CHAPTER 7
EXAMINING THE RELATIONSHIP BETWEEN ENVIRONMENTAL SAFETY AND CHILDREN WALKING TO AND FROM SCHOOL (RESULTS AND DISCUSSION)

7.1 Introduction

The previous chapter provided evidence that traffic safety is a contributing factor in choosing a child's active travel mode to school. However, none of the factors that represented traffic safety were significant in the models. The results also showed that neighbourhood safety factors affect children's travel mode to school, however, there are some issues that are still not clear and need to be addressed: How to improve the parental perception of traffic safety and neighbourhood safety? Which part of traffic safety and neighbourhood safety can be explained by built environment factors? Do contributing factors vary across different socio-economic status areas?

One of the primary hypotheses of the analytical framework is that traffic safety is not the only influential factor in choosing a travel mode for a primary-age child, neighbourhood safety factors are as important as traffic safety. Moreover, the relationship between traffic safety, personal safety and children walking to school is moderated by socio-economic and socio-demographic factors. Additionally, urban form factors affect the perception of parents and children of traffic safety and neighbourhood

safety (McMillan, 2003). Finally, parental perception about safety varies across different socio-economic areas.

This chapter explains and tests the concept of the mediating and moderating factors and the difference between individual elements across different areas. It moves beyond the analysis presented before by examining the direct relationships between variables rather than a basic test of association. The analysis used the larger data sample using children's and parents' perception of personal and traffic safety on street segments to increase the power of a big sample size in detecting the small impacts of variables (McMillan, 2003; McDonald et al., 2009; Timperio et al., 2006; Yeung et al., 2008).

7.2 Mediators and Moderators

Figure 7.1 shows the moderation model in this study. It contains one pathway: (A), which is a direct relationship between the dependent and independent variables; and (AB), which illustrates the indirect impact of urban form through the independent variables.

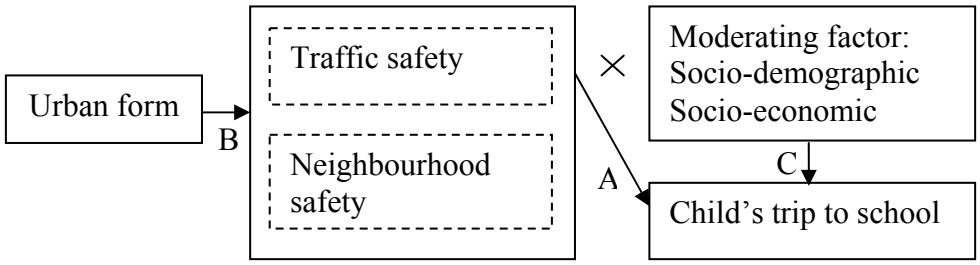

Figure 7. 1: The moderation model of the analytical framework shows how traffic safety and neighbourhood safety impact on children walking to and from school.

As discussed earlier in the methodology chapter, other variables such as urban form affect a child's trip to school on foot through traffic safety and neighbourhood safety factors. Therefore, the safety factors work as mediator variables within the relationship between urban form and a child's school travel pattern (McMillan, 2003). It

is likely that it is the independent variables that shape the decision about a child's travel mode to school (path A). However, their effect on the choice of travel mode for children may vary across different categories of the moderator variable. In this study, it is suggested that socio-economics, socio-demographics, cultural norms and parent's attitude are moderating factors in the relationship between traffic safety, neighbourhood safety and choosing a child's travel mode to school (path C, Figure 7.1).

To develop an effective policy on children's trip to school, there is a need to identify all the contributing variables in choosing the mode of travel to school for children including traffic safety. Moreover, knowing the factors that moderate the relationship between the safety factors and parental decisions about children's modes of transportation to school seems necessary. Additionally, it is vital to understand the level of influence of a factor (independent factor and moderators) across different socio-economic areas.

7.3 Hypothesis test

The analysis presented in chapter 6 showed that there are several variables representing moderating factors that strongly affect a child's walking to and from school even when the traffic safety and neighbourhood safety variables were entered into the model. Furthermore, neighbourhood safety factors had a significant impact on children's trip to school on foot even when traffic safety variables were included in the model.

Alternatives hypothesise in this study claim 1) traffic safety and neighbourhood safety factors influence on modes of children's transportation to and from school. 2) The traffic safety and neighbourhood safety factors that prevent children to walk to and from school autonomously vary across different areas. To test these hypotheses non-parametric tests for more than two samples (Kruskal Wallis test) were selected, because variables are categorical (nominal and ordinal). Following tables shows the result of

test for the first hypothesis. Small *P* value provides evidence against null hypothesis because they say the observed data are unlikely when the null hypothesis is true. Use of "significant" means the observed difference is not likely due to chance; it does not mean 'important' or 'meaningful". When the results are statistically significant at the level we selected, then we accept the alternative hypothesis. Therefore, we can accept that traffic safety and neighbourhood safety factors influence on parental decision making about modes of children's travel to and from school (Tables 7.1 & 7.2).

Table 7.1: Hypothesis testing: The influence of traffic safety and neighbourhood safety on walking to school.

	Cross a road with more than 4 lanes of traffic	Cross a road at an intersection that doesn't a stop sign to stop traffic	Cross a road without a painted crosswalk	Parents encourage children to walk to school	elements children like to be changed, existence of police officer	Elements which child doesn't like to see on their way to school or they scare of them, traffic jam	Elements which child doesn't like to see on their way to school or they scare of them, motorcycle	density of the school immediate neighborhood	street width in meter	pavement width in meter	Mix land use are present
Chi-square	0.481	7.815	3.044	209.2	19.435	22.542	16.187	12.325	21	9.8	10
df	3	3	3	3	3	3	3	3	3	3	3
Sig.	0.923	**0.05**	0.385	**0**	**0**	**0**	**0.001**	**0.006**	**0**	**0**	**0**

*Note: Kruskal Wallis Test
Grouping variable: Modes of children travel to school; for *p* value the conventions were applied:
p >.10: the observed difference is "not significant" *p*<.10: the observed difference is "marginally significant" *p* < .05: the observed difference is "significant" *p*<.01: the observed difference is" highly significant"

Table 7.2: Hypothesis testing: The influence of traffic safety and neighbourhood safety on walking from school.

	Cross a road with more than 4 lanes of traffic	Cross a road at an intersection that doesn't have a stop sign to stop traffic	Cross a road without a painted crosswalk	Walk along the road that have traffic going more than 30km/hr.	Parents encourage children to walk to school	Elements which child doesn't like to see on their way to school or they scare of them, motorcycle	Pavement is present for entire road (both side)	number of lanes for traffic	street length in meter
Chi-square	8.07	17.669	18.15	23.82	159.38	16.141	4.07	4.07	22.3
df	2	2	2	2	2	2	2	2	3
Sig.	**.018**	**.000**	**.000**	**.000**	**.000**	**.000**	.130	.131	**.000**

*Note: Kruskal Wallis Test
Grouping variable: Modes of children travel back home
for *p* value the conventions were applied:
p >.10: the observed difference is "not significant", *p*<.10: the observed difference is "marginally significant", *p* < .05: the observed difference is "significant", and *p*<.01: the observed difference is" highly significant"

We also accept barriers to children in their walking to and from school vary across different socio-economic areas (see Table 7.3).

To understand the effects of traffic safety and neighbourhood safety on walking to and from school, there is need to reveal which parts of these factors were effective, those that could be explained by urban form or those that could not. This chapter focuses on two main objectives: 1) neighbourhood safety factors and traffic safety factors affect a child's trip to school and they are influenced by urban form factors, and 2) socio-demographic and socio-economic factors moderate the relationship between traffic safety, neighbourhood safety and parental decisions about their children's mode of travel to and from school.

Table 7.3: Hypothesis testing: The traffic safety and neighbourhood safety factors that prevent children to walk to and from school autonomously vary across different areas.

	Cross a road with more than 4 lanes of traffic	Cross a road at an intersection that doesn't have a stop sign to stop traffic	Cross a road without a painted crosswalk	Walk along the road that have traffic going more than 30km/hr.	Parents encourage children to walk to school	Elements children like to be changed, existence of police officer	Elements which child doesn't like to see on their way to school or they scare of them,	Elements which child doesn't like to see on their way to school or they scare of them,	Pavement is present for entire road (both side)	Density of the school immediate neighborhood	Street width in meter	pavement width in meter	Mix land use are present
Chi-square	50.5	5.4	2.2	4.2	18.2	49.7	9.9	22.3	43.7	292.	44.3	84.7	96.4
df	2	2	2	2	2	2	2	2	2	2	2	2	2
Sig.	**.000**	.067	.31	.118	**.000**	**.000**	**.007**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**

*Note: Kruskal Wallis Test
Grouping variable: Areas in Tehran with different socio-economic status

for *p* value the conventions were applied:
$p > .10$: the observed difference is "not significant", $p < .10$: the observed difference is "marginally significant", $p < .05$: the observed difference is "significant", and $p < .01$: the observed difference is" highly significant"

The traffic safety and neighbourhood safety factors are latent variables since they were not observed or measured directly in this study; however, they were represented by other measured variables (McMillan, 2003; Pont et al., 2009). In contrast to the previous chapter, which directly measured independent variables that represented neighbourhood safety and traffic safety, this analysis added some indexes. Each index is clarified by at least two variables from the parent's and children's survey to better represent the latent variables and to reduce the amount of measurement error in the factors (Antonini et al., 2006).

The Cronbach's alpha (0.70) was calculated to evaluate the reliability of each index. In the beginning all the variables representing safety factors used in previous analysis (chapter 6) were used in each index. However, if these variables or any other variables had Cronbach's alpha lower than the acceptable level (<0.70) they were eliminated from the index. Table 7.4 summarizes the indexes and reports the Cronbach's alpha for each of the factors.

Table 7. 4: Summary of indexed independent variable and Cronbach's alpha

Traffic safety index:
TSIa (Parents' survey) = TRAFLAN+NOTRAFSIGN+CRONOPAV+WALKNOPAV+TRAFKMH
Cronbach's Alpha= 0.80
TSIb (Parents' survey) = DRIVECARE+ WALKNOSEP+ WALKNROWPAV
Cronbach's Alpha= 0.74
TSI (Children's survey) = CROSNOZEBRA+ HIGHSPEEDCAR
Cronbach's Alpha= 0.70

Table 7.4, continued

Neighbourhood safety index:

NSI (Parents' survey) = ESCORT+MORPPL+MORCHL

Cronbach's Alpha= 0.75

NSI (Children's survey) = KIDABDUC+POLICE

Cronbach's Alpha= 0.77

The traffic safety index is the sum of the five-part question that asked parents about potential physical barriers in the neighbourhood regarding traffic safety their child might encounter if he/she walked to and from school independently. Answers were either "yes" or "no".

> "If your child were to walk to and from school (if your child does already walk to and from school), would they have to do any of the following on their way to/from school?
> a. Cross a road with more than 4 lanes of traffic?
> b. Cross a road at an intersection that does not have a street signal or a stop sign to stop traffic?
> c. Cross a road without painted crosswalks?
> d. Walk in the road or on the edge of road because there is no pavement?
> e. Walk along a road that has traffic moving at more than 30kh/hr?"

These questions target elements of street design and the physical environment that are related to traffic safety, traffic speed and volume, lack of facilities for all street users (pedestrians and vehicles) and the absence of safe crossing points (Lang et al., 2011; Leden et al., 2006; Miller et al., 2004). The parents stated the current situation in this question without considering their children's current modes of travel to school. The Cronbach's alpha for this index is 0.80. The index value can vary from 0 to 5. A higher value on this index is indicative of more physical impediments for children in their walking to and from school.

Traffic safety is also the sum of a three-part question that asked parents how likely would it be that they would allow their child to walk to school on their own.
Answers were listed on a 5-point scale with 1 being very likely and 5 being very unlikely.

"Would allow your child to walk to and from school if:
a.…drivers paid more attention to pedestrian children.
b.…there are bushes/fences to separate traffic and pedestrians.
c.…the pavements were not narrow"

These questions also target elements of the street design, which are related to traffic safety, traffic speed, and lack of facilities for children pedestrians. It also considered the drivers' attitude towards pedestrians and the parents' feeling about that. The Cronbach's alpha for this index is 0.74. The index value can vary from 0 to 15. A higher value on this index indicates that parents are more uncomfortable to allow their children to walk to school on their own.

Moreover, Traffic safety indexes from the children's survey are the sum of two items from their composition. They were asked to explain about the barriers they may face if they walk to and from school on their own (the items were extracted from their creative writing as the researcher explained to them while they were writing). As explained in detail in chapter 4, the children's creative writing was transformed to certain questions that could be answered either "yes" or "no".

"If you were to walk to and from school on your own, would you have to do any of the following on your way to/from school?
a. Cross a road without having any painted crossing?
b. Cross a road with high speed traffic "

The question was aimed at elements of the physical environment that related to traffic safety, traffic speed and volume and improving the environment for pedestrians. The Cronbach's alpha for this index is 0.70 and the value of the index can be varied from 0 to 3. A higher value represented more physical barriers regarding traffic safety to children in their trip to school on foot.

The neighbourhood safety index is the sum of three items from the question that asked parents about the requirements needed to give permission to a child to walk to

and from school. Answers were listed on a five-point scale with 1 being very unlikely and 5 being very likely.

> "Would you allow your child to walk to and from school if:
> a.... you or an adult you knew/elder siblings could walk with her/him
> b.... there were more people walking in the neighbourhood
> c.... other children walked together to and from school"

These items focused on adult supervision, general safety of the neighbourhood regarding crime and number of pedestrians on the street as factors that may influence the perceptions of parents concerning the personal safety of their children walking to and from school (Johansson, 2003; Fyhri & Hjorthol, 2009; Bean et al., 2008). The Cronbach's alpha for this index is 0.75. The index value can vary from 0 to 15. A higher value on the index shows a more negative perception of safety.

Furthermore, the neighbourhood safety index is the sum of two items from the question that asked children about elements in the neighbourhood that scare them or prevented them from walking to and from school on their own. Answers were either "yes" or "no".

> "Is there any scary thing in the neighbourhood (related to personal safety) which prevents you from walking to and from school independently?
> a. Are you scared of being abducted?
> b. Do you like to see police officers in the neighbourhood to protect children against strangers? "

These items focus on the children's perception of personal safety in the neighbourhood; however, it is not clear whether it is their own opinion or whether they were influenced by their parents (Ahlport et al., 2008; Farver et al., 2000; Pont et al., 2009). Especially as they said "my mummy scared if something happened to me" or "my mummy says we can only trust police officers". The Cronbach's alpha for this index is 0.77. The index value can range from 0 to 2. A higher value on the index shows a more negative perception of safety.

The specific hypothesis for each independent factor is:

1- Perceived traffic safety is hypothesized to be the most important factor concerning children's transportation to school, but the effect may vary across different levels of moderator factors.
2- Perceived neighbourhood safety is hypothesized to affect children's transportation to school, but the influence may vary across different levels of moderator factors.
3- The representative factors of Traffic safety and neighbourhood safety in the built environment may vary across different socio-economic areas.

The relationship between traffic safety, neighbourhood safety and children's travel pattern to and from school was tested using two models (the influence of each relationship was tested individually).

7.4 Traffic safety hypothesis

Parents reported that absence of painted crosswalks, high speed traffic along the streets in the neighbourhood (more than 30 km/hr), lack of well-connected pavements, insufficient width of pavements, and lack of separation between traffic and pedestrians decreased the probability of children walking to and from school, especially on their own. Children also reported a lack of knowledge of traffic safety education, fear of having a car accident, lack of painted crosswalks; high speed cars and absence of pavements constrained their walking to and from school independently. This provides some support for the general traffic safety assumption that is part of the policies in Iran.

