CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

There have been several studies conducted on children's walking and cycling in respect of urban planning and health issues. They indicate that several factors impact on the relationship between the built environment, traffic safety, neighbourhood safety and choosing a child's mode of transportation to school. However, existing research on children's travel patterns, traffic safety, personal safety, urban design and physical activity provide limited documentation concerning the complexity of the association because of:

1- The absence of a comprehensive framework that shows how safety traffic, personal safety, and other influential variables relate to one another in respect of the impact on a child's mode of travel to school.

2- Lack of focus on a child's walking to and from school autonomously.

3- Limited research on looking at the different travel patterns of children across different income groups.

4- Very limited research on examining the influential factors on children's travel to and from school separately.

5- Most of the studies concerning children's travel to school used a qualitative approach to reveal the influential factors on parental decisions about children's journey to school. However, there is a need to do some studies that quantitatively examine the relationship between the specific traffic safety and neighbourhood safety factors with children's travel patterns to and from school (Johansson, 2003; Pan et al., 2009).

6- Focus group studies confirmed the above results; however, making direct comparisons across focus groups inappropriate (Ahlport et al., 2008).

In addition to all aforementioned reasons, very little research exists that examines the relationship between the variables and a child's mode of travel to and from school in developing countries. Therefore, the existing literature cannot answer the question of how traffic and personal safety in a neighbourhood affect a child's trip to and from school across different income groups in urban areas in a developing country. However, existing research provide a good background to develop a new and comprehensive framework to study this relationship.This chapter reviews the current literature that relates to children's travel patterns to and from school.

Conceptual models of influential factors on overall children physical activity include three primary categories that impact on modes of children's travel to school: first, individual characteristics include socio-demographics, household characteristics, preferences, cultural norm and attitude. Second, the social environment factors which refer to elements in built environment which influence on parental and children's perceptions of personal safety in neighbourhood. Third, the built environment factors which include physical elements in communities. The built environment factors are divided into three categories: land use, transportation systems, and urban design elements (Weigand, 2008). While reviewing the literature began with explaining

influential factors on overall adult physical activity and travel patterns, understanding those factors provides a useful background to discuss about modes of children's travel to and from school and informing the programs that promote walking to and from school.

Starting with Chicago School in the 1920s and 30s, researchers have emphasized the relationship between environment and travel behaviour. Jacob (1962) explored the associations between community relationships, safety and design. She highlighted the importance of the number of people on the street who increased the potential of supervision and safety in the neighbourhood. Appleyard (1981) showed how the streets' layouts affect people behaviour.

With having this background, both fields have continued to study how environment affects people travel behaviour. However there have been important differences in how transportation and sociology researchers have examined neighbourhood effects. Transportation studies are more focus on evaluating the claims of New Urbanism, direct relationship between improving built environment and increased walking. In contrast, urban sociologists have conceptualized neighbourhoods from a social perspective and socio-economic status of neighbourhoods. From urban sociologists view personal safety in neighbourhoods has been seen as one of the most important influential factors in choosing school travel mode for children. However, most of sociology literature has ignored the relationship between physical environment and social environment and how they affect on children's school travel patterns (Badland & Schofield, 2005; Buchanan et al., 2006, Stewart, 2011).

The following sections focus on literatures about built environment and travel behaviour, built environment and health, socio-economic status of neighbourhoods and travel behaviour, and personal safety in neighbourhoods and travel patterns, to

understand the relationship between different factors and children trip to school and identify level of their influence on choosing modes of children's travel to and from school.

2.2 Urban planning – transportation and urban design

Many studies try to identify physical elements in built environment which are associated with encouraging or discouraging children to walk to and from school. Understanding the elements helps policy makers to educate people on benefits of walking and making changes in one or more features to improve perceptions as a way to impact on travel behaviour. Previous travel models principally forecast the probability of choosing private cars by adults. Studies which concern the association between the methods of transportation and urban design has generally focused on two paths:

1- Testing the model empirically to anticipate travel comfort, travel demands, travel cost and travel time.

2- Explanatory research to identify factors that impact on the travel pattern (Camagni et al., 2002; Banister, 2008; Guo, 2009).

