive Medicine 50, S106–S125.

Rasht Comprehensive Transportation Study. 2011. Final report. Municipality of Rasht, Iran.

Roth, M.A., Millett, C.J. and Mindell, J.S., 2012. The contribution of active travel (walking and cycling) in children to overall physical activity levels: a national cross sectional study. Preventive Medicine 54, 134–139.

Sahlqvist, S., Song, Y.N. and Ogilvie, D., 2012. Is active travel associated with greater physical activity? The contribution of commuting and non-commuting active travel to total physical activity in adults. Preventive Medicine 55, 206–211.

Schlossberg, M., Greene, J., Phillips, P., Johnson, B. and Parker, B., 2006. School trips: effects of urban form and distance on travel mode. Journal of the American Planning Association 72, 337–346.

Shi, Z., Lien, N., Kumar, B. and Holmboe-Ottesen, G., 2006. Physical activity and associated socio-demographic factors among school adolescents

in Jiangsu Province, China. Preventive Medicine: An International Journal Devoted to Practice and Theory 43, 218–221.

Spallek, M., Turner, C., Spinks, A. and Bain, C., 2006. Walking to school: distribution by age, sex and socio-economic status. Health Promotion Journal of Australia 17, 134–138.

Su, J.G., Jerrett, M., McConnell, R., Berhane, K., Dunton, G., Shankardass, K., Reynolds, K., Chang, R. and Wolch, J., 2013. Factors influencing whether children walk to school. Health & Place 22, 153–161.

Voorhees, C.C., Ashwood, S., Evenson, K.R., Sirard, J.R., Rung, A.L., Dowda, M. and Mckenzie, T.L., 2010. Neighborhood design and perceptions: relationship with active commuting. Medicine and Science in Sports and Exercise 42, 1253–1260.

Vovsha, P. and Petersen, E., 2005. Escorting children to school: statistical analysis and applied modeling approach. Transportation Research Record, Journal of the Transportation Research Board, 131–140.

Wilson, J.E., Marshall, J., Wilson, R. and Krizek, J.K., 2010. By foot, bus or car: children's school travel and school choice policy. Environment and Planning A 42, 5 pages.

Yarlagadda, A.K. and Srinivasan, S., 2007. Modeling children's school travel mode and parental escort decisions. Transportation 35 , no. 2, 201–218.

Yelavich, S., Towns, C., Burt, R., Chow, K., Donohue, R., Sani, H., Taylor, K., Gray, A., Eberhart-Phillips, J. and Reeder, A.I., 2008. Walking to school: frequency and predictors among primary school children in Dunedin, New Zealand. New Zealand Medical Journal 121, 51–58.

Yeung, J., Scott, W. and Andrew, P.H., 2008. Child transport practices and perceived barriers in active commuting to schoo. Transportation Research Part A 42, no. 6, 895–900.