The general hypothesis is that traffic safety affects children's travel pattern, and it varies by levels of the moderator variable (Bringolf-Isler et al., 2008; Ahlport et al., 2008; Point et al., 2009; Fyhri & Hjorthol, 2009; Zargar et al., 2003). There are a large number of variables that are represented as moderators; however, they were used one by one to test the interaction with the independent variables:

1- Number of children under 5 years old in a household,
2- Children' age,
3- Children's gender,
4- Number of people holding driving licence in a household,
5- Household monthly income,
6- Mother's occupation,
7- Parent's qualification,
8- Distance between home and school,
9- Parents' attitude (being convenient for parent to drive their children to and from school using their own car),
10- Parents' attitude (cultural norms) (when parents think walking to school gives an opportunity to their children to interact with their peers).

Some of the aforementioned factors moderated the relationship between a child's walking to school and the independent variables. Some of the moderating factors only influenced the relationship between the independent variables and a child walking back home (i.e. mother's occupation).

7.5 Analytical methods

This study tries to identify the influence of a large number of independent variables on dependent variables. Therefore, the analysis was refined to test particular variable combinations for any possible mediation that may decrease the bias. The analysis emphasised more broadly the influence of traffic safety and neighbourhood safety factors (the parts which are explained by the built environment and the perception of safety) on children's walking to and from school on their own, while being moderated by certain factors (McMillan, 2003).

A series of regression equations were used to examine the effect of traffic safety and neighbourhood safety on children's travel pattern to school. The first multinomial logit regression models only contained the neighbourhood safety variables and the variables representing moderating factors, as outlined in the conceptual model Figure 7.1 and described in Table 6.2.

$$\text{Log}\,(P_B/P_A) = \beta_1\text{HTO} + \beta_2\text{CP} + \beta_3\text{CCHL} + \beta_4\text{AP} + \beta_5\text{SD} + \beta_6\text{SE} + \beta_7\text{NSI} \quad (1)$$

$$\text{Log}\,(P_C/P_A) = \beta_1\text{HTO} + \beta_2\text{CP} + \beta_3\text{CCHL} + \beta_4\text{AP} + \beta_5\text{SD} + \beta_6\text{SE} + \beta_7\text{NSI} \quad (1)$$

$$\text{Log}\,(P_D/P_A) = \beta_1\text{HTO} + \beta_2\text{CP} + \beta_3\text{CCHL} + \beta_4\text{AP} + \beta_5\text{SD} + \beta_6\text{SE} + \beta_7\text{NSI} \quad (1)$$

A=Walk to school independently,

B=Walk to school with an adult,

C=Go to school with private car,

D=Go to school by school bus.

Equation (1) established the impact of the neighbourhood safety factors on the likelihood of a child walking to school relative to other travel modes, without traffic safety and urban form variables in the equation.

$$\text{Log}\,(P_B/P_A) = \beta_1\text{HTO} + \beta_2\text{CP} + \beta_3\text{CCHL} + \beta_4\text{AP} + \beta_5\text{SD} + \beta_6\text{SE} + \beta_7\text{NSI} + \beta_8\text{TSI} \quad (2)$$

$$\text{Log}\,(P_C/P_A) = \beta_1\text{HTO} + \beta_2\text{CP} + \beta_3\text{CCHL} + \beta_4\text{AP} + \beta_5\text{SD} + \beta_6\text{SE} + \beta_7\text{NSI} + \beta_8\text{TSI} \quad (2)$$

$$\text{Log}\,(P_D/P_A) = \beta_1\text{HTO} + \beta_2\text{CP} + \beta_3\text{CCHL} + \beta_4\text{AP} + \beta_5\text{SD} + \beta_6\text{SE} + \beta_7\text{NSI} + \beta_8\text{TSI} \quad (2)$$

Equation (2) included the same variables as equation (1) plus the traffic safety variables, determining the influence of the neighbourhood safety factors on the probability of a child walking to school while controlling for traffic safety, and the impact of traffic safety on the likelihood of a child walking to school relative to other transportation modes while controlling for the neighbourhood safety.

$$\text{Log}\,(PB/PA) = \beta1\text{HTO} + \beta2\text{CP} + \beta3\text{CCHL} + \beta4\text{AP} + \beta5\text{SD} + \beta6\text{SE} + \beta7\text{NSI} + \beta8\text{TSI} + \beta9\text{UF} \quad (3)$$

$$\text{Log}\,(PC/PA) = \beta1\text{HTO} + \beta2\text{CP} + \beta3\text{CCHL} + \beta4\text{AP} + \beta5\text{SD} + \beta6\text{SE} + \beta7\text{NSI} + \beta8\text{TSI} + \beta_9\text{UF} \quad (3)$$

$$\text{Log}\,(PD/PA) = \beta1\text{HTO} + \beta2\text{CP} + \beta3\text{CCHL} + \beta4\text{AP} + \beta5\text{SD} + \beta6\text{SE} + \beta7\text{NSI} + \beta8\text{TSI} + \beta_9\text{UF} \quad (3)$$

Equation (3) included the same variables as equation (2) plus the urban form variables, determining the influence of the neighbourhood safety factors and traffic safety factors on the probability of a child walking to school relative to other transportation modes while controlling for urban form. It also examined the effect of urban form on the likelihood of a child walking to school relative to other travel modes while controlling for the neighbourhood safety and traffic safety factors (McMillan, (2003). It showed that neighbourhood safety and traffic safety mediate the relationship between urban form and child's trip to school.

These three equations were the same as those used in chapter 6 except that the indexed independent factors were used rather than individual variables to offer neighbourhood safety and traffic safety. The equations show the relationship of the indexed factors on the probability of a child walking with an adult, use private car and use school bus over a child's walking to school independently. All the aforementioned equations were recalculated once more with a change in the dependent variable to children's travel modes back home from school. They examined the likelihood of a child's walking with an adult, use private car and take school bus back home over children walking on their own back home. After the initial test, equation (3) was recalculated with interaction terms for each independent variable to establish whether the relationships changed across the levels of moderating factors (for both groups of dependent variables; children's travel mode to school and back home).

However, these regressions only showed the association between the independent variables and parental decisions about a child's trip to school. It could not show whether or not the contributing variables in children's travel pattern choices are influenced by urban form. Therefore, three more regressions were necessary.

The previous chapter presented that built environment factors influence perceived neighbourhood safety and perceived traffic safety. It also showed that the perceived safety factors impact on parental decisions about the children's mode of travel to and from school. However, it is not clear how much variation in the independent variables may be correlated to the built environment. Boarnet and Crane (2001) suggested using a two-step method; this means that, first, neighbourhood safety and traffic safety were regressed on built environment factors, to investigate the impact of the built environment on neighbourhood safety and traffic safety (using logistic regression).

$$NS+TS = f(UF) \quad (4)$$

The factors of traffic safety and neighbourhood safety that were significant in the model were then used in a second regression to investigate the impact of actual neighbourhood safety and actual traffic safety factors on a child walking to school independently relative to other alternatives (equation 5). The models were recalculated for children's mode of travel back home (equation 6). The equations were the same as equation (1) with the exception that only urban form variables that were significantly related to safety (personal and traffic) were included in the analysis and the rest of variables remained as the original ones.

$$\text{Log}(PB/PA) = \beta 1HTO + \beta 2CP + \beta 3CCHL + \beta 4AP + \beta 5SD + \beta 6SE + \beta 7NSI_1 + \beta 8TSI + \beta 9UF \quad (5)$$

$$\text{Log}(PC/PA) = \beta 1HTO + \beta 2CP + \beta 3CCHL + \beta 4AP + \beta 5SD + \beta 6SE + \beta 7NSI_1 + \beta 8TSI + \beta_9 UF \quad (5)$$

$$\text{Log}(PD/PA) = \beta 1HTO + \beta 2CP + \beta 3CCHL + \beta 4AP + \beta 5SD + \beta 6SE + \beta 7NSI_1 + \beta 8TSI + \beta_9 UF \quad (5)$$

After the initial test, equation (5) was recalculated with interaction terms for each independent variable to establish whether the hypothesized associations changed across levels of moderating factors.

7.6 Results

The series of regression equations used in this chapter supported the results found in chapter 6 – that traffic safety is associated directly with likelihood of a child walking to

and from school independently – however, it is not the only contributing factor and the strength of the relationship is still not completely clear. The findings of the two initial regressions revealed the general relationships of the perceived safety variables, non-urban form variables and dependent variables (children's mode of travel to and from school). The two-way method was used to test the effect of urban form variables on children's walking to school without an adult through traffic safety and neighbourhood safety. Then, the regressions were recalculated with the interaction terms of non-urban form variables to examine the impact of moderating factors on the relationship. Finally, the outcomes were organized based on the different socio-economic groups in the final stage of regression (combined models), which show the different barriers for children in their walking to school across three socio-economic areas.

Neighbourhood safety indexes and traffic safety indexes were regressed on the children's mode of transportation to school while non-urban form variables were included in the model. First, the results of the model to predict the probability of children walking to school over other transportation alternatives are presented. This is followed by the results of the model, which predicts the probability of the children walking back home relative to other transportation alternatives.

7.6.1 Initial regressions

7.6.1.1 Socio-economic and socio-demographic factors (Children's mode of travel to school)

The effect of socio-economic and socio-demographic factors was examined in the models to predict children's mode of transportation to school (Table 7.5). Remarkably, the number of children under 5 years old in a household, and the number of people in a household who hold a driving licence became significant in the model examining the probability of walking with parents relative to children walking on their own.

The presence of younger siblings in a household (especially under 5 years old, UNDER5; p=0.003<0.05) was positively related with children walking to school. This shows that children who have a sibling who is under 5 years old are more likely to walk to school on their own, which is consistent with the findings of other studies (Zhang, 2006). Sending children to school by private car did not fit the parents' schedule (DRIVEFIT; p=0.008<0.05); therefore, children have to walk to school. However, they are more likely to walk with an adult to school (their mother, or somebody their parents know).

In the second model, the number of cars in a household (HOUSHLDCAR; p=0.001<0.05), parents' feeling about children walking to school (PARFEELWAK; p=0.00<0.05) and presence of siblings who are younger than 5 years old (UNDER5; p=0.017<0.05) became significant in increasing the likelihood of being driven by parents relative to children walking to school. Number of cars in a household was negatively related to children walking to school. This revealed that the presence of more than one car in a household decreased the probability of children walking to school, which was anticipated and consistent with other literature (Hine, 2009; K. Pont et al., 2009).

Table 7. 5: Association between non-urban form factors on parental decisions about travel modes of children to school after entering indexes

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	18.367	4.856	14.304	.000
	HOUSHLDCAR	-.029	.607	.002	.962
	[MOTOR=1.00]	.471	.663	.503	.478
	[KIDFEELWAK=.00]	-.462	.497	.866	.352
	[HEALTH=1.00]	-.899	.768	1.371	.242
	[PARFEELWAK=.00]	**1.245**	**.698**	**3.180**	**.075**
	[UNDER5=.00]	**1.683**	**.571**	**8.685**	**.003**
	[KIDGEN=1.00]	**-2.260**	**.562**	**16.174**	**.000**
	[KIDSNU=1.00]	**-1.267**	**.704**	**3.236**	**.072**
	[HOUSINCOM=1.00]	.222	.874	.064	.800
	[HOUSINCOM=2.00]	-.463	.705	.432	.511
	[DADTRVLMOD=1.00]	.047	.570	.007	.935
	[SAFE=1.00]	1.465	.984	2.214	.137

	[TRAF=1.00]	-.778	.542	2.065	.151
	KIDAGE	**-1.178**	**.384**	**9.414**	**.002**
	[DRIVEFIT=1.00]	**-4.399**	**1.661**	**7.015**	**.008**
driven by parents	Intercept	-21.454	5.828	13.552	.000
	HOUSHLDCAR	**2.821**	**.816**	**11.955**	**.001**
	[MOTOR=1.00]	**2.218**	**.871**	**6.478**	**.011**
	KIDFEELWAK=.00]	**-1.186**	**.681**	**3.032**	**.082**
	[HEALTH=1.00]	-.554	.962	.331	.565
	[PARFEELWAK=.00]Table 7.5: Continued	**4.529**	**.878**	**26.601**	**.000**
	[UNDER5=.00]	**2.290**	**.955**	**5.746**	**.017**
	[KIDGEN=1.00]	-1.126	.722	2.432	.119
	[KIDSNU=1.00]	1.030	.868	1.407	.236
	[HOUSINCOM=1.00]	**-2.322**	**1.120**	**4.300**	**.038**
	[HOUSINCOM=2.00]	**-1.711**	**.817**	**4.391**	**.036**
	[DADTRVLMOD=1.00]	**-2.462**	**.827**	**8.854**	**.003**
	[SAFE=1.00]	**19.134**	**.847**	**509.769**	**.000**
	[TRAF=1.00]	**1.449**	**.755**	**3.681**	**.055**
	KIDAGE	-.067	.476	.020	.888
	[DRIVEFIT=1.00]	**-4.084**	**1.850**	**4.876**	**.027**
school bus	Intercept	14.645	5.425	7.287	.007
	HOUSHLDCAR	.891	.718	1.541	.214
	[MOTOR=1.00]	**1.955**	**.817**	**5.722**	**.017**
	[KIDFEELWAK=.00]	.189	.628	.091	.763
	[HEALTH=1.00]	**-1.477**	**.859**	**2.953**	**.086**
	[PARFEELWAK=.00]	**5.746**	**.844**	**46.338**	**.000**
	[UNDER5=.00]	**2.297**	**.758**	**9.193**	**.002**
	[KIDGEN=1.00]	**-2.045**	**.675**	**9.183**	**.002**
	[KIDSNU=1.00]	-.175	.809	.047	.829
	[HOUSINCOM=1.00]	**-4.123**	**1.099**	**14.065**	**.000**
	[HOUSINCOM=2.00]	**-2.161**	**.785**	**7.575**	**.006**
	[DADTRVLMOD=1.00]	-.156	.724	.046	.829
	[SAFE=1.00]	-.633	1.170	.293	.588
	[TRAF=1.00]	.761	.697	1.192	.275
	KIDAGE	**-1.358**	**.453**	**8.997**	**.003**
	[DRIVEFIT=1.00]	**-3.230**	**1.836**	**3.096**	**.078**

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

Parents who never encourage their children to walk to school for any reason (most probably because of the lack of safety) (PARFEELWAK; p=0.00<0.05), decreased the probability of children walking to school. This shows the influence of parental perception on choosing school travel mode for their children after controlling for traffic safety and neighbourhood safety factors (Fyhri & Hjorthol, 2009). Parents declared different reasons for being reluctant to allow their children to walk to school, especially on their own, such as: air pollution and its impact on children's health, heavy school bags that children have to carry while going to school and lack of safety in the neighbourhood. The number of children in a household who are under 5 years old

(UNDER5; p=0.017<0.05) was negatively associated with the probability of children walking to school over being driven by parents. This shows that parents, who have at least one child younger than one, who goes to school, prefer to drive their children to school.

Finally, children's age, number of children who are under 5 years old in a household, number of people in a household who hold a driving licence, parents feeling about children walking to school and average monthly household income became significant in the model comparing the probability of using a school bus relative to children walking to school.

In the third model, the parents' feeling about their children walking to school, number of people who hold a driving licence in a household and the number of children in a household who are under 5 years old in this model, had the same relationship with children walking to school as they had in previous models. The average of monthly household income was negatively related to the probability of children walking to school over using a school bus. This reveals that children from low-income families (HOUSINCOM; p=0.00,0.05) are more likely to walk to school on their own rather than using a school bus that is consistent with previous research (Pont et al., 2009). The result also showed that an increase in children's age (KIDAGE; p=0.003<0.05) increased the likelihood of their walking to school.