The first generations of travel behaviour models (e.g., Four-Step model) were trip generation models. They were statistical equations designed to predict trip outcomes and not the behavioural processes that went into deciding about a trip (Timperio et al., 2006; Domencich & McFadden, 1975). The Four-Step model was traditionally used by transportation agencies in the forecasting of travel demand. The model contains four stages: trip generation, trip distribution, mode choice and route choice. It was primarily executed in sequence, although feedback loops do exist in some versions of the model (McNally, 1997; McMillan, 2003). A major limitation of this model is that since it is primarily a forecasting tool and notwithstanding true behavioural theory, temporal and

spatial constraints are largely absent in the model building process. This is in conflict with how these factors actually play a role in an individual's decision about a trip (Goodwin & Hensher, 1978; Antonini et al., 2006). In addition, the model is designed to examine trips as individual events rather than interconnected activities, which makes it difficult to outline the complexity of trip making (McNally, 2006; McMillan, 2005).

Adult trips are those that are typically modelled, since they are automobile trips. Walking and cycling are rarely considered in the Four-Step models unless they provide a connection to transit. They are typically only considered utilitarian trips, not trips that may be generated for recreational purposes (the same is also true for auto travel "for the fun of it"). Because of these limitations, generally, the Four-Step model cannot explain why travel happened, just where and how much of it may occur (McNally, 2006, Domencich & McFaddan, 1975).

The Activity-Based framework to study travel behaviour was developed to overcome the limitations of the Four-Step model. The framework attempts to improve the understanding and prediction of travel behaviour by recognizing its complexity. It also addresses the need to develop a model that is more relevant for policy applications (Goodwin & Hensher, 1978, McMillan, 2007). The framework suggests that an understanding of travel behaviour cannot only be based on an examination of travel attributes (e.g., time and cost of travel). Rather it must consider the effect of individual preferences and constraints on choice, as well as the attributes of the destination (Goodwin & Hensher, 1978; Panter & Jones, 2008; Cerin et al., 2009). Therefore, travel is recognized as a derived demand (trips are made for a purpose, e.g. transport or leisure) and is a combination of overall household demand for activities rather than one's individual trips. Therefore, it is necessary to answer the questions "what, when,

where, how and why" the household activity patterns are considered to determine travel behaviour (Stoner & Milione, 1978; Pooley et al., 2011).

Through the recognition of the impact of the household on overall travel patterns, the Activity-Based framework implicitly includes the children's needs for transportation. Travel is seen as a sequence of events (not isolated trips) that are influenced by elements such as the school's opening hours and location of a child's school in relation to the parent's workplace. These are examples of temporal, spatial and interpersonal constraints on trip decisions that are neglected in the traditional Four-Step model (Beck & Greenspan, 2008; Wilson & Menotti 2007; McMillan, 2003).

The Activity-Based framework focuses on the effect of preferences, constraints and destination attributes on travel behaviour. It is also well suited to the understanding of walking and cycling behaviour. While optimizing the time and cost of travel are important factors in deciding to travel by these modes (as in a private car), elements such as enjoyment, good for personal health and the environment, discomfort, and lack of bicycle paths are other factors that impact on travel decision-making and studies with an activity approach should identify them.

Moving the Activity-Based approach from the point of being a framework to a model for the study of travel patterns has not been easy. The approach is more suitable for a local study than regional travel pattern studies since the data collection requires detailed Activity-Based surveys that are often expensive and time consuming (McNally, 1997, ch. 4). Therefore, this approach is not appealing to either the researchers or the practitioners. They have to collect a lot of conventional trip-based data rather than the more behaviourally-based data such as spatial, temporal and interpersonal constraints on households, individuals and destination attributes (McNally, 1997, ch. 4). The Activity-Based approach would likely support the hypothesis that other factors besides

the built environment influence a child's trip to school. However, the lack of critical urban form data makes it difficult to address the overall question of how the built environment, traffic safety and personal safety relates to a child's trip to school using this framework.

Despite their limitations, both the Four-Step model and the Activity-Based framework provide valuable insight in that they clearly suggest how variables relate through a process of travel decision-making and travel pattern. In particular, the Activity-Based framework has advanced the discussion and research concerning the complexity of travel behaviour by highlighting the interplay of various factors on travel decisions.

The complexities of the Activity-Based approach to travel behaviour have motivated others to search for other theoretically-based behavioural frameworks that empirically test hypothesized transportation-land use links. In 2001, Boarnet and Crane, both collectively and with various authors, contributed to the discussion concerning the relationship between land use and travel behaviour. They expanded upon the behavioural framework introduced by Domenich and McFaddan (1975) of an econometric model of travel demand, using utility maximization as the primary behavioural goal of each individual (Boarnet & Crane, 2001; Boarnet & Greenwald, 2000; Greenwald & Boarnet, 2001). The main point of their argument is that the impact of land use on travel behaviour is its effect on the generalized price of travel (i.e., travel cost and time), not its relationship to more subjective variables, such as quality of life or sense of community.

These researches cannot answer the question of how the built environment, traffic safety and neighbourhood safety impact on a child's trip to school. The reasons are their focus on adult travel, motorized modes of transportation and the easily measured

separate variables of travel pattern and land use. These researches are based on the concept of utility maximization, which assumes full knowledge of choice sets and does not take into account spatial and temporal constraints (Jones, 1978). Moreover, these researches ignore the local cultural complexity of a trip decision for a non-motorized user of the transportation system and the household characteristics that go into travel decisions. Therefore, different approach is need to consider all factors and their influence on transportation.

Travel pattern studies that include an analysis of non-motorized travel have increased significantly in the past decade (e.g., Handy & Clifton, 2001; Plaut, 2005; Martinez et al., 2008; Banister, 2008; Buehler et al., 2011). Such literature is important since the experiences and comforts of a pedestrian vary greatly from that of a car driver. Since walking and cycling happen on a smaller scale of the transportation system than motorized modes of travel; there are some other conflicts among different street users (e.g. pedestrians, cyclists, and drivers). These conflicts can be listed as the environmental qualities (Urban design, traffic safety, and neighbourhood safety), values and needs that vary according to their individual characteristics (Lee et al., 2008; Whyte, 2006).

The Discrete Choice model is similar to the Activity-Based framework for studying pedestrian walking behaviour. The model is based on speed direction and visual angles. It has four different models:

1- Destination choice model (selecting shortest path by pedestrians)

2- Route choice model

3- Driver behaviour on the road

4- Preferences (probability of walking based on time and speed towards some destinations)

There are two approaches in this model: pedestrians as a flow and pedestrians as a set of individuals or agents (Antonini et al., 2006; Train, 2003). The Traveller-First approach was developed to expose people with a similar travel attitude to multiple path options rather than comforting travel behaviour across distinct neighbourhoods. As such, it can also identify the effect of the pedestrian environment on the utility of walking (Guo, 2009). It is very useful for policymakers to improve the particular streets by not only reducing accidents and saving time for all users, but also by improving the aesthetics of the elements.

In a comparison of four neighbourhoods from the inner and outer city of Shanghai, Pan et al. (2009) found that neighbourhood-scale urban form affect travellers' preferences for modes of travel after the effects of socio-economic factors are controlled. The study found that pedestrian friendly urban form (mixed-land uses, density and commercial services) makes the non-motorized modes a possible option. Other studies also found that land use factors influence walking indirectly by impacting on travel time and distance (Wedagama et al., 2006; Holt et al., 2009).

A Utility-Consistent model approach that includes motorized and non-motorized modes measured the local physical environment as a potential influence on travellers' choice of non-motorized mode (Rodriguez, 2004, Guo, 2009). The study found that mixed land use, higher densities and street connectivity support walking, while the presence of pavements, pavement width and neighbourhood terrain is uncertain. It concluded that pedestrians are very sensitive to the physical attributes of the environment. Therefore, these factors impact on choosing walking as the preferred mode for an adult; however, it did not show how these preferences are formed and reinforced.

Handy (1996) compared four Bay Area neighbourhoods and found that an increased number of walking trips to destinations was positively associated with shorter distances and street design elements that may affect the perceived level of accessibility (e.g., narrow streets, shaded pavements, front porches). The study found that the average frequency of walks and the percentage of individuals who walked to commercial areas in a month were higher in traditionally-designed neighbourhoods as compared to modern (post-WWII) neighbourhoods. It is suggested that shorter distances might be an effective factor in the relationship between walking and urban design. Rodriguez (2004) found that the appeal of walking and cycling was affected by sloping terrain.