These results showed that when controlling for traffic safety, neighbourhood safety and socio-economic and socio-demographic at the same time, none of the variables was significant except children's gender (KIDGEN; p=0.002<0.05). The findings supported that it is necessary to examine the impact of traffic safety and neighbourhood safety for both female and male children.

The other variables kept their previous relationships, as seen in previous regressions (Table 7.5), except that the number of children in a household was no longer significant when controlling for the impact of traffic safety and neighbourhood safety on children walking to school.

7.6.1.2 Socio-economic and socio-demographic factors (Children's mode of travel back home)

The impact of socio-economic and socio-demographic factors on parental decisions about the children's mode of travel back home was examined (Table 7.6). Household income was negatively associated with the likelihood of a child walking back home without an adult. This indicated that when the household income increased the probability of children walking back home decreased. The result is consistent with other studies (Hine, 2009).

The presence of only one person in a household who holds a driving licence (DRIVELIC; p=0.002<0.05) increased the probability of children being driven by their parents over their walking back on their own. Parents who never encouraged their children to walk back home (PARFEELWAK; p=.00<0.05) prefer to drive their children while going back home rather than allowing them to walk back on their own. Children from households with lower monthly income (HOUSINCOM; p=0.011<0.05) are more likely to walk on their own rather than using a school bus to go back home from the school. These findings are statistically significant and consistent with other literature.

Table 7. 6: Association between non-urban form factors on parental decisions about travel modes of children back home after entering indexes

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	1.287	.944	1.859	.173
	[SAFE=1.00]	**-1.585**	**.896**	**3.128**	**.077**
	[PARFEELWAK=.00]	.455	.451	1.016	.313

	[DRIVELIC=1.00]	.299	.431	.482	.488
	[STRANG=1.00]	**.774**	**.406**	**3.633**	**.057**
	[HOUSINCOM=1.00]	-.223	.589	.144	.704
	[HOUSINCOM=2.00]	-.533	.506	1.113	.291
driven by parents	Intercept	-17.968	.964	347.277	.000
	[SAFE=1.00]	**15.904**	**.686**	**537.521**	**.000**
	Table 7.5: Continued				
	[PARFEELWAK=.00]	**3.928**	**.867**	**20.549**	**.000**
	[DRIVELIC=1.00]	**-3.778**	**1.190**	**10.075**	**.002**
	[STRANG=1.00]	-.766	.642	1.426	.232
	[HOUSINCOM=1.00]	.393	1.066	.136	.712
	[HOUSINCOM=2.00]	-.060	.701	.007	.932
school bus	Intercept	1.323	1.223	1.171	.279
	[SAFE=1.00]	**-3.520**	**1.182**	**8.875**	**.003**
	[PARFEELWAK=.00]	**4.691**	**.741**	**40.062**	**.000**
	[DRIVELIC=1.00]	-.746	.549	1.845	.174
	[STRANG=1.00]	.351	.508	.479	.489
	[HOUSINCOM=1.00]	**-2.065**	**.814**	**6.439**	**.011**
	[HOUSINCOM=2.00]	**-1.384**	**.575**	**5.807**	**.016**

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

7.6.1.3 Traffic safety and neighbourhood safety factors (Children's mode of transportation to school)

The current models show that both traffic safety and neighbourhood safety have relationships with the likelihood of a child walking to school independently relative to a child walking to school with an adult, being driven by parents and using a school bus (Table 7.7). The neighbourhood safety index (NSI) (children survey) was associated positively with the probability of a child walking to school on foot without an adult. This indicates that as the value of the indexes increased, the likelihood of walking independently also increased. This result was in an anticipated direction since the higher value on the NSI reflects an increase in safety (perceived personal safety in the neighbourhood) in an area around the school with a ½ kilometre radius from the school main gate. However, the NSI from the parental survey had no effect on children's trip to school. This can be explained in that increasing the number of pedestrians does not

convince parents to allow their children to walk on their own, as they said "I can trust people on the road if they are parents of other children". This result was not anticipated, as other literature showed that an increase in the number of people on the street will increase the perception of safety (Johansson, 2003; Timperio, 2006; Bringolf-Isler et al., 2008)

The traffic safety indexes (TSI) were negatively related to the probability of a child walking to school without an adult, relative to other transportation alternatives. This suggests that as the value of the indexes increased, the likelihood of walking independently decreased. This result was in the expected direction as well, as a higher value on the TSI expresses a very large amount of perceived traffic barriers for children in their walking to school on their own. Generally, the rest of the variables had the same results as in chapter 6. The results of this model show that entering the traffic safety factors changed the impact of the neighbourhood safety factors on children walking to school independently relative to other alternatives.

After adding built environment variables into model equation 2, both TSI and NSI remained significant with their negative and positive association respectively with a slight increase in the magnitude of their coefficients. The relationships between non-urban form variables and children's travel pattern to school were changed.

Those variables in previous models which affected significantly on children's walking to school remained significant except children's gender that does not affect this model at all. People in a household who are holding driving license are increasing the probability of children's walking to school with an adult over their independent walking. Interestingly, children's age and monthly household income only impact the third model. Younger children and those who are from rich family are more likely to use school bus to go to school. The direction of relationship between the rest of non-

urban form variables and children's walking to school was consistent with other literature.

Before examining the influence of built environment factors on choosing travel mode for children, the results of regressing traffic safety and neighbourhood safety on built environment is presented. The following series of regressions explore the direct relationship between traffic safety indexes, neighbourhood safety indexes and built environment factors.

Table 7. 7: Relationship between traffic safety and neighbourhood safety with the likelihood of children walking to school

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	5.984	5.603	1.141	.285
	HOUSHLDCAR	.971	.897	1.172	.279
	[PARFEELWAK=.00]	**4.075**	**1.264**	**10.391**	**.001**
	[DRIVELIC=1.00]	**2.370**	**1.009**	**5.517**	**.019**
	[UNDER5=.00]	**2.511**	**.879**	**8.148**	**.004**
	[KIDSNU=1.00]	-.821	1.196	.471	.492
	[HOUSINCOM=1.00]	-.150	1.469	.010	.919
	[HOUSINCOM=2.00]	.142	1.079	.017	.895
	KIDAGE	-.930	.575	2.613	.106
	[POLICE=.00]	-.617	.881	.490	.484
	[CROSNOZEBRA=1.00]	**-3.184**	**1.197**	**7.074**	**.008**
	[CROSNOPAV=.00]	**-3.020**	**1.512**	**3.989**	**.046**
	[TRAFLAN=.00]	**7.180**	**1.951**	**13.539**	**.000**
	[WALKNOPAV=.00]	**-3.753**	**1.395**	**7.238**	**.007**
driven by parents	Intercept	-12.132	7.147	2.881	.090
	HOUSHLDCAR	**3.858**	**1.069**	**13.035**	**.000**
	[PARFEELWAK=.00]	**7.258**	**1.507**	**23.199**	**.000**
	[DRIVELIC=1.00]	.283	1.294	.048	.827
	[UNDER5=.00]	**2.086**	**1.112**	**3.520**	**.061**
	[KIDSNU=1.00]	.945	1.390	.462	.497
	[HOUSINCOM=1.00]	-.791	1.831	.186	.666
	[HOUSINCOM=2.00]	-.626	1.131	.306	.580
	KIDAGE	.078	.686	.013	.909
	[POLICE=.00]	.913	.991	.847	.357
	[CROSNOZEBRA=1.00]	**-3.214**	**1.304**	**6.078**	**.014**
	[CROSNOPAV=.00]	-2.542	1.604	2.512	.113
	[TRAFLAN=.00]	**6.559**	**2.052**	**10.211**	**.001**
	[WALKNOPAV=.00]	**-4.619**	**1.570**	**8.656**	**.003**
school bus	Intercept	1.465	6.871	.045	.831
	HOUSHLDCAR	1.259	.989	1.619	.203

Table 7.7 : Continued

[PARFEELWAK=.00]	**10.861**	**1.620**	**44.936**	**.000**
[DRIVELIC=1.00]	**2.671**	**1.177**	**5.148**	**.023**
[UNDER5=.00]	**2.461**	**1.056**	**5.428**	**.020**
[KIDSNU=1.00]	1.818	1.365	1.776	.183
[HOUSINCOM=1.00]	**-5.643**	**1.745**	**10.461**	**.001**
[HOUSINCOM=2.00]	-1.618	1.125	2.069	.150
KIDAGE	**-1.174**	**.683**	**2.952**	**.086**
[POLICE=.00]	1.097	.974	1.267	.260
[CROSNOZEBRA=1.00]	**-3.012**	**1.303**	**5.347**	**.021**
[CROSNOPAV=.00]	**-4.009**	**1.617**	**6.150**	**.013**
[TRAFLAN=.00]	**9.337**	**2.031**	**21.136**	**.000**
[WALKNOPAV=.00]	**-3.940**	**1.588**	**6.158**	**.013**

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

The findings show the effect of the built environment factor on traffic safety variables (equation 4) (Table 7.7). The proportion of street segments in the specific area with no pavement (WALKNOPAV; p=0.007<0.05) impact on traffic safety variables. The average of street traffic lanes (TRAFLAN; p=0.00<0.05) in the specific area also impacts on parental perception of traffic safety and increased children's walking to school with an adult over their walking on their own. An increased in street traffic lanes may allow more vehicles to enter the neighbourhood.

Furthermore, wide streets even with painted crosswalks (CROSNOZEBRA; p=0.008<0.05) decreased the probability of children walking to school independently. Interestingly, narrow streets (TRAFLAN; p=0.00<0.05) were negatively associated with the probability of a child walking to school. This means that when the percentage of narrow streets increased in a neighbourhood the likelihood of children walking to school decreased. These findings contrast with the results of previous studies (Clifton & Kreamer-Fults, 2007; Staunton et al., 2003). In narrow streets in Tehran, pavements are totally absent (insufficient width of the street); however, they still allow vehicles to enter, which make them dangerous for pedestrians and especially for children.

The percentage of street segments within ½ kilometre of school with first floor windows facing the street, streetlights and lack of abandoned buildings did not have any impact on increasing the perception of personal safety in the neighbourhood. Increase in block size was also negatively related with children walking due to the impact on the parent's perception of safety in the neighbourhood.

As discussed in the previous chapter, mixed land use was hypothesized as having a positive association with a child's independent trip to school on foot. The result may be due to the impact of other moderator factors or may be regarded as a cultural norm. As parents said "I don't feel comfortable if my daughter wants to buy something from the shops along the route on her way back home from school". They mentioned that young shopkeepers may misbehave; therefore, they do not feel comfortable if their children, especially their female children, want to walk to and from school on their own. This is not consistent with the findings of other studies, which showed that children are likely to visit the retail shops after school hours; therefore, they may have to cross the roads more. The study suggested calming down the traffic in such areas to suit the needs (Dissanayake et al., 2009). This means that the same issues that decreased traffic safety did not improve personal safety.

The presence of first floor windows was hypothesized to have a significant effect on children's school travel pattern. As mentioned in chapter 6, in accordance with the construction regulations, half of all blocks in Tehran have first floor windows facing the street. However, people prefer to cover these windows or not to use clear glass to maintain their privacy, so they cannot observe the streets.

To examine the probability of children walking to school relative to being driven by parents, number of cars in a household and number of people in a household who are holding driving license were not significant any more. In the last model, which

compared the probability of walking to school over using a school bus, number of cars in a household was not significant anymore; however, average monthly household income (HOUSINCOM; r= -5.64, p=0.001<0.05) and age of children (KIDAGE; r= -1.174, p=0.086<0.1) impact negatively on choosing modes of travel for children, which was anticipated.

Several elements of traffic safety were significant in equation (2). The proportion of street segments within ½ kilometre of school with more than four lanes of traffic (TRAFLAN) was negatively related to the likelihood of children walking to school on their own over other transportation modes to school. At the same time, it was positively associated with children being escorted by their parents (p=0.00<0.05) or using motorized modes to school (p=0.001<0.05), especially using a school bus (p=0.00<0.05). The absence of painted crosswalks (from the surveys of both the parents and children) within ½ kilometre of school (CROSNOZEBRA) was negatively associated with the probability of children walking independently over other alternatives. The absence of pavements was also negatively related with the likelihood of a child walking to school on their own. It was positively associated with children walking with an adult or using motorized travel modes (p=0.014<0.05).

The result of these series of regressions provided data regarding the relationships between the independent variables and the probability of children walking to school on their own as well as the impact of the built environment on both variables.

7.6.1.4 Traffic safety and neighbourhood safety factors (Children's mode of transportation back home)

The current models show that both actual and perceived traffic safety factors are related to the likelihood of a child walking back home independently relative to children walking back home with an adult, being driven by parents and using a school bus (Table

7.8). The neighbourhood safety index (NSI) (parental survey and children survey) did not impact on the probability of a child walking back home without an adult. This can be explained in that most children who are being driven by their parents in the morning, walk back home because the school hours do not fit with their parents' work schedule. Therefore, children whose mothers are not housewives are more likely to walk back home from school as well as those who stay very close to the school. It is increasing the number of children who walk back home, thus can convince other parents to allow their children to walk on their own as well (peer pressure), and is consistent with other literature (Timperio et al., 2006; Bringolf-Isler et al., 2008).

Table 7. 8: Relationship between traffic safety and neighbourhood safety with likelihood of children walking back home

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	7.800	3.673	4.511	.034
	HOUSHLDCAR	**-1.208**	**.499**	**5.849**	**.016**
	[KIDFEELWAK=.00]	-.418	.474	.778	.378
	[PARFEELWAK=.00]	**3.574**	**.724**	**24.370**	**.000**
	[DRIVELIC=1.00]	**1.152**	**.575**	**4.011**	**.045**
	[MUMOCUP=1.00]	-.578	.597	.938	.333
	[HOUSINCOM=1.00]	-1.469	.893	2.709	.100
	[HOUSINCOM=2.00]	**-1.533**	**.696**	**4.861**	**.027**
	KIDAGE	**-.637**	**.350**	**3.307**	**.069**
	[CROSNOZEBRA=1.00]	**-1.343**	**.552**	**5.916**	**.015**
	[CROSNOPAV=.00]	**-2.812**	**.958**	**8.610**	**.003**
	[TRAFLAN=.00]	**2.900**	**.810**	**12.804**	**.000**
	[NONTRAFSIGN=.00]	**1.647**	**.793**	**4.313**	**.038**
driven by parents	Intercept	10.394	6.188	2.821	.093
	HOUSHLDCAR	**1.772**	**1.002**	**3.129**	**.077**
	[KIDFEELWAK=.00]	-.720	.941	.585	.444
	[PARFEELWAK=.00]	**8.926**	**1.557**	**32.858**	**.000**
	[DRIVELIC=1.00]	**-2.923**	**1.487**	**3.862**	**.049**
	[MUMOCUP=1.00]	**1.713**	**.954**	**3.225**	**.073**
	[HOUSINCOM=1.00]	.408	1.684	.059	.809
	[HOUSINCOM=2.00]	-.225	1.141	.039	.844
	KIDAGE	**-2.208**	**.618**	**12.751**	**.000**
	[CROSNOZEBRA=1.00]	**-2.620**	**1.005**	**6.797**	**.009**
	[CROSNOPAV=.00]	**-5.922**	**1.709**	**12.000**	**.001**
	[TRAFLAN=.00]	**4.361**	**1.294**	**11.353**	**.001**

Table 7.8: Continued

	[NONTRAFSIGN=.00]	**5.396**	**1.692**	**10.174**	**.001**
school bus	Intercept	13.067	4.881	7.167	.007
	HOUSHLDCAR	-.646	.735	.771	.380
	[KIDFEELWAK=.00]	**1.502**	**.695**	**4.676**	**.031**
	[PARFEELWAK=.00]	**8.698**	**1.131**	**59.136**	**.000**
	[DRIVELIC=1.00]	1.085	.792	1.874	.171
	[MUMOCUP=1.00]	.850	.752	1.276	.259
	[HOUSINCOM=1.00]	**-6.793**	**1.356**	**25.089**	**.000**
	[HOUSINCOM=2.00]	**-3.722**	**.884**	**17.725**	**.000**
	KIDAGE	**-1.793**	**.478**	**14.062**	**.000**
	[CROSNOZEBRA=1.00]	-.463	.709	.426	.514
	[CROSNOPAV=.00]	**-6.348**	**1.537**	**17.057**	**.000**
	[TRAFLAN=.00]	**5.101**	**1.000**	**26.007**	**.000**
	[NONTRAFSIGN=.00]	**4.172**	**1.407**	**8.789**	**.003**

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

The relationships between non-urban form variables and children's travel pattern to school were changed. The traffic safety indexes (TSI) (from the surveys of both the parents and the children) were negatively related to the probability of a child walking back home independently relative to other transportation alternatives. It is suggested, that as the value of the indexes increased, the likelihood of walking independently decreased.