Forsyth et al., (2007) also confirmed the results of this study with emphasizing on residential density and its influence on distance between home and desired destinations. Later Craig et al. (2002) assessed the relationship between the number of destinations and walking rates in urban areas and suburban areas. The study found that mixed land used and greater street connectivity relate to walking for a purpose in urban areas but less in suburban areas. Gallimore et al., (2011) conducted a study in US and compared walk ability of suburban with new urban communities. The study found that new urban routes offered greater traffic safety, personal safety, attractiveness, diversity, and accessibility. The authors concluded the new urban routes can create better walking conditions, that is consistent

Selberg (1996) indicated that streets are a space for social activities, a variety of activities and opportunities in the area increase and strengthen the social use of streets. Handy & Clifton, (2001) Handy and colleagues also examined the factors that influence walking trips based on trip purpose in a study of six Austin, Texas neighbourhoods. The neighbourhoods were divided equally into traditional (built early in the 1900s near the

city centre), early-modern (built soon after World War II near the city centre) and late-modern (built in the past two decades near the urban fringe). When looking at the impact of local shopping on travel mode choice, Handy & Clifton (2001) found that distance to a store was a stronger predictor of walking trip frequency, increasing each mile in distance can reduce four trips per month (or as authors state, one trip per quarter mile of distance).

Planning theories such as New Urbanism, assume a strong relationship between the built environment and people travel behaviour. These theories believe a neighbourhood where destinations are close, the roads are interesting, and safety concerns are minimized can promote walking for both transportation and leisure. There are some other difficulties that some elements in the built environment can be more easily changed, such as cross-walks or traffic signs, while others, such as the distance between home and school or street pattern and connectivity are larger scale planning issues and cannot be modified at neighbourhood level. However, some studies conducted to assess the aspects of the built environment and the results show that several physical elements have a significant influence on parental decision making about the modes of travel for children to school (Mitra & Buliung, 2011).

Schlossberg et al., (2006) show built environment is not the only influential factor in the parental decision- making process and seems to be more related to walking compared to cycling. Studies also confirmed that variables such as presence of pavements, percentage of grid street networks, walking quality environment (facility accessibility) and mixed land use had a greater explanatory power for non-motorized travel modes than motorized travel modes. However, improving these built environment features alone will not increase walking among the resident population (Panter & Jones 2008; Van Dyck et al., 2009). Other studies have also found that the quality of

pedestrian environment plays a role in the decision to walk. Elements such as commercial and/or mixed use development, busy streets and general safety in a neighbourhood affect walking activity (Cervero, 2002; Panter et al., 2010). Studies also revealed that access to facilities (local shopping, recreation spaces) in residential areas is associated with an increasing level of physical activity (Panter & Jones, 2008). A study in Boston also revealed using motorized modes of travel is sensitive to street connectivity and car availability, while population density and transit supply also matter (Zhang, 2006)..

None of the aforementioned studies examined children's travel pattern. However, the explicit assessment of non-motorized travel modes advanced the discussion on the relationship between the travel pattern and the built environment. It also provides a starting point for further research. What is still largely absent from this literature is a comprehensive understanding of the structural relationships between the variety of variables and selecting modes of travel. However, travel behaviour model studies by Dissanayake et al. (2009), and Rodriguez (2004) show that the relationships between built environment variables and choosing modes of travel vary across different travel patterns. Therefore, information is needed concerning the relative influence of the built environment variables that represent traffic safety and personal safety in respect of non-motorized modes over motorized modes of travel.

Studies that directly addressed how built environment impact on children's travel. Boarnet et al (2005) confirmed changes in built environment, such as improving pavements and cross walks, can encourage children to walk to school. McMillan (2003) found that the relationship between built environment and children's travel to school is indirect. Three urban form elements, abandoned buildings, street lights and street widths, were significantly impact on choosing modes of travel to school in her study.

The clear message from the majority of the studies is that the built environment matters, but it may only have a marginal effect on parental decision making about their children's trip to school. However, this conclusion is still being refined as researchers try to develop better measures of the physical environment at different scale, e.g. neighbourhood, region (Harrison et al., 2011; Dalton et al., 2011).