Those variables in previous models that significantly affected children walking to school remained significant. However, variables such as children's age (KIDAGE; p=0.069<0.1), average monthly household income (HOUSINCOM; p=0.027<0.05), and number of people in a household who hold a driving licence (DRIVELIC; p=0.045<0.05) increase the probability of children walking to school with an adult over their independent walking. The direction of relationship between the rest of the non-urban form variables and children walking to school was consistent with other literature.

To examine the probability of children walking to school relative to being driven by parents, the same non-urban form variables relating to children's trip to school with a slight difference in their coefficients. The only difference occurred in the last model, which compared the probability of walking to school over using a school bus, in which mother's occupation (MUMOCUP; p=0.073<0.1) became significant, which was anticipated.

This result was in the expected direction as well, as a higher value on the TSI expresses a very large amount of perceived traffic barriers for children in their walking back home on their own. Three traffic safety factors from the parental TSI influenced the probability of children walking back home on their own over their walking back home with an adult. Lack of painted crosswalks (CROSNOPAV; p=0.003<0.05), decrease in number of lanes of traffic (TRAFLAN; p=0.00<0.05), and absence of stop signs to stop traffic at intersections (NONTRAFSIGN; p=0.038<0.05) increased the probability of children walking back home over their walking with their parents. The absence of crosswalks from the children's survey (CROSNOZEBRA; p=0.015<0.05) also increased the likelihood of walking back home with parents over children walking independently. Generally, the rest of the variables had the same results as in chapter 6. The results of this model show that after entering the traffic safety factors into the model, the neighbourhood safety factors no longer had an impact on children's independent walking back home relative to other alternatives.

7.6.1.5 Built environment factors (Children's mode of transportation to school)

After adding built environment variables into model equation 2, the TSI remained significant with its negative association and with a great increase in the magnitude of the coefficients (Table 7.9). However, some of them replaced other factors, absence of traffic signs at intersections and painted crosswalks (CROSNOPAV; p=0.930>0.1) had

no more impact on the first two models after built environment factors were entered into the model. However, the number of lanes of traffic (TRAFLAN; p=0.006<0.05) remained significant with almost the same magnitude. Other factors from the parental TSI became significant in that model. Children who had to walk along a road that had narrow pavements (<1m) (PAVWIDTH; p=0.049<0.05) were more likely to walk to school with an adult rather walking on their own. The presence of mix land uses in the neighbourhood (MIXU; p=0.013<0.05) increased children walking to school with an adult over their autonomous walking that was unexpected result. However, parents thought young shopkeepers are potential to harass their children especially female children. Children who live in high or moderate density neighbourhoods (DENSITY; p=0.014<0.05); p=0.002<0.05) are more likely to walk to school relative to us school bus. The relationships between non-urban form variables and children's travel pattern to school also were changed. Children who had to cross a road at an intersection that doesn't have a street signal or a stop sign to stop traffic (NONTRAFSIGN; p=0.013<0.05) are more likely to be escorted by an adult to go to school rather walking on their own or with their friends.

Younger children (KIDAGE; p=0.00<0.05) are more likely to be escorted or being driven by their parents or using school bus to go to school. Variables such as average monthly household income (HOUSINCOM; p=0.05<.05), number of children in family (KIDSNU; p=0.003<0.05), gender of children (KIDGEN; p=0.042<0.05), number of children under 5 years old in a household (UNDER5; p=0.00<0.05), number of people who are holding driving license in a household (DRIVELIC; p=0.037<0.05), and education level of parents (EDUPAR; p=0.008<0.05) are associated with predicting the probability of children walking to school with an adult over children independent walking. Female children are more likely to be escorted with their parents to go to school which is consistent with the findings from other research that showed

parents are more concerned about their female children (Cooper et al., 2005). When the average monthly household income is low, children are more likely to walk to school independently over walking with their parents. Parents with higher education level are less likely to allow their children to walk to school autonomously.

Children's perception of lack of traffic safety (MOTOR; p=0.001<0.05) and personal safety in the neighbourhood (POLICE; p=0.021<0.05) also makes parents to escort their children to go to school. Some children fears of motors who ride on pavements instead of on the street, therefore, reluctant to walk to school on their own. Some other children thinks there are not enough police officers in the neighbourhood to defend them if anything happens to them, as such ask their parents to escort them while going to school.

The relationship between variables and probability of using school bus by children over walking to school is almost the same as last model. There are just two differences: children's perception about lack of police officers does not affect the model anymore and second presence of the streets with more than 8 meters width in the neighbourhood (STWIDTH; p=0.00<0.05) makes parents to drive their children rather allowing them to walk to school.

In the third model which compare the likelihood of using school bus by children to go to school over walking to school autonomously, children who lived in denser neighbourhoods (DENSITY; p=0.014<0.05) were more likely to walk to school on their own or with their friends rather using school bus. The average of street width and number of people who are holding driving licence in a household were no longer significant. The rest of variables were associating in choosing modes of travel for children similar to the other models with different in magnitudes of impacts.

Table 7. 9: Influence of built environment factors on predicting the probability of children walking to school

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	30.664	5664.794	.000	.996
	KIDAGE	**-6.034**	**1.688**	**12.780**	**.000**
	[DENSITY=1.00]	31.057	5664.761	.000	.996
	[DENSITY=2.00]	25.599	5664.760	.000	.996
	[MOTOR=1.00]	**9.181**	**2.784**	**10.874**	**.001**
	[POLICE=.00]	**-3.421**	**1.479**	**5.354**	**.021**
	[PARFEELWAK=.00]	.119	1.566	.006	.939
	[NONTRAFSIGN=.00]	**-7.399**	**2.966**	**6.222**	**.013**
	[HOUSINCOM=1.00]	-2.027	2.372	.730	.393
	[HOUSINCOM=2.00]	**-4.783**	**2.458**	**3.787**	**.050**
	[KIDSNU=1.00]	**-6.966**	**2.306**	**9.126**	**.003**
	[KIDGEN=1.00]	**3.514**	**1.730**	**4.127**	**.042**
	[UNDER5=.00]	**10.314**	**2.476**	**17.349**	**.000**
	[EDUPAR=1.00]	**9.484**	**3.594**	**6.963**	**.008**
	[EDUPAR=2.00]	1.855	2.531	.537	.464
	[DRIVELIC=1.00]	**3.645**	**1.743**	**4.370**	**.037**
	[TRAFLAN=.00]	**5.316**	**1.943**	**7.489**	**.006**
	[CROSNOPAV=.00]	.270	3.051	.008	.930
	[PAVWIDTH=1.00]	1.218	2.264	.289	.591
	[PAVWIDTH=2.00]	1.257	2.240	.315	.575
	[PAVWIDTH=3.00]	**5.648**	**2.870**	**3.873**	**.049**
	[MIXU=.00]	**-5.430**	**2.190**	**6.145**	**.013**
	HOUSHLDCAR	-.614	1.347	.208	.649
	[STWIDTH=1.00]	-7.628	14.502	.277	.599
	[STWIDTH=2.00]	-3.819	14.124	.073	.787
	[STWIDTH=3.00]	-7.794	14.264	.299	.585
	[STWIDTH=4.00]	-8.114	14.094	.331	.565
driven by parents	Intercept	-15.352	8798.162	.000	.999
	KIDAGE	**-3.461**	**1.710**	**4.100**	**.043**
	[DENSITY=1.00]	19.189	8798.145	.000	.998
	[DENSITY=2.00]	7.953	8798.145	.000	.999
	[MOTOR=1.00]	**10.278**	**3.174**	**10.485**	**.001**
	[POLICE=.00]	-.463	1.871	.061	.804
	[PARFEELWAK=.00]	**9.559**	**2.636**	**13.154**	**.000**
	[NONTRAFSIGN=.00]	**-8.121**	**3.335**	**5.929**	**.015**
	[HOUSINCOM=1.00]	**-9.079**	**4.027**	**5.083**	**.024**
	[HOUSINCOM=2.00]	**-9.080**	**3.296**	**7.588**	**.006**
	[KIDSNU=1.00]	**-5.639**	**2.374**	**5.641**	**.018**
	[KIDGEN=1.00]	**6.405**	**2.244**	**8.144**	**.004**
	[UNDER5=.00]	**13.444**	**3.279**	**16.809**	**.000**
	[EDUPAR=1.00]	**-10.273**	**4.314**	**5.670**	**.017**
	[EDUPAR=2.00]	**-9.700**	**3.456**	**7.879**	**.005**
	[DRIVELIC=1.00]	-1.588	2.225	.509	.475
	[TRAFLAN=.00]	**4.156**	**2.297**	**3.275**	**.070**
	[CROSNOPAV=.00]	-1.695	3.058	.307	.579

Table 7.9: Continued

	[PAVWIDTH=1.00]	**-8.640**	**3.989**	**4.691**	**.030**
	[PAVWIDTH=2.00]	1.694	3.758	.203	.652
	[PAVWIDTH=3.00]	**8.070**	**3.975**	**4.122**	**.042**
	[MIXU=.00]	**-4.429**	**2.488**	**3.168**	**.075**
	HOUSHLDCAR	**10.820**	**2.679**	**16.311**	**.000**
	[STWIDTH=1.00]	5.483	3.639	2.271	.132
	[STWIDTH=2.00]	**16.007**	**1.910**	**70.205**	**.000**
	STWIDTH=4.00]	-14.622	6649.743	.000	.998
school bus	Intercept	101.167	27.901	13.148	.000
	KIDAGE	**-9.231**	**2.203**	**17.557**	**.000**
	[DENSITY=1.00]	**-12.801**	**5.202**	**6.056**	**.014**
	[DENSITY=2.00]	**-16.875**	**5.574**	**9.165**	**.002**
	[MOTOR=1.00]	**8.353**	**3.075**	**7.380**	**.007**
	[POLICE=.00]	**4.177**	**2.337**	**3.196**	**.074**
	[PARFEELWAK=.00]	**19.019**	**3.703**	**26.377**	**.000**
	[NONTRAFSIGN=.00]	2.891	3.656	.625	.429
	[HOUSINCOM=1.00]	**-19.278**	**3.823**	**25.424**	**.000**
	[HOUSINCOM=2.00]	**-11.619**	**3.157**	**13.546**	**.000**
	[KIDSNU=1.00]	1.296	2.250	.332	.565
	[KIDGEN=1.00]	**5.243**	**2.136**	**6.026**	**.014**
	[UNDER5=.00]	**12.194**	**2.896**	**17.734**	**.000**
	[EDUPAR=1.00]	**-17.579**	**4.890**	**12.922**	**.000**
	[EDUPAR=2.00]	**-20.120**	**4.607**	**19.071**	**.000**
	[DRIVELIC=1.00]	3.299	2.130	2.400	.121
	[TRAFLAN=.00]	**10.674**	**2.363**	**20.405**	**.000**
	[CROSNOPAV=.00]	**-11.263**	**4.129**	**7.440**	**.006**
	[PAVWIDTH=1.00]	**-10.136**	**3.763**	**7.254**	**.007**
	[PAVWIDTH=2.00]	.354	2.699	.017	.896
	[PAVWIDTH=3.00]	1.792	2.805	.408	.523
	[MIXU=.00]	**-5.285**	**2.647**	**3.987**	**.046**
	HOUSHLDCAR	2.277	2.008	1.286	.257
	[STWIDTH=1.00]	-40.047	2716.721	.000	.988
	[STWIDTH=2.00]	1.305	14.151	.009	.927
	[STWIDTH=3.00]	1.240	14.205	.008	.930
	[STWIDTH=4.00]	-7.240	14.249	.258	.611

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

The direction of relationship between these non-urban form variables and children's walking to school are consistent with other literature. Other studies also showed that the most popular economic variables that have an impact on parental decisions about the children's mode of transportation to and from school are household car ownership and household average monthly income (Pont et al., 2009; Hine, 2009).

Influential factors on choosing travel mode of school for children are different on their trip back home (Table 7.10).

Table 7. 10: Influence of built environment factors on predicting the probability of children walking back home

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	27.139	7.940	11.683	.001
	BKLENGHT	**-.039**	**.009**	**20.295**	**.000**
	KIDAGE	-.825	.537	2.356	.125
	[NOPAV=.00]	-1.453	1.229	1.397	.237
	[STPAV=.00]	**3.190**	**.992**	**10.331**	**.001**
	[MOTOR=1.00]	**3.560**	**1.362**	**6.828**	**.009**
	[PARFEELWAK=.00]	**2.874**	**1.264**	**5.165**	**.023**
	[NONTRAFSIGN=.00]	.825	1.111	.552	.458
	[DADTRVLMOD=1.00]	**-4.685**	**1.165**	**16.162**	**.000**
	[HOUSINCOM=1.00]	**-5.697**	**1.531**	**13.846**	**.000**
	[HOUSINCOM=2.00]	**-4.176**	**1.213**	**11.844**	**.001**
	[DRIVELIC=1.00]	1.437	.965	2.215	.137
	[TRAFLAN=.00]	**2.736**	**1.496**	**3.344**	**.067**
	[CROSNOPAV=.00]	-1.313	1.319	.991	.319
	[TRAFKMH=.00]	**-4.774**	**1.529**	**9.749**	**.002**
	[HEALTH=1.00]	**3.371**	**1.314**	**6.580**	**.010**
	HOUSHLDCAR	**-7.380**	**1.591**	**21.524**	**.000**
school bus	Intercept	14.507	12.520	1.343	.247
	BKLENGHT	**.022**	**.009**	**6.156**	**.013**
	KIDAGE	**-5.143**	**1.247**	**16.996**	**.000**
	[NOPAV=.00]	2.850	4.116	.480	.489
	[STPAV=.00]	-.294	1.473	.040	.842
	[MOTOR=1.00]	**4.742**	**1.859**	**6.506**	**.011**
	[PARFEELWAK=.00]	**21.388**	**4.633**	**21.314**	**.000**
	[NONTRAFSIGN=.00]	**10.148**	**4.006**	**6.417**	**.011**
	[DADTRVLMOD=1.00]	**5.591**	**2.856**	**3.832**	**.050**
	[HOUSINCOM=1.00]	**-12.004**	**2.805**	**18.309**	**.000**
	[HOUSINCOM=2.00]	**-7.871**	**2.007**	**15.382**	**.000**
	[DRIVELIC=1.00]	**-2.823**	**1.567**	**3.245**	**.072**
	[TRAFLAN=.00]	**12.433**	**2.788**	**19.888**	**.000**
	[CROSNOPAV=.00]	**-11.659**	**3.891**	**8.977**	**.003**
	[TRAFKMH=.00]	**-8.428**	**2.950**	**8.163**	**.004**
	[HEALTH=1.00]	**7.858**	**2.519**	**9.728**	**.002**
	HOUSHLDCAR	**4.903**	**2.820**	**3.024**	**.082**

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

Parents who thought that walking to and from school is good for their children's health (HEALTH; p=0.010<0.05), will most probably accompany their children while walking back home rather than let them walk on their own (Banister, 2008). This can be explained as they said they think it is good for their health as well and want to take this opportunity. Parents who believed the neighbourhood was not safe enough (PARFEELWAK; p=0.023<0.05); never encouraged their children to walk back home, were also more likely to accompany them while walking back home relative to allowing their children to walk on their own (Panter & Jones, 2008). Children who were scared of motorcycles that ride on the pavements instead of the road (MOTOR; p=0.009<0.05) were also more likely to walk back home with an adult relative to walking on their own.