A study conducted in Belgium found that high walk able neighbourhoods (having connected and gridded street pattern with good accessibility to public transportation, and mixed land use) encouraged people to walk and cycle more (van Dyck et al., 2009). The findings of this study are consistent with results of studies from Australia (Owen et al., 2004) and United States (Frank et al., 2005). However, another study in Boston with path-based measure showed people who like to walk, choose pedestrian-friendly neighbourhoods; as such walking trips are more in these neighbourhoods (Guo, 2009). None of the aforementioned studies examined the association between walk able environment and walking and cycling to school. Ahlport et al., (2008) found while supportive environment is necessary, is not sufficient condition to increase walking and cycling to school. Napier et al., (2010), examined the association of parental and children's perception of walk ability in neighbourhood with walking in three communities in US: a walk able new urban community, a mixed community, and a less walk able standard suburban community. The study concluded students walk more in walk able communities, when they lives near to school and their parents had less perceived barriers to walking.

As researchers have begun focusing more on walking and cycling, better ways of measuring physical elements in neighbourhoods have been developed (Sirard & Slater, 2008; Pucher & Buehler, 2010) . Hume et al., (2009) modelled walking and cycling trips in Melbourne, Australia using traditional measures of built environment, e.g.

distance between work place and home, land use diversity, as well as neighbourhood safety. They concluded that the influence of neighbour design e.g. crossed walks and presence of traffic light on the decision to walk is greater than land use.

Saelen & Handy (2008) reviewed all studies about built environment correlates to walking from 2002-2006 in US. The result of their work showed shorter distance to work, shopping, leisure activities in or near residential areas, and interesting environment thereby supporting walking. They also showed that traffic calming programs including widening pavements, narrowing down streets at pedestrian crossing, adding speed bumps and landscape also increased walking. Another study of children's school travel behaviour in US found that the pedestrian environment between school and home (as measured by average pavements width, and proportion of roads with complete pavements, and distance between home and school) is also very important in children's walking to school (Ewing et al., 2004).

2.3   Public health – physical activity

The built environment and modes of transport are increasingly being linked to physical activity participation and population health outcomes. In the beginning, these disciplines, focus less on examining the utility in walking and focus more on the psychosocial factors (e.g. norms and beliefs) that influence the activity itself (McMillan, 2003; Panter & Jones, 2008). However, recent studies with a sustainable approach consider walking as a healthy means of transportation to reduce car use, which, in turn, will lead to a reduction in emissions and traffic jams (Banister, 2008). These researches showed that considering walking as a transportation mode can decrease the travel demand and time, and is a healthy transportation mode that benefits all street users. However, cultural norms and the convenience of using the car appear to be more important to users than the environmental problems caused by using motor vehicles. It

confirms that policies cannot be successful without the understanding and acceptance of people (Gardner & Abraham, 2007; Hamed & Olaywah, 2000; Plaut, 2005; Banister, 2008). A study in Auckland on built environment and public health found that key feature in built environment which are related to physical activity are density, subdivision age, street connectivity and mixed land use (Badland & Schofield, 2005).

The majority of the research on walking and physical activity in general, has been guided by theories that examine the influence of intrapersonal and social variables (e.g., health belief model, trans-theoretical model and theories of reasoned action and planned pattern) (King et al., 2002). Variables, such as independent effectiveness ("one's confidence to engage in physical activity despite facing barriers")(Lewis et al., 2002,28), self motivation, enjoyment, perceived health or fitness and social support from a spouse, family, peers or friends, were positively associated with overall physical activity in adults (Bird, 2005). Barriers to physical activity included time pressure, work and school, having a small child and inconvenience, which had high negative associations with overall physical activity in adults (Bean et al., 2008; Dissanayake & Morikawa, 2010). Variables such as knowledge of the benefits of walking as a transportation mode to have a healthy and safer environment also have some relation to engaging in physical activity as an adult (Owen et al., 2004; Rodriguez, 2004).

The field of physical activity research then moved towards theories that suggest that there are multiple levels of influence on active travel decisions. The social-ecological model and social-cognitive theory suggest that travel behaviour is affected by intrapersonal (walking and cycling motivation), interpersonal (discussion between parents and children) and organizational (supportive school community, pavements and crossing guards) factors. This highlights the complexity of the travel pattern that the research is trying to explain (King et al., 2002; Ahlport et al., 2008).