Only two traffic safety factors impact significantly on predicting the probability of children walking back home with an adult over their walking back home on their own. An increase in block length (BKLENGHT; p=0.00<.05) will decrease the likelihood of the children walking back home with an adult. This is explained in that an increase in block length will decrease the intersections.

To examine the probability of children using a school bus to go back home over their walking back home on their own, a few non-urban form variables had an impact on children's trip to school. An increase in the children's age (KIDAGE; p=0.00 <0.05) decreased the children's use of a school bus when going back home. Other studies also showed that age is the most important factor for parents when choosing the modes of travel for their children to go school (Timperio et al., 2006; Fyhri & Hjorthol, 2009). Children from households with higher average monthly income (HOUSINCOM; p=0.050<0.05) are more likely to use a school bus back home over walking on their own. An increase in the number of cars in a household (HOUSHLDCAR; p=0.08<0.1) also made parents send their children back home by school bus over allowing them to

walk back home independently. This showed that the number of cars in a household is related to household income, thus, more cars in a household means the richer the family. Therefore, parents could afford to send their children back home by school bus. When there is only one person in a household who holds a driving licence (DRIVELIC; p=0.072<0.05), it decreased the probability of using a school bus by children when going back home. This also showed the relation between holding a driving licence, number of cars in a household and household monthly income. Most probably, when there is only one car in a household, only one person holds a driving licence.

Children who were scared of motorcycles that ride on the pavements (MOTOR; p=0.011<0.05), parents who never encouraged their children to walk to and from school for safety reasons (PARFEELWAK; p=0.00<0.05), and parents who thought walking is good for children's health (HEALTH; p=0.002<0.05) had the same impact and direction of association on predicting the probability of using a school bus over children walking back home on their own. Fathers' mode of travel to work (DADTRVLMOD; p=0.050<0.05) also impacted on the model. Children whose fathers walked to their work or used public transportation were more likely to use a school bus when going back home.

In this model NSI did not have any impact on the likelihood of using a school bus by children over their walking back home on their own. However, the TSI from the parent's survey were influential in the model. The proportion of street segments within ½ kilometre of school with no pavements (CROSNOPAV; p=0.003<0.05) increased, children going back home by school bus over their walking back home independently also increased. When children did not have to cross a road with more than 4 lanes of traffic (TRAFLAN; p=0.00<0.05) they were more likely to go back home by school bus relative to walking back home on their own. As parents said "it is easier for them to

arrange the same mode of transportation for their children to come back home when they send them to school by school bus".

An increase in block length (BKLENGHT; p=0.013<0.05) increased the number of children using a school bus while going back home. A lack of stop signs to stop traffic at intersections (NONTRAFSIGN; p=0.011,0.05) , lack of painted crosswalks (CROSNOPAV; p=0.003<0.05) and presence of roads that had traffic moving at more than 30 km/hr (TRAFKMH; p=0.004<0.05) increased the probability of choosing a school bus over walking back home independently. None of the built environment factors had a significant impact on this model, which showed that the parental perception of traffic safety is more important than actual safety in choosing motorized modes of travel over walking (Yeung et al., 2008).

7.7 The relationship between built environment factors and environmental safety factors

7.7.1 Neighbourhood safety indexes

Urban form was regressed on neighbourhood safety indexes. The result shows that the neighbourhood safety variables are influenced by built environment variables, and nearly 35% of the variation in NSI can be explained by urban form factors. This means that several built environment variables are related to the NSI, although not always in the expected direction (Table 7.11).

Table 7.11: the effects of built environment factors on neighbourhood safety factors

Independent variables	undesirable person	shops	moreppl	kidabduc	police	Child preference to walk	Parents encourage their child
	Significance						
STPAVONE	0.735	0.814	**0.008(-)**	0.373	0.576	0.157	0.761
NOPAV	**0.055(-)**	0.586	**0.019(-)**	**0.037(+)**	0.377	0.435	0.164
NOSEPPAV	**0.551(+)**	0.852	0.796	0.713	**0.011(-)**	0.51	**0.001(+)**
PARK	0.639	**0.044(+)**	0.312	0.346	0.159	0.623	0.958
NOABBLD	0.653	0.9	0.331	0.48	0.49	0.731	0.115
DENSITY	0.907	0.216	0.231	0.619	0.368	0.628	**0.001(-)**

Table 7.11 , continued							
TRFLANE	0.726	0.147	0.123	0.831	**0.085(+)**	**0.051(+)**	0.195
STWIDTH	0.371	0.732	**0.083(-)**	0.392	0.524	0.786	0.831
BKLENGHT	0.488	**0.031(-)**	**0.083(-)**	0.349	0.132	0.154	0.595
PAVWIDTH	0.163	0.557	0.734	0.805	0.124	0.101	0.823
MIXU	0.345	**0.001(+)**	**0.008(+)**	0.827	0.958	0.693	0.456

Note: presence of 50% blocks with first floor windows facing the street did not have any influence on parental and children's perception of safety; presence of more pedestrian (adult or children) on the street also did not relate to built environment factors and were all excluded from the table. (-)(+) shows the direction of the relationship between independent variables and perceived safety. $p<0.05$: significant, $0.1>p>0.05$ modest relationship

The percentage of blocks within ½ kilometres of school with first floor windows facing the street was not significantly related to NSI. Streetlights do not have any influence on parent's perception of safety in the neighbourhood. However, it did have an influence on children's perception of traffic safety. This result is the opposite of findings of the studies on crime safety (Jacobs, 1961; Johansson, 2003). The percentage of blocks with mixed land use within ½ kilometres of school was not significantly associated with NSI. However, generally, it promoted walking in the neighbourhood because of providing shorter distances to facilities, which was an

anticipated finding (parents confirmed the result as well) Van Dyck et al. (2009) also found the same thing in their studies, which examined the walk ability of the neighbourhood based on objective attributes.

The average block length (BKLENGHT; r=-0.083) of those blocks within the specific area was negatively associated with the NSI, as was expected. The average street width (STWIDTH; r=-0.083) was also negatively related to NSI in local streets, which was also predicted. Leden et al. (2006) found that visibility is very important to children below 12 years old; therefore, it is vital to decrease the number of directions that vehicles can approach from (decrease the lanes of traffic). The proportion of blocks with complete pavement networks was negatively associated with neighbourhood safety indexes, which was not predicted (Beck & Greenspan, 2008). This happened because

only main streets have complete pavement networks on both sides, and because the lack of traffic safety less people would like to walk on local streets.

The result of equation (4) indicates that those variables of NSI that were influenced by the built environment were significantly related with the likelihood of a child walking to and from school. This shows that neighbourhood safety is an effective factor on a child's school travel pattern. It has a high significant result in equation (1) and (2) and strong explanatory power. Although some NSI variables showed results that were contrary to the findings of other studies, these results were anticipated.

7.7.2 Traffic safety indexes

Using equation (3) the built environment was regressed on traffic safety independent variables. More than 50% of the changes in traffic safety are influenced by the built environment and several of the variables were associated with the index (Table 7.12).

Table 7.12: The effects of built environment factors on traffic safety factors

Independent variables	trflan	notrfsign	crosnopav	walknopav	trafkhm	drivcare	walknosep
	Significance						
STPAVONE	**0.056(-)**	**0.088(-)**	**0.018(-)**	**0(-)**	0.441	0.193	**0.081(-)**
NOPAV	**0.031(-)**	**0.005(-)**	**0.002(-)**	**0(-)**	**0(-)**	0.242	0.751
NOSEPPAV	0.344	0.307	0.461	0.162	0.11	0.394	**0.075(-)**
PARK	0.232	0.243	0.258	0.417	**0.001(-)**	0.578	0.838
NOABBLD	0.194	0.256	0.576	0.205	0.225	0.973	0.833
DENSITY	0.581	0.511	0.301	0.457	**0.048(-)**	0.257	0.442
TRFLANE	**0.003(-)**	0.399	0.399	0.487	**0.001(-)**	0.417	0.247
STWIDTH	0.148	0.982	0.543	**0.095(-)**	0.649	0.382	0.163
BKLENGHT	0.124	0.252	0.295	0.86	**0.058(-)**	0.766	**0.078(+)**
PAVWIDTH	0.39	**0.064(-)**	0.122	0.182	0.347	0.499	0.114
MIXU	0.104	0.605	0.269	**0.06(+)**	0.267	**0.02(-)**	0.119

Table 7.12: continued

Independent variables	walknrowpav	highspeedcar	crosnozebra	child preference to walk	envpedfrdly	motor
	Significance					
STPAVONE NOPAV	0.151	0.542	**0.003(-)**	0.157	**0.045(+)**	0.866
	0.995	0.466	**0.09(-)**	0.435	0.248	0.132

Table 7.12 Continued						
NOSEPPAV	**0.021(-)**	0.514	0.743	0.51	0.571	0.957
PARK	0.14	**0.003(+)**	0.331	0.623	0.991	0.147
WIN		**0.016(-)**	**0.092(-)**	0.754		0.145
NOABBLD	0.588	0.211	0.354	0.731	0.644	0.475
DENSITY	0.391	0.424	0.315	0.628	0.21	0.325
TRFLANE	0.61	0.245	0.685	**0.051(+)**	0.134	0.758
STWIDTH	0.115	0.425	0.885	0.786	0.622	0.699
BKLENGHT	0.192	**0.034(-)**	0.608	0.154	0.51	**0.066(-)**
PAVWIDTH	0.143	0.587	0.195	0.101	0.419	0.235
MIXU	**0.022(-)**	0.766	0.843	0.693	0.715	0.762

Note: (-)(+) shows the direction of the relationship between independent variables and perceived safety.
Note: presence of 50% blocks with first floor windows facing the street did not have any influence on parental and children's perception of safety; and was excluded from the table. (-)(+) shows the direction of the relationship between independent variables and perceived safety. $p<0.05$: significant, $0.1>p>0.05$ modest relationship

The percentage of blocks within ½ kilometres of school with first floor windows facing the street (WIN) do not have any association with the parents' perception of traffic safety. However, the presence of first floor windows facing the street (WIN; r=-0.092) affected the children's perception of traffic safety. This is explained in that children notice the first floor windows facing the streets mostly on local streets, which are narrower and there is no pavement there or with insufficient width. In fact, the impact of this variable is not direct. Streetlights do not have any influence on the perception of traffic safety, which is consistent with the findings of other studies that showed that this variable increased the perception of personal safety (Johansson, 2003).

The proportion of blocks within a specific area with speed bumps showed a significant association with the traffic safety index, which was anticipated, because the presence of speed bumps causes drivers to slow down and increase the level of comfort about traffic safety (Leden et al., 2006). The percentage of blocks within ½ kilometres of school with mixed land use (MIXU; r=+0.06) was positively associated with the perception of traffic safety. The result was predicted, as the literature showed that the presence of mixed land use makes the neighbourhood more pedestrian friendly

(provides shorter distance to facilities). However, the areas with mixed land use attract more cars as well. Studies showed that residential areas are safer for children due to the level of traffic flow (Dissananyake et al., 2009).

Other urban form variables such as neighbourhood density (DENSITY; r=-0.048) are negatively related to the traffic safety index, which means that denser neighbourhoods cause drivers to slow down and decrease traffic safety concerns. The result is consistent with other studies (Boarnet & Crane, 2001; Bringolf-Isler et al., 2008).

The average of the block length on street segments within ½ kilometres of school was positively related to TSI, the result was predicted. Shorter block lengths provide more crossings and decrease the perception of safety regarding traffic. The percentage of blocks within the specific area with a complete pavement network was significantly related to TSI. This was consistent with other studies that showed that providing pavements promotes more walking and decreases the concern about traffic safety. The result shows that pavement width, and if they were present on both sides for the entire road, is more important and is positively associated with the traffic safety index (Beck & Greenspan, 2008).

The results from equation (4) show that some parts of the TSI are influenced by the built environment; however, not all of them were associated with a child walking to school independently. Unlike the NSI result, the built environment variables had quite a high explanatory power for the TSI. Several variables were significant and were in the expected directions, although the coefficients were rather small. Since the TSI was significant in the initial regressions, we can conclude that the part of the TSI that is not influenced by the built environment elements is the most important part of the TSI

impacting the likelihood of a child walking to school and that it varies when they are escorted by an adult (Table 7.9).

The rest of the variables preserved the relationships seen in the results of the earlier regressions (Table 7.4) except children's gender and the number of children in a household, which had no effect on TSI. Children's age remained with its high significant impact in the TSI model in predicting the probability of using a school bus over walking to school independently (Table 7.10).

7.8 Interactions

The regression equations including interaction variables show that there are some differences in the effect of the safety factors (those influenced by the built environment) on a child walking to school without an adult over other transportation alternatives (walking with adult, being driven by parent, taking school bus) when socio-economic and socio-demographic factors are interacting with them.

Using equation (5), the children's transportation to school was regressed on the safety variables in equation (4) while moderating factors were in interaction terms. The results suggest that when the interaction terms were entered into the equation, the part of the NSI and TSI, which is explained by urban form factors, is still significant (Table 7.13). The number of people in a household who hold a driving licence had no effect on children's travel pattern to school when they were in interaction terms.

The number of children in a household who are under 5 years old was negatively associating with the likelihood of a child walking to school. Interestingly, the association between the factors of the NSI that were influenced by the built environment and travel pattern were not changed by the father's mode of travel to their work and the number of children in a household. However, the magnitude of impact of

TSI factors that were influenced by built environment on children's trip to school were changed by the number of children in a household.

The average of the monthly household income had no effect on the relationship between environmental safety factors and choosing motorized modes relative to children walking to school. However, it changed the relationship between the TSI and also the built environment factors with the likelihood of children walking with an adult relative to children walking on their own. There was also interaction between the part of the TSI influenced by the built environment and mother's occupation or household income, however, these factors at interaction terms changed the magnitude of effect of only one TSI factor (width of pavement). The relationship between the TSI items influenced by the built environment and children walking to school was modified by the children's age. This suggests that the perception of the parents and children of traffic safety affected by the built environment impact on the choice of school travel mode based on children's age.

Children's gender also changed the relationship between the independent and dependent variables. This suggests that the perception of the parents and children of neighbourhood safety and traffic safety affect the decision about walking to school independently at different levels of parental attitude and preferences, number of children under 5 in a household, children's age and gender, mothers' occupation, education level of parents, number of cars in a household, and the average monthly household income.