Studies using a socio-ecological approach recognize multiple sources of influence on people travel behaviour and provide a useful analytical framework for choosing methods of travel. These studies may capture the behaviour of travellers within the transportation system and predict travel demands. It is also need to see the interaction of physical environmental factors with other variables (e.g. car ownership) (Alfonzo, 2008; Abbe et al., 2007; Franzini et al., 2010). The results of their studies also showed that being physically active outdoors is related to physical environmental factors; however, the relationship is moderated by neighbourhood social and cultural factors (Alfonzo, 2008; Bean et al., 2008).

In the limited research that has begun to look at the effect of environmental factors on physical activity in adults, access to facilities that support physical activity (walking paths, local stores and parks) was positively associated with activity, while the impact of perceived safety and heavy traffic on activity showed mixed results (Carnegie, et al., 2002).

In a study that focused specifically on walking activity, Giles-Corti and Donovan (2002) found that the rate of walking for health benefits was higher among people who:

1- Had the greatest access to public open space (compared to those with the lowest).

2- Lived on streets with minor traffic and/or some trees (compared to those who lived on streets with major traffic and no trees).

3- Lived on streets with footpaths (i.e., pavements) and/or shops compared to those who lived on streets with no footpaths or shops).

The focus of physical activity research on activity for a purpose other than transport (i.e., general leisure-time physical activity) provides more detailed information on what may affect an individual's decision to walk. This singular focus must also be

recognized as a limitation in the research. Since most of the research generally addresses leisure-time physical activity and not walking for a purpose, it is not clear whether the variables that affect the decision to walk are the same as those affecting cycling, running or playing soccer. Moreover, it is not obvious if walking for a purpose, such as the walk to school, is influenced differently than walking for recreation (Hume et al., 2009). Work by Handy (1996) concerning the role of the built environment to motivate people to walk revealed that it played a greater role in the decision to walk to a destination than to walk for recreation.

In addition, like much of the research in transportation and urban design, the majority of these studies were cross-sectional correlation research or intervention studies in which causality relations may not be inferred and the explanatory framework is absent. Comprehensive Model-building is inadequate in physical activity research and, especially concerning active commuting to school. There is a limitation in advancing the knowledge of what influences physical activities and particularly walking to school (Lewis et al., 2002). However, research on physical activities contributed to the development of a framework for built environment factors, socio-environmental factors and a child's trip to school. Despite many travel behaviour models that focused on travel time, travel demand and travel cost, these researches highlight the environmental attributes that can influence a decision to walk.

2.4   Public health – the journey to school

The journey to school has gained the attention of those supporting a more sustainable transport system, probably because it appears easy to identify the influential factors and gives the impression of being a convenient journey to reduce car-trips (Black et al., 2001). Since the 1990s, research has looked at the relationship between the built environment and children trip to school. However, few studies directly assessed the

relationship between the built environment and children's modes of travel to school (Ulfrasson & Shankar, 2008; Crane, 1998).

The question concerning what the barriers are in the built environment for children walking to and from school independently, or the reasons for driving children to school, is often complex (Granville et al., 2002). A widely used approach in existing research to answer the question is the study of behavioural models of children travelling to school (Hamed & Olaywah, 2000). However, the research failed to answer the question because of the limited focus on children and their autonomous walking to and from school. More importantly, these researches did not consider children as an independent pedestrian in the neighbourhood. However, children are a group with a low limit of tolerance, which should be considered in the design of streets and managing traffic (Selberg, 1996; Zargar et al., 2003).

There are some current policies and programmes, such as Safe Routes to School (SR2S), which assumes that there is a fairly direct relationship between the built environment and children's trips to and from school. The findings of SR2S showed that if the urban form is improved, children would walk to and from school more often. However, that programme did not test the exact and clear factors that contributed to it; neither did they assess how much those factors affect it. Moreover, they did not examine whether or not there were any other influential factors on children's trip to school.