Furthermore, the regression equations, including the interaction variables, show that there are some differences in the effect of the safety factors (those influenced by the built environment) on a child walking back home without an adult over other transportation alternatives when socio-economic and socio-demographic factors are

interacting with them. Only the socio-economic and socio-demographic factors that had a significant impact on the previous models were included in the interaction terms.

Table 7.13: Regression with interaction variables to establish the effect of TSI and NSI factors on the probability of children's walking to school

			x KIDGEN	x KIDAGE	x UNDER5	x KIDSNU
		B	B	B	B	B
walking with an adult	[MOTOR=1.00]	**9.181**	-0.305	-0.688		-0.709
	[POLICE=.00]	**-3.421**	0.564	0.394		0.446
	[TRAFLAN=.00]	**5.316**	0.857	1.064	0.703	1.286
	[PAVWIDTH=3.00]	**5.648**	1.408	1.529	1.159	0.489
driven by parents	[MOTOR=1.00]	**10.278**	0.707	0.57		0.315
	[TRAFLAN=.00]	**4.156**	1.791	2.043	1.548	1.829
	[PAVWIDTH=1.00]	**-8.64**	-4.602	-5.757	-3.924	-4.771
	[PAVWIDTH=3.00]	**8.07**	0.464	-0.332	1.01	0.914
	[STWIDTH=2.00]	**16.007**	-1.773	2.508	20.096	2.696
school bus	[MOTOR=1.00]	**8.353**	1.591	1.404		1.515
	[POLICE=.00]	**4.177**	2.273	1.79		2.127
	[TRAFLAN=.00]	**10.674**	2.964	3.047	2.913	3.277
	[PAVWIDTH=1.00]	**-10.13**	-0.624	-0.345	-0.895	-10.136

			x MUMOCUP	x PAREDU	x CAR	x INCOME
		B	B	B	B	B
walking with an adult	[MOTOR=1.00]	**9.181**	-0.708			
	[POLICE=.00]	**-3.421**	0.74	0.756	0.225	0.444
	[TRAFLAN=.00]	**5.316**	1.336		1.574	1.114
	[PAVWIDTH=3.00]	**5.648**	1.344	1.687	1.003	1.683
driven by parents	[MOTOR=1.00]	**10.278**	0.435			
	[TRAFLAN=.00]	**4.156**	1.992	1.911	1.619	1.719
	[PAVWIDTH=1.00]	**-8.64**	-4.538	-4.672	-4.529	-4.866
	[PAVWIDTH=3.00]	**8.07**	1.034	0.782	1.108	1.083
	[STWIDTH=2.00]	**16.007**	2.779	2.565	2.588	2.415
school bus	[MOTOR=1.00]	**8.353**	1.301			
	[POLICE=.00]	**4.177**	2.133	1.806	1.682	2.144
	[TRAFLAN=.00]	**10.674**	3.319	3.802	3.187	3.691
	[PAVWIDTH=1.00]	**-10.13**	-233	-0.398	-0.475	-0.414

*Note: the bolded column shows the B before entering interaction variables.

The presence of only one person in a household who holds a driving licence changed the relationship between the TSI factors and the probability of children walking back home with an adult over their independent walking. After putting this

factor in interaction terms, the presence of streets with more than 4 lanes of traffic was no longer significant in the model. The presence of streets with traffic moving at more than 30 km/hr also no longer had any effect on the model.

The presence of only one person in a household who holds a driving licence changed the relationship between TSI factors and the probability of children using a school bus to go back home over their independent walking. After putting this factor in interaction terms, the presence of streets with more than 4 lanes of traffic still remained significant in the model. The presence of streets that have traffic moving at more than 30 km/hr also no longer had any effect on the model. In other words, this variable in interaction terms can change the perception of traffic safety, as decrease or increase the transportation alternatives in a household.

After putting a father's mode of travel to work in interaction terms, children who did not have to cross roads with more than 4 lanes of traffic were more likely to walk with an adult back home or use a school bus to go back home over walking on their own. This showed that there were other influential factors in choosing the mode of travel for children to go back home. Father's who walked or used public transportation to go to their work were less likely to walk back home with their children, because they are at work. Therefore, they have to arrange transportation for their children to go back home. The absence of pavements or insufficient width of pavements was more important to them in not allowing their children to walk back home on their own.

This suggests that parent's and children's perception of neighbourhood safety and traffic safety affect the decision about walking back home independently at different levels of parental attitude and preferences, children's age, the average monthly household income, fathers' mode of travel to go to work, household car ownership, and number of persons in a household who hold a driving licence.

Table 7.14: Regression with interaction variables to establish the effect of TSI and NSI factors on the probability of children's walking back home

			x CAR	x INCOME	x MUMOCUP	x KIDAGE
		B	B	B	B	B
walking with an adult	**BKLENGHT**	**-0.039**	-0.009	-0.004	-0.005	-0.005
	[STPAV=.00]	**3.19**	20.799		20.731	19.174
	[MOTOR=1.00]	**3.56**	0.018	-0.57	-0.568	-0.407
	[TRAFLAN=.00]	**2.736**	0.7	-0.213	-0.024	-0.191
	[TRAFKMH=.00]	**-4.774**	-1.646	-0.716	-1.114	
school bus	**BKLENGHT**	**0.022**	0.007	0.11	0.005	0.005
	[MOTOR=1.00]	**4.742**	1.576	0.986	1.434	1.541
	[TRAFLAN=.00]	**12.433**	2.338	2.988	1.861	1.964
	[CROSNOPAV=.0	**-11.659**	-1.327			-2.283
	[TRAFKMH=.00]	**-8.428**		-3.804	-2.571	

			x DADTRL	x DRIVELIC	x PARFEEL
		B			
walking with an adult	**BKLENGHT**	**-0.039**	-0.005	-0.005	-0.004
	[STPAV=.00]	**3.19**	4.783	3.436	4.206
	[MOTOR=1.00]	**3.56**	-0.517	-0.482	-0.438
	[TRAFLAN=.00]	**2.736**	0.027	-0.589	0.117
	[TRAFKMH=.00]	**-4.774**	-0.994	-0.461	-0.896
school bus	**BKLENGHT**	**0.022**	0.002		0.004
	[MOTOR=1.00]	**4.742**	1.179	1.13	0.912
	[TRAFLAN=.00]	**12.433**	0.903	0.486	2.19
	[CROSNOPAV=.0 0]	**-11.659**	-1.078	-0.622	-1.328
	[TRAFKMH=.00]	**-8.428**	-1.068	-0.855	-1.564

*Note: the bolded column shows the B before entering interaction variables

7.9 Comparing the environmental barriers for children in their walking to and from school

Previous regression showed the different barriers for children walking to school in Tehran without considering the socio-economic status of areas. However, other studies conducted on children's transportation to school, revealed there are some differences between a child's mode of travel to school across different socio-economic status areas (Dissanayake et al., 2009; De Vasconcellos, 2004). This study focused on exploring environmental barriers; therefore, only traffic safety factors that negatively impacted on the probability of a child walking independently to and from school and the

neighbourhood safety factors that positively affected the likelihood of a child's autonomous walking to and from school were compared across income groups. The results are illustrated in Table 7.15.

Table 7. 15: ANOVA test shows the initial difference between barriers across income groups.

		Sum of Squares	Mean Square	F	Sig.
Cross a road with more than 4 lanes of traffic	**Between Groups**	**10.880**	**5.440**	**28.18**	**.000**
Cross a road at an intersection that doesn't have a street signal or a stop sign to stop traffic	**Between Groups**	**1.357**	**.678**	**2.728**	**.066**
Cross a road without a painted crosswalk	Between Groups	.568	.284	1.142	.320
Walk along the road that have traffic going more than 30kh/hr.	Between Groups	.773	.387	2.147	.118
Parents encourage children to walk to school	**Between Groups**	**4.399**	**2.200**	**9.411**	**.000**
elements children like to be changed, existence of police officer	**Between Groups**	**11.717**	**5.859**	**27.75**	**.000**
Elements which child doesn't like to see on their way to school or they scare of them, traffic jam	**Between Groups**	**2.018**	**1.009**	**5.043**	**.007**
Elements which child doesn't like to see on their way to school or they scare of them, motorcycle	**Between Groups**	**3.760**	**1.880**	**11.63**	**.000**
Pavement is present for entire road (both side)	**Between Groups**	**10.368**	**5.184**	**23.85**	**.000**
density of the school immediate neighbourhood	**Between Groups**	**67.786**	**33.893**	**170.1**	**.000**
street length in meter	Between Groups	994.761	497.381	.062	.940
pavement width in meter	**Between Groups**	**75.913**	**37.957**	**52.72**	**.000**
street width in meter	**Between Groups**	**52.135**	**26.068**	**29.88**	**.000**
Mix land use are present	**Between Groups**	**20.012**	**10.006**	**59.36**	**.000**

The ANOVA test was used to show the initial difference of barriers across income groups. The result of the ANOVA test showed that parental concerns about their children crossing the roads when there are no painted crosswalks and children walking along roads that have traffic moving at more than 30km/hr do not vary across different socio-economic status areas. Furthermore, the effect of block length on children's trip to school does not vary across different income groups. The rest of the built environment

factors and the perception of parents and children of neighbourhood safety and traffic safety vary across different areas.

To obtain a more accurate image of these differences across different income groups, the Scheffe test was used (Table 7.16). The result of the Post Hoc tests (Scheffe) showed how the aforementioned variables vary across three socio-economic status areas with multiple comparisons. It revealed that parental concerns about traffic safety (children crossing a road that does not have any street signal or stop sign) and parents' preference in choosing other transportation alternatives relative to children walking to school on their own did not vary between high-income areas and middle-income areas. Children's perception about traffic safety (fear of having a car accident) does not vary between high-income areas and low-income areas as well as between middle-income areas and low-income areas. Finally, the presence of mixed land use does not vary between middle-income and low-income areas. The other environmental variables vary across three income groups.

Table 7. 16; Scheffe test, provide multiple comparison across areas

Dependent Variable		(J) Areas in Tehran	Mean Difference (I-J)	Std. Error	Sig.
Cross a road with more than 4 lanes of traffic	**High income area**	**Middle income area**	**.17145**	**.06543**	**.033**
		Low income area	**-.20208**	**.05421**	**.001**
	Middle income area	**High income area**	**-.17145**	**.06543**	**.033**
		Low income area	**-.37352**	**.05176**	**.000**
	Low income area	**High income area**	**.20208**	**.05421**	**.001**
		Middle income area	**.37352**	**.05176**	**.000**
Cross a road at an intersection that doesn't have a street signal or a stop sign to stop traffic	**High income area**	Middle income area	.10000	.07391	.401
		Low income area	**.14325**	**.06153**	**.068**
	Middle income area	High income area	-.10000	.07391	.401
		Low income area	.04325	.05829	.759
	Low income area	**High income area**	**-.14325**	**.06153**	**.068**

Table 7.16; Continued		Middle income area	-.04325	.05829	.759
Cross a road without a painted crosswalk	High income area	Middle income area	.10864	.07392	.340
		Low income area	.04152	.06154	.797
	Middle income area	High income area	-.10864	.07392	.340
		Low income area	-.06712	.05830	.516
	Low income area	High income area	-.04152	.06154	.797
		Middle income area	.06712	.05830	.516
Walk along the road that have traffic going more than 30kh/hr.	High income area	Middle income area	.04583	.06424	.775
		Low income area	.10394	.05361	.154
	Middle income area	High income area	-.04583	.06424	.775
		Low income area	.05810	.04999	.509
	Low income area	High income area	-.10394	.05361	.154
		Middle income area	-.05810	.04999	.509
Parents encourage children to walk to school	**High income area**	Middle income area	.04183	.06528	.814
		Low income area	**-.15749**	**.05496**	**.017**
	Middle income area	High income area	-.04183	.06528	.814
		Low income area	**-.19932**	**.05152**	**.001**
	Low income area	**High income area**	**.15749**	**.05496**	**.017**
		Middle income area	**.19932**	**.05152**	**.001**
elements children like to be changed, existence of police officer	**High income area**	**Middle income area**	**-.20879**	**.06868**	**.010**
		Low income area	**-.41603**	**.05874**	**.000**
	Middle income area	**High income area**	**.20879**	**.06868**	**.010**
		Low income area	**-.20724**	**.05248**	**.000**
	Low income area	**High income area**	**.41603**	**.05874**	**.000**
		Middle income area	**.20724**	**.05248**	**.000**
Elements which child doesn't like to see on their way to school or they scare of them, traffic jam	**High income area**	**Middle income area**	**.19270**	**.06071**	**.007**
		Low income area	.09798	.05086	.157
	Middle income area	**High income area**	**-.19270**	**.06071**	**.007**
		Low income area	-.09472	.04848	.149
	Low income area	High income area	-.09798	.05086	.157

Table 7.16; Continued

		Middle income area	.09472	.04848	.149
Elements which child doesn't like to see on their way to school or they scare of them, motorcycle	**High income area**	**Middle income area**	**.26402**	**.05500**	**.000**
		Low income area	**.12544**	**.04622**	**.026**
	Middle income area	**High income area**	**-.26402**	**.05500**	**.000**
		Low income area	**-.13858**	**.04356**	**.007**
	Low income area	**High income area**	**-.12544**	**.04622**	**.026**
		Middle income area	**.13858**	**.04356**	**.007**
Pavement is present for entire road (both side)	**High income area**	**Middle income area**	**.42240**	**.06167**	**.000**
		Low income area	**.26480**	**.05330**	**.000**
	Middle income area	**High income area**	**-.42240**	**.06167**	**.000**
		Low income area	**-.15760**	**.05043**	**.008**
	Low income area	**High income area**	**-.26480**	**.05330**	**.000**
		Middle income area	**.15760**	**.05043**	**.008**
density of the school immediate neighbourhood	**High income area**	**Middle income area**	**.42179**	**.05905**	**.000**
		Low income area	**.90566**	**.05103**	**.000**
	Middle income area	**High income area**	**-.42179**	**.05905**	**.000**
		Low income area	**.48387**	**.04828**	**.000**
	Low income area	**High income area**	**-.90566**	**.05103**	**.000**
		Middle income area	**-.48387**	**.04828**	**.000**
street length in meter	High income area	Middle income area	3.42483	11.83645	.959
		Low income area	3.45592	10.22974	.945
	Middle income area	High income area	-3.42483	11.83645	.959
		Low income area	.03109	9.67900	1.000
	Low income area	High income area	-3.45592	10.22974	.945
		Middle income area	-.03109	9.67900	1.000
pavement width in meter	**High income area**	**Middle income area**	**1.14547**	**.11224**	**.000**
		Low income area	**.53139**	**.09701**	**.000**
	Middle income area	**High income area**	**-1.14547**	**.11224**	**.000**
		Low income area	**-.61408**	**.09178**	**.000**
	Low income area	**High income area**	**-.53139**	**.09701**	**.000**
		Middle income area	**.61408**	**.09178**	**.000**

Table 7.16; Continued

street width in meter	**High income area**	**Middle income area**	**.49072**	**.12355**	**.000**
		Low income area	**.81808**	**.10678**	**.000**
	Middle income area	**High income area**	**-.49072**	**.12355**	**.000**
		Low income area	**.32736**	**.10103**	**.006**
	Low income area	**High income area**	**-.81808**	**.10678**	**.000**
		Middle income area	**-.32736**	**.10103**	**.006**
Mix land use are present	**High income area**	**Middle income area**	**-.49376**	**.05431**	**.000**
		Low income area	**-.48652**	**.04694**	**.000**
	Middle income area	**High income area**	**.49376**	**.05431**	**.000**
		Low income area	.00724	.04441	.987
	Low income area	**High income area**	**.48652**	**.04694**	**.000**
		Middle income area	-.00724	.04441	.987

The result of the ANOVA test and Post Hoc tests (Scheffe) revealed that most of the environmental variables vary across different areas in Tehran and that it is not because of a sample error. However, it is still not clear whether the relationship between these variables and choosing the mode of transportation for children to go to and from school varies across different income-groups or not. Therefore, the relationships were compared in multinomial regression while the output was organized based on different socio-economic areas in Tehran (Table 7.17, Table 7.18, and Table 7.19).