Fundamental questions about how parents and children choose mode of travel for children's trip to and from school (does children's preferences influence on parental decision making?) and what the barriers are to children in their autonomous walking to and from school and if the barriers very across different income groups or vary for children's trip to and from school are not answered yet. This study examines the child's

travel behaviour with considering multiple influences of individual attributes, household, and neighbourhoods. This social-ecology perspective, retrieved from developmental psychology and urban sociology, contrasts with the microeconomic framework employed in most of transportation research. This requires a new perspective to study children travel to and from school. Social ecology explicitly recognizes the multiple sources of influence on modes of children's travel to and from school and provides a useful analytical framework.

The social ecology perspective recognizes that all environments which children are exposed influence on their travel behaviour. Most researchers have acknowledged the importance of household characteristics for understanding children's school travel behaviour. However, social ecology represents a shift from individualistic paradigms, where one's travel behaviour is determined from a set of individual factors, to a model where multiple sets of factors influencing at different levels, e.g. children, household, neighbourhood (King et al., 2002; McDonald, 2005; Beck & Greenspan, 2008; Ahlport et al., 2008). It confirms several factors influence mode choice for children: distance between home and school, urban form, child's age and gender, household car availability and the number of cars in a household, number of children in a household and their age, parents' work pattern, personal safety, traffic safety and children's travel preferences. However, few statistical analysis of the relative influence of various factors has been done (Weigand, 2008; Sirard & Slater, 2008).

Some recent studies used a comprehensive transportation disciplinary model incorporating physical environment factors and social processes that impact on physical activities. However, they did not consider the interaction between aforementioned factors (Franzini et al., 2010). Other research with a similar approach indicated that the

traffic dangers and social dangers must be considered in parallel if we want to avoid having any barriers concerning the children's journey (Johansson, 2003).

Very limited research has looked directly at relationship between total physical activity of children and their walking to and from school, and what research found has shown contradictory results. Cooper et al., (2005) examined how walking to school impact overall primary-aged children's physical activity in Denmark. Their findings showed boys who walked to school were significantly more overall active than girls who also walked to school. Other study in US found that walking to school increase only a small amount (3%) of children's total weekly physical activity (Sirard et al., 2005). Since children are deeply embedded in their family contexts, parents' attitude plays an important role in cultivating habits in children. As such, supportive parents who encourage their children to interact with the environment and allow them to enjoy some of the childhood adventures were positively associated with physical activities and walking (Kingham & Ussher, 2007; Ahlport et al., 2008; Pont et al., 2009, Panter et al., 2010). These findings are useful to educate parents and children on benefits of children's walking to and from school that is cheap and good for children's health as well public health.

Studies relating to the built environment and public health also suggest that the built environment has some association with children's travel mode. For example Frank and Engelke (2005) and Ewing et al. (2004) found that mixed land use and residential density were positively related to physical activity. One study found that the perception of places to play is positively associated with children's physical activities (Hume et al., 2009).They also revealed that block size and block length are related to obesity and other health outcomes. Studies also showed children from highly-walk able neighbourhoods with grid-style are more active compared to those from low-walk able

lollipop style neighbourhoods (Pont et al., 2009). These studies showed a small but significant association between the built environment and health. Moreover, all these studies are cross-sectional and cannot explain causality.

Kelly-Schwartz et al. (2004) used hierarchical linear modelling with more detailed measures of the built environment. The result of the study showed a positive relationship between a connected street network and health, but a negative relationship between density and health. It suggested further analysis of the data with more attention concerning the complex relationship between the built environment and health. In a related research using the same data set, Doyle et al. (2006) found that the built environment influences people's walking rate in less crime-prone areas, even after controlling for a variety of individual variables related to health.

Other studies explored the relationship between the built environment and air pollution. They found that improving the built environment can discourage people to drive their own car, and increase the traffic safety and personal safety. Since the main source of air pollution in developing countries (i.e. Iran) is motor vehicle emissions, by improving the built environment, the air pollution may improve as well (Briggs et al., 2008).

The research that focused on walking and cycling developed a better assessment of the physical environmental factors. Banister (2008) indicated that pedestrians, cyclists and drivers play different role on the streets. One study showed that to get a clear understanding of the factors influencing the travel pattern, cycling and walking should be examined separately (Hume et al., 2009).In one of the few studies that explicitly examined bicycle use, Troped et al. (2001) and Troped (2006), looked at the association between the objective physical environmental factors and the use of a community rail trail. The authors found that steep hills and greater distance from home

to the trail were associated with the non-use of the rail trail. While, since the 1990s, the Dutch government has invested a lot in promoting cycling, focussing on children's trip to school by providing parking areas for bicycles around the schools (Martens, 2007).