7.9.1 Barriers for children in their walking to school across different income areas

In high-income areas, the most important barrier was negative parental perception of traffic safety, which makes parents choose motorized modes for their children going to school over allowing them to walk to school on their own. Another barrier in these areas was the presence of streets with more than 4 lanes of traffic in the neighbourhood (TRAFLAN; p=0.059<0.10), that children have to cross to go to school. This causes parents to send their children to school by school bus rather than allowing them to walk

to school. In neighbourhoods where average of street width is more than 10 meters (STWIDTH; p=0.00<0.05) parents prefer to walk with their children to school; however street width does not impact on choosing motorized modes of travel for their children. Several socio-demographic and socio-economic variables also decreased the likelihood of children walking to school on their own. Parental preference for driving their children to school or walking with them over allowing them to walk on their own was influenced by the children and household characteristics (i.e. number of children in a household, children's age and household accessibility to car).

Table 7. 17: Barriers for children in their walking to school in high income areas

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	43.655	19.585	4.968	.026
	KIDAGE	**-4.713**	**2.038**	**5.348**	**.021**
	[MIXU=.00]	-2.107	1.375	2.348	.125
	[TRAFLAN=.00]	**4.320**	**2.291**	**3.555**	**.059**
	[KIDSNU=1.00]	-2.516	1.565	2.584	.108
	[UNDER5=.00]	**4.843**	**2.806**	**2.979**	**.084**
	HOUSHLDCAR	.540	2.369	.052	.820
	[STWIDTH=3.00]	**18.222**	**1.208**	**7.674**	**.000**
driven by parents	Intercept	-41.803	4184.711	.000	.992
	KIDAGE	-.878	1.791	.241	.624
	[MIXU=.00]	19.308	2.334	.000	.993
	[TRAFLAN=.00]	-2.771	1.767	2.458	.117
	[KIDSNU=1.00]	-2.492	1.896	1.728	.189
	[UNDER5=.00]	20.174	3.922	.000	.995
	HOUSHLDCAR	**7.430**	**2.882**	**6.646**	**.010**
	[STWIDTH=3.00]	8.384	9.880	.208	.499
school bus	Intercept	18.961	21.615	.770	.380
	KIDAGE	**-4.218**	**2.032**	**4.307**	**.038**
	[MIXU=.00]	-.628	1.507	.174	.677
	[TRAFLAN=.00]	**4.395**	**2.356**	**3.480**	**.062**
	[KIDSNU=1.00]	**-4.718**	**1.731**	**7.428**	**.006**
	[UNDER5=.00]	23.171	5.883	1.786	.781
	HOUSHLDCAR	1.083	2.412	.202	.653
	[STWIDTH=3.00]	1.872	1.256	2.222	1.36

*Note: the reference category is: walk with friends/alone; variables are significant at p≤0.05

In middle-income areas, negative parental perception of traffic safety in the neighbourhood (absence of signs in intersections to stop traffic) and presence of pavements with insufficient width (≤ 1m) caused parents to walk with their children to

school or send them to school by school bus rather than allowing them to walk on their own. The presence of streets with more than 4 lanes of traffic in the neighbourhood (TRAFLAN; p=0.00<0.05) that children have to cross to go to school makes parents driving their children to school with a private car rather than allowing them to walk to school. Interestingly, denser neighbourhoods (DENSITY; p=0.083<0.1) make parents to walk with their children to school or send them to school by school bus, which is not consistent with other studies. It is explained that denser areas have narrower streets without pavements in Tehran, thus is more dangerous for children to walk along these streets on their own.

Table 7. 18: Barriers for children in their walking to school in middle income areas

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	-13.497	1963.405	.000	.995
	KIDAGE	**2.930**	**1.319**	**4.934**	**.026**
	[KIDSNU=1.00]	-.241	1.558	.024	.877
	HOUSHLDCAR	.327	2.264	.021	.885
	[DENSITY=1.00]	**1.638**	**.945**	**3.004**	**.083**
driven by parents	Intercept	-37.450	18.542	4.079	.043
	KIDAGE	**4.797**	**1.682**	**8.137**	**.004**
	[TRAFLAN=.00]	**-23.197**	**2.509**	**85.461**	**.000**
	[KIDSNU=1.00]	**-3.882**	**2.203**	**3.104**	**.078**
	[KIDGEN=1.00]	-.406	1.649	.061	.805
	HOUSHLDCAR	**6.255**	**2.318**	**7.279**	**.007**
	[DENSITY=1.00]	8.408	2.333	.011	.279
school bus	Intercept	14.406	9.957	2.093	.148
	KIDAGE	.443	1.029	.185	.667
	[KIDSNU=1.00]	.715	1.182	.366	.545
	[KIDGEN=1.00]	-.466	1.161	.161	.688
	HOUSHLDCAR	-.944	1.310	.520	.471
	[DENSITY=1.00]	**1.232**	**.659**	**3.494**	**.062**

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

Obviously older children are more independent and less walk with their parents or being driven by them to school. Children's gender and presence of a child who is under 5 years old in a household has no effect on this model.

In low-income areas (table 7.18), the presence of pavements with insufficient width (≤1.2m) and streets of 10 m width makes parent walk to school with their

children relative to allowing to them to walk on their own. Negative parental perception about personal and traffic safety in the neighbourhood (e.g. presence of addicted people on the street and high traffic speed) led to the use of motorized modes of travel for children to go to school. The presence of pavements less than 1 m wide (PAVWIDTH; p=0.00<0.05) and the presence of blocks in a neighbourhood with a dominance of narrow streets (STWIDTH; p=0.00<0.05)) (street width was 6 m and 8 m), makes parents drive their children to school (with car or motorbike) rather than giving permission to them to walk on their own. Finally, negative parental perception about personal and traffic safety in the neighbourhood, presence of pavements less than 1 m wide and a decrease in block length, causes parents to prefer to send their children to school by school bus and not allow them to walk to school on their own. Lack of painted cross walks and presence of motor cycles that rides on pavements also, makes parents to walk to school with their children. While car/motor cycle is available in a household, parents prefer to use it rather walking with their children to school.

Table 7. 19: Barriers for children in their walking to school in low income areas

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	23.143	9.407	6.053	.014
	KIDAGE	**-3.035**	**1.073**	**8.000**	**.005**
	[HOUSINCOM=1.00]	2.581	2.027	1.621	.203
	[HOUSINCOM=2.00]	2.431	1.580	2.366	.124
	[POLICE=.00]	-5.940	3.811	2.430	.119
	[MOTOR=1.00]	**11.964**	**6.844**	**3.056**	**0.080**
	[MUMOCUP=1.00]	**-4.177**	**1.590**	**6.898**	**.009**
	[KIDGEN=1.00]	**3.093**	**1.214**	**6.490**	**.011**
	[UNDER5=.00]	**3.592**	**1.058**	**11.532**	**.001**
	[EDUPAR=1.00]	**6.816**	**2.252**	**9.159**	**.002**
	[EDUPAR=2.00]	1.636	1.358	1.450	.229
	[DRIVELIC=1.00]	**2.550**	**1.362**	**3.507**	**.061**
	[PARFEELWAK=.00]	.166	1.001	.028	.868
	[PAVWIDTH=1.00]	3.396	2.270	2.239	.135
	[PAVWIDTH=2.00]	1.845	2.134	.748	.387
	[PAVWIDTH=3.00]	**6.825**	**3.090**	**4.879**	**.027**
	HOUSHLDCAR	.229	.994	.053	.818
	[STWIDTH=1.00]	-5.365	4.044	1.759	.185
	[STWIDTH=2.00]	-2.039	3.480	.343	.558
	[STWIDTH=3.00]	**-7.262**	**3.791**	**3.670**	**.055**
	[STWIDTH=4.00]	-3.125	3.325	.883	.347
	[TRAFLAN=.00]	.839	.571	2.160	.142

Table 7.19: Continued

	BKLENGHT	-.002	.003	.280	.597
	[HOUSHLDCAR]	**-2.139**	**.806**	**7.034**	**.008**
	[CROSNOPAV=1.00]	**2.128**	**1.102**	**3.732**	**.053**
driven by parents	Intercept	-99.777	47.104	4.487	.034
	KIDAGE	**-6.379**	**3.430**	**3.459**	**.063**
	[HOUSINCOM=1.00]	1.201	3.065	.154	.695
	[HOUSINCOM=2.00]	1.461	1.831	.636	.425
	[MUMOCUP=1.00]	4.600	4.786	.924	.337
	[POLICE=.00]	-41.914	2.907	0.103	0.749
	[MOTOR=1.00]	-90.394	6.811	0.230	0.631
	[KIDGEN=1.00]	**7.593**	**3.874**	**3.843**	**.050**
	[UNDER5=.00]	**18.471**	**8.467**	**4.759**	**.029**
	[EDUPAR=1.00]	.257	5.497	.002	.963
	[EDUPAR=2.00]	**36.883**	**17.199**	**4.599**	**.032**
	[DRIVELIC=1.00]	19.813	12.055	2.701	.100
	[PARFEELWAK=.00]	**37.517**	**20.720**	**3.279**	**.070**
	[PAVWIDTH=1.00]	24.724	2.621	.000	.991
	[PAVWIDTH=2.00]	**84.548**	**8.649**	**95.560**	**.000**
	[PAVWIDTH=3.00]	101.522	9.523	87.341	.947
	HOUSHLDCAR	**33.441**	**17.186**	**3.786**	**.052**
	[STWIDTH=1.00]	**-123.772**	**32.619**	**14.398**	**.000**
	[STWIDTH=2.00]	**-30.984**	**16.881**	**3.369**	**.066**
	[STWIDTH=3.00]	-63.745	12.775	2.453	.934
	[STWIDTH=4.00]	-96.279	21.983	4.651	.874
	[TRAFLAN=.00]	-.310	.712	.189	.663
	BKLENGHT	**.009**	**.004**	**5.231**	**.022**
	[HOUSHLDCAR]	**4.266**	**1.682**	**6.424**	**.011**
	[CRONOPAV=1.00]	**4.970**	**1.552**	**10.258**	**.001**
school bus	Intercept	101.962	23929.286	.000	.997
	KIDAGE	**-24.468**	**10.688**	**5.241**	**.022**
	[HOUSINCOM=1.00]	-.511	7.639	.004	.947
	[HOUSINCOM=2.00]	-17.023	12.301	1.915	.166
	[POLICE=.00]	18.626	8.055	0.001	0.974
	[MOTOR=1.00]	-10.427	8.078	0.028	0.868
	[MUMOCUP=1.00]	**-29.613**	**15.563**	**3.620**	**.057**
	[KIDGEN=1.00]	6.745	7.330	.847	.357
	[UNDER5=.00]	5.254	1.688	9.691	0.002
	[EDUPAR=1.00]	**33.120**	**15.142**	**4.784**	**.029**
	[EDUPAR=2.00]	**38.182**	**20.535**	**3.457**	**.063**
	[DRIVELIC=1.00]	**38.638**	**19.459**	**3.943**	**.047**
	[PARFEELWAK=.00]	**55.933**	**29.929**	**3.493**	**.062**
	[PAVWIDTH=1.00]	63.182	41.410	2.328	.127
	[PAVWIDTH=2.00]	**90.432**	**50.810**	**3.168**	**.075**
	[PAVWIDTH=3.00]	**84.078**	**47.118**	**3.184**	**.074**
	HOUSHLDCAR	12.930	10.061	1.652	.199
	[STWIDTH=1.00]	-17.031	24.772	.003	.995
	[STWIDTH=2.00]	-32.296	23.206	.001	.999
	[STWIDTH=3.00]	-53.010	23.199	4.900	.998
	[STWIDTH=4.00]	-65.228	23.196	7.430	.998
	[TRAFLAN=.00]	**-1.364**	**.759**	**3.235**	**.072**
	BKLENGHT	**.007**	**.004**	**2.763**	**.096**
	[HOUSHLDCAR]	1.682	1.446	1.354	.245
	[CROSNOPAV=1.00]	2.333	1.664	1.965	.161

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

7.9.2 Barriers for children in their walking back home from school across different income areas

To analyse the barriers for children in their walking back home from school, being driven by their parents was not included in the analysis (Table 7.20, 7.20and 7.21). This is because of the inaccessibility to a car for more than 90% of the sample in the afternoon (Buliung et al., 2009). More than 70% of households only had one car and only one person held a driving licence. The person was most likely the father who was at work in the afternoon and was not able to pick the child up from school (as mentioned earlier in chapter 3, primary schools in Iran are dismissed at 12:30 pm).

In high-income areas, negative parental perception of safety (both traffic and personal) in the neighbourhood made them walk with their children back home from school rather than allowing them to walk back home on their own. Negative parental perception of traffic safety at the quadrant level also caused them to accompany their children while walking back home. Parents reported that if their children had to cross a road without painted crosswalks or walk along a road that has traffic moving at more than 30km/hour while walking back home, they would prefer to walk with them to avoid taking risks. The results also showed that the absence of painted crosswalks, presence of high speed traffic on the roads (more than 30km/hr) and streets with more than 4 lanes of traffic (TRAFLAN; p=0.00<0.05) lead to using a school bus over walking independently back home from school. Parent are more likely to walk back home with their younger and female children.

Table 7. 20: Barriers for children in their walking back home in high income areas

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	-.691	1.108	.389	.533
	[TRAFKMH=.00]	**4.813**	**1.818**	**7.010**	**.000**
	[CROSNOPAV=.00]	**-2.100**	**.866**	**5.881**	**.015**
	[TRAFLAN=.00]	1.411	1.201	1.379	.240

	Table 7.20: Continued				
	[PARFEELWAK=.00]	**2.126**	**1.026**	**4.290**	**.038**
	[KIDAGE]	**-2.471**	**.904**	**7.479**	**.006**
	[KIDGEN=1.00]	**3.155**	**1.741**	**3.282**	**.070**
school bus	Intercept	-22.114	.907	594.770	.000
	[TRAFKMH=.00]	**4.972**	**2.005**	**6.151**	**.000**
	[CROSNOPAV=.00]	**-20.472**	**1.109**	**340.820**	**.000**
	[TRAFLAN=.00]	**21.931**	**1.171**	**350.928**	**.000**
	[PARFEELWAK=.00]	**22.664**	**.000**	**352.889**	**.023**
	[KIDAGE]	-6.309	1.295	2.108	.399
	[KIDGEN=1.00]	7.879	5.316	2.152	.432

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

In the middle-income areas, children from households with higher monthly income were less likely to walk back home on their own. Parents are more likely to walk with their older children back home rather provide school bus for them. The only influential traffic safety factor in this model is absence or presence of painted crosswalks at intersections. The findings show presence of crosswalks will decrease the probability of using school bus to go back home by children.

Table 7. 21: Barriers for children in their walking back home in middle income areas

		B	Std. Error	Wald	Sig.
walk with parents/elder siblings	Intercept	-1.802	2328.537	.000	.999
	[HOUSINCOM=1.00]	**3.178**	**1.555**	**4.179**	**.041**
	[HOUSINCOM=2.00]	**2.303**	**1.396**	**2.719**	**.099**
	[KIDAGE]	**3.430**	**1.579**	**4.717**	**.030**
	[DADTRVLMOD=1.00]	**-4.073**	**1.969**	**4.278**	**.039**
	[CROSNOPAV=.00]	-1.284	.942	1.857	.173
school bus	Intercept	19.197	.548	1228.452	.000
	[HOUSINCOM=1.00]	-1.609	1.517	1.126	.289
	[HOUSINCOM=2.00]	.993	.915	1.179	.278
	[KIDAGE]	-.598	1.170	.262	.609
	[DADTRVLMOD=1.00]	.430	1.279	.113	.737
	[CROSNOPAV=.00]	**-2.190**	**.806**	**7.393**	**.007**

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

In low-income areas, parental concerns about traffic safety increased the likelihood of their walking with children back home from school relative to allowing the children to walk back home independently. The absence of stop signs at intersections to stop traffic decreased the likelihood of children walking back home on

their own. The absence of pavements on both sides of the roads (STPAV; p=0.003<0.05) and an increase in block length (BKLENGHT; p=0.022<0.05) also decreased the probability of children's independent walking back home. Absence of roads which has traffic going less than 30 km/hr makes parent to give more independency to their children in their trip back home. However, those parents who consider walking as a healthy travel mode prefer to walk with their children to have daily exercise. Parental negative perception of personal safety and traffic safety in the neighbourhood also decreased the children's independent walking back home from school. The results also show that parents are more likely to walk with their female children, which is consistent with other studies. Moreover, if parent can afford to provide school bus for their children to go back home or if car is available to them, they will choose motorized travel mode for their children to go back home rather walk with them or allowing them to walk back home on their own.

Table 7. 22: Barriers for children in their walking back home in low income areas

		B	**Std. Error**	**Wald**	**Sig.**
walk with parents/elder siblings	Intercept	22.687	4.150	29.890	.000
	KIDAGE	**-1.522**	**.338**	**20.215**	**.000**
	[NONTRAFSIGN=.00]	**-2.384**	**.556**	**18.378**	**.000**
	HOUSHLDCAR	**-2.575**	**.669**	**14.806**	**.000**
	BKLENGHT	**-.012**	**.004**	**10.078**	**.002**
	[STPAV=.00]	**1.706**	**.578**	**8.728**	**.003**
	[PARFEELWAK=.00]	-.316	.556	.324	.569
	[DRIVELIC=1.00]	**.857**	**.508**	**2.851**	**.091**
	[HOUSINCOM=1.00]	**-1.718**	**.821**	**4.379**	**.036**
	[HOUSINCOM=2.00]	-.424	.708	.359	.549
	[TRAFLAN=.00]	.144	.725	.039	.843
	[KIDGEN=1.00]	**1.185**	**.612**	**3.744**	**.053**
	[HEALTH=1.00]	**3.047**	**.898**	**11.522**	**.001**
	[TRAFKMH=.00]	**-1.847**	**.845**	**4.782**	**.029**
	[DADTRVLMOD=1.00]	**-1.489**	**.584**	**6.491**	**.011**
school bus	Intercept	16.148	5.860	7.594	.006
	KIDAGE	**-2.103**	**.546**	**14.816**	**.000**
	[NONTRAFSIGN=.00]	**-1.654**	**.683**	**5.865**	**.015**
	HOUSHLDCAR	1.061	1.030	1.060	.303
	BKLENGHT	.005	.004	1.469	.226
	[STPAV=.00]	.992	.802	1.531	.216

Table 22: Continued

[PARFEELWAK=.00]	**4.273**	**.990**	**18.615**	**.000**
[DRIVELIC=1.00]	**1.466**	**.711**	**4.252**	**.039**
[HOUSINCOM=1.00]	**-4.532**	**1.180**	**14.755**	**.000**
[HOUSINCOM=2.00]	**-2.881**	**.844**	**11.653**	**.001**
[TRAFLAN=.00]	**7.681**	**3.285**	**5.465**	**.019**
[KIDGEN=1.00]	-2.514	1.933	1.691	.193
[TRAFKMH=.00]	-5.379	3.883	1.919	.166
[HEALTH=1.00]	**6.950**	**1.777**	**15.297**	**.000**
[DADTRVLMOD=1.00]	.050	.749	.004	.947

Note: the reference category is: walk with friends/alone; variables are significant at $p \leq 0.05$

7.10 Discussion

Children's perceptions of the neighbourhood and its relationship with their modes of transportation to and from school have not been assessed widely. Most of the earlier studies that used a qualitative approach and map drawing techniques highlighted the importance of social interaction as well as the physical features of the neighbourhood, such as green spaces among children. This study is one of the first to use a mixed method approach (where quantitative is dominant) to measure the factors in the neighbourhood and examine the association between them and the travel mode of children to and from school.

The hypothesis tested in this chapter was that traffic safety negatively influences children walking to and from school independently, however, it is not the only contributing factor. Neighbourhood safety is also associated with a child's trip to school on foot, and, these barriers to children's walking varied across different socio-economic areas. The results support the hypothesis by indicating that traffic safety and neighbourhood safety impacts on children walking to and from school, however, the relationship varies when children go to school and back home. Particularly, the results suggest that:

1- Children's perceptions of personal safety affect the probability of a child walking to school and were moderated by children's gender and age, household income, and mother's occupation.
2- Children's perceptions of personal safety did not affect their mode of travel while going back home.
3- Children's perceptions of traffic safety affect the likelihood of their walking to school and were moderated by the number of people in a household who hold a driving licence, parent's education level, children's gender and age, household income, and the number of children in a household.
4- Children's perceptions of traffic safety also impact on their modes of travel back home and were moderated by the number of children under 5 years old in a household, father's travel mode to work, number of persons in a household who hold a driving licence, education level of parents, children's gender, household income, number of children in a household, and mother's occupation.
5- Parents' perceptions of safety also impacts on children's travel mode to school, and was moderated by the number of children in a household, children's age, children's gender, number of children under 5 years old in household, parents education level, number of people who hold a driving licence in a household, father's travel mode, household income and mothers' occupation.
6- Parents' perceptions of traffic safety also affect the children's travel mode back home and were moderated by the number of children under 5 years old in the household, father's travel mode to work, number of people who hold a driving licence in the household, education level of parents, children's age, household income and mothers' occupation.

7- Parents who believed the neighbourhood was not safe would not allow their children to walk to and from school on their own. The main reason they indicated was the presence of undesirable people in the neighbourhood. The relationship between this variable and parental decision about their children's trip to school was statistically significant.

8- Seven built environment factors also impact on children's travel mode to and from school. Street width, pavements with insufficient width, lack of mixed land uses in neighbourhoods, and neighbourhoods with high and moderate density impacted on the children's trip to school, while only the presence of pavements on the both sides of the street segments, block length, and lanes of traffic on the streets impact on travel modes of children back home. The relationship between these variables and travel modes of children were moderated by household income.

Policies in Iran suggest that improving traffic safety through making changes in urban form will change the children's travel pattern to school. This is possibly true, but is it the only effective factor concerning children's trip to school? Based on the concept of "one size fits all", are the factors exactly the same across different socio-economic areas? The analysis in this chapter attempted to answer these questions and develop a deeper understanding of the condition. The results from study presented in previous chapters only showed the relationships between the variables of traffic safety and neighbourhood safety and children's transportation to school, and assumed that traffic safety is the most important independent variable without considering different socio-economic areas (Ulfarsson & Shankar, 2008; Schofield et al., 2008).

The purpose of this analysis was to test the hypothesized association between traffic safety and neighbourhood safety and choosing a child's independent walking to

and from school. It also explored factors that affect the relationship. This framework of analysis is more common in the psychology or medical sciences literature, however, recently it is considered in the travel pattern as well, especially if a study tries to assess the influence of modification in physical environment on travel pattern (Bringolf-Isler et al., 2008; Beck & Greenspan, 2008; Wen et al., 2008; Panter et al., 2010).

The initial hypothesis is valid although the analysis showed that perceived traffic safety is moderated by some socio-demographic and socio-economic variables. For example, the parent's and children's feelings about the safety of the neighbourhood in terms of traffic may vary depending on the child's age. A possible explanation for this question is that older children feel more independent and might be aware of traffic dangers and their desire influences their parent's decision (Miller et al., 2004; Kingham & Ussher, 2007). However, a child's perception of traffic safety did not change across the gender of children (Hume et al., 2009; McDonald, 2011; Martin et al., 2007).

In addition, the presence of younger children in a household occupies the time of the parents and decreases their concern or restrictions on the elder child's travel pattern. Previous research also showed that the number of children in a household, especially young children, affect the choice of transportation mode (Zhang, 2006), however, they did not find that it could even change the effect of traffic safety on the perception of parents and children.

The average household income moderated the perception of parents and children about traffic safety. Children from lower-income households were more likely to walk to and from school. This is consistent with the findings of other studies that showed that low-income people usually stay near to facilities to reduce travel distance and avoid travel cost. Additionally most of the people with lower income do not have access to a car or only have one car. In addition, they may not be able afford to provide a school

bus for their children to send them to school (because the fee is quite high in Iran) (Wen et al., 2008). In other words, lower income families may not have other options for sending their children to and from school (McDonald et al., 2009).

The perception of parents and children of traffic safety in the neighbourhood varies depending on the mother's occupation. Mothers who are not housewives are not able to walk back home with their children or drive them back home. Therefore, they have to arrange motorized transportation for their children to go back home or allow them to walk on their own. This showed that parent's work schedule or their other commitments influence their decision regarding the mode of transportation for their children (Wen et al., 2008).

The provision of pavements with sufficient width was identified by parents as an important physical element that would encourage them to allow their children to walk to and from school. However, research exploring the impact of the presence of pavements on promoting children walking has not yet found any clear relationships between these two variables. The results also showed children who stay in denser neighbourhoods are more likely to walk to school which is consistent with other studies. Moreover, increased in block lengths increased in using school bus by children while going back home that was anticipated.

Some studies indicated that improving the built environment (i.e. provision of pavements) could cause a small change in the mode of transportation (Yeung et al., 2008; McDonald et al., 2010). This is true, particularly because these changes are usually limited to the immediate environment around the schools. Thus, children may need to negotiate heavy traffic close to their home (Timperio et al., 2006; Kingham et al., 2011). Parents also highlighted the lack of traffic lights and signs to stop traffic at intersections as an influential factor on their decisions about modes of travel for

children. Studies show that while installing traffic lights may cost a lot for many schools and local authorities, painted crosswalks and other types of traffic calming devices may be achievable (Zomervrucht, 2006; Timperio et al., 2006; Mitra & Buliung, 2011).

Children also indicated that people who ride motorcycles on pavements instead of the street prevent them from walking to and from school on their own. They are terrified of having an accident with or being abducted by a motorcyclist, as the motorcycles are ridden very fast. This issue was highlighted by children from lower income neighbourhoods. There are some stands on pavements at different distances to prevent motorcycles being ridden on the pavements; however, the problem is still there (Figure 7.2). Children from all neighbourhoods were worried about being abducted, and they cited that the presence of police officers around the school might build a sense of security in them.

Figure 7. 2: Stands on pavements to prevent motor cycles being ridden on pavements

This study investigated parents' and children's perceptions of factors that influenced children's transportation mode. However, there is evidence that the perceptions of the environment may not match the objective measures (Owen et al., 2004). Therefore, the objective measures of the environment were used to establish their perceptions validity. However, the results suggested that parents' perceptions play a more important role than the objective measures in parents' decisions about children's trip to school and is consistent with other literature (Yeung et al., 2008).

In the current study, most of the children who walk to and from school were accompanied by an adult. It is socially constructed as the normal practice to go to and from school and is considered as "good parenting" (Bean et al., 2008). Parents' perceptions of personal safety in the neighbourhood were also moderated by certain variables. For example, the parent's perception of personal safety in a neighbourhood may vary for their female and male children, also boys and girls had a different perception of personal safety in a neighbourhood. Moreover, when the mother did not work, parents were more concerned about their children's safety. The results confirm the finding of Wen et al., (2008); however, they did not find anything about the effect of a mother's occupation on a child's travel mode. Additionally, they did not show how it could moderate the influence of neighbourhood safety on parents' decision-making.

For the children's trip back home, the children's perception of safety was no longer effective. The explanation for this result is that the number of children who walk back home increased and children were more interested in walking with their friends (peer pressure). This result is consistent with other research (Timperio et al., 2006). Parents' perceptions about traffic safety impact on children's trip back home. However, the representative factors were different from those factors that impact on the travel mode of children to school. Street width, pavement width and lack of traffic signs to

stop traffic at intersections were effective on children's trip to school. While, lack of painted crosswalks, street segments that have traffic moving at more than 30 km/hr impact on the travel mode of children returning home. Street segments with more than four lanes of traffic influenced the travel mode of children to and from school. This shows that socio-demographic and socio-economic factors are more important in choosing the mode of travel for a child while going back home to compare to the physical elements of the neighbourhood.

Impediment factors for children walking to school in high-income areas and middle-income areas were almost similar – the presence of undesirable people due to the existence of foreign workers in the construction sites across the neighbourhoods. Additionally, street segments with more than 4 lanes of traffic and the presence of narrow pavements. However in low-income areas the absence of pavements, narrow pavements and narrow streets prevented children from walking to school on their own (Figure 7.3 and Figure 7.4).

Figure 7. 3 and Figure 7. 4: construction sites in middle income (left side) and low-income areas.

Narrow pavements are considered as a major problem across three different areas for children in their walking to school but with different reasons. It can be explained that previously there were a large number of gardens in high-income areas. However, old gardens and mansions were destroyed to make way for massive new apartment blocks. Furthermore, the fines for cutting down the trees or building high-rise brought a considerable amount of money to the municipality. Therefore, Tehran lost its liveable neighbourhood areas (Shahshahani, 2003).

Wide streets provide good access to traffic. Due to the high price of land in those areas, the owners tried to expand their lot as much as they could. As such, pavements were omitted completely in local streets or too narrow. In lower-income areas, streets are too narrow (< 6m), thus, it is impossible to provide pavements with sufficient width for walking (Figure 7.6 and Figure 7.7.). In middle and low-income areas on street parking also reduces the width of the street and children's visibility, which makes the neighbourhood more dangerous for children to walk (Dissanayake et al., 2009).

For the children's trip back home, the lack of painted crosswalks and street segments that have high speed traffic were considered as barriers for children in their walking back home across high and middle-income areas (Figure 7.8). In lower-income areas the lack of traffic signs to stop traffic, absence of pavements and increased block lengths prevented children from walking back home on their own. The results show that the travel behaviour of children was more sensitive to parents' perceptions about traffic safety on their trip back home.

Figure 7.5: on-street parking in middle income areas.

Figure 7. 6: wide streets in high-income areas with narrow pavements

Figure 7. 7: narrow streets in low-income areas without pavements

Figure 7. 8: wide streets with more than 4 lanes of traffic in middle- income areas

7.11 Conclusion

The relationships examined in the analysis have contributed to the knowledge by indicating what the policy makers really target when improving traffic safety and neighbourhood safety (Which influential factors are explained by urban form, and which of them require educating people). The analysis provides support for the hypothesis that the association between traffic safety and a child walking to school is significant; however, not all of the influential items were explained by urban form. Moreover, traffic safety is not the only independent variable; neighbourhood safety has a direct relationship with a child's trip to school on foot as well. However, both of these indexes were modified by internal factors. This information can help urban planners and policymakers in determining how to use the supplies and investments more efficiently (e.g. adding speed bumps is necessary but is not enough, urban planning need to separate traffic with pedestrian and provide pavements with sufficient width for walking (> 1.2m) as well).. At the same time, testing the differences in the effectiveness of variables across different income-groups of population can lead to a more fair distribution of supplies.