The conclusion from the majority of studies conducted is that the built environment has a marginal impact on children's active commuting to school. The rationale for the structure of the contributing factors in shaping barriers in the built environment from both the children's and parents' views in choosing active travel modes to school is outlined in the following sections.

The most difficult aspect of modelling children's travel behaviour is that their travel choices strongly rely on their parents' perceptions of safety in the neighbourhood and their beliefs about what modes are appropriate. Parents comfort with the child's use of independent travel modes to go to and from school influences the overall mode choice. However, it is impossible with large-scale surveys to measure how parents feel about their child's autonomous travel to and from school. Therefore, the model which is employed in this research considers the characteristics of neighbourhoods, households, and children and examines their relative impacts on children's mode choice to go to and from school. Although there is limited literature directly on the topic of children's travel to and from school, this study draws from previous research on children's travel behaviour, the relationship between travel and the built environment, neighbourhood effects, the influence of non-urban form factors, and physical activity.

All factors that are relating to built environment and walking to school are summarized below (Figure 2.1):
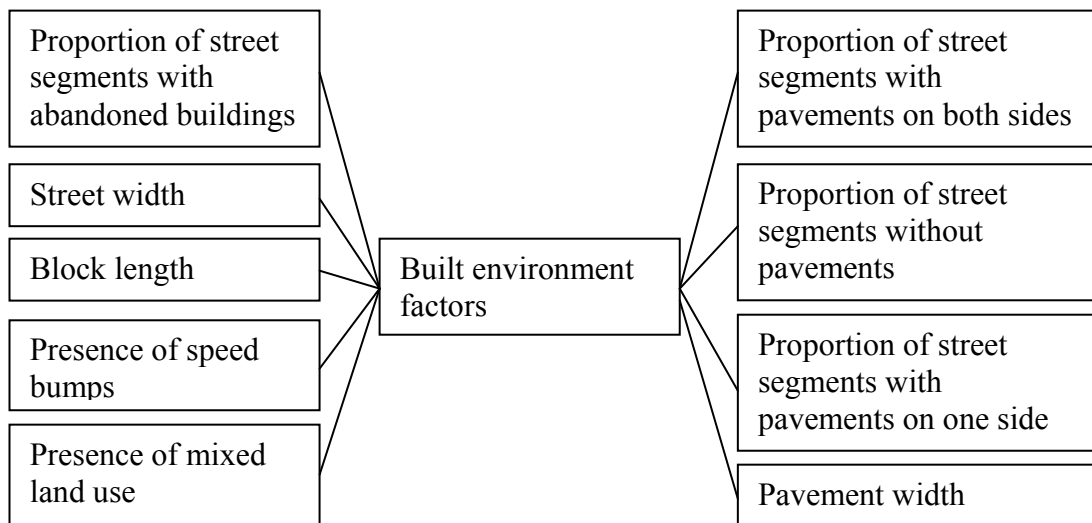
Figure 2.1: Built environment factors which correlates with walking to and from school

2.4.1 Neighbourhood safety

In 1997, Safe Routes to School (SR2S) programs, aimed at making the school journey safer and healthier for children. This program assumes a direct relationship between improving the built environment and increasing the number of children walking to and from school. However, the evaluation of SR2S showed lack of personal safety in a neighbourhood may decrease a child's walking to and from school (Corsi, 2002; Boarnet et al., 2005).

Many studies have been conducted concerning personal safety in neighbourhoods, but they rarely went deeper to recognize the specific features of the neighbourhood that are related to children's fears, which lead to a decrease in their walking to and from school. Studies have showed that for primary school-aged children, physical environmental factors are less important than social factors; parents are more worried about their children being abducted rather than being physically injured (Granville et a.l, 2002; Yeung et a.l, 2008; McNeill et al., 2006). From the aforementioned personal safety issues are prime concerns for parents in choosing children's travel mode (Merom et al., 2006; McDonald, 2007; Schlossberg et al., 2006; Hume et al., 2009; Wendel et

al., 2009). Studies showed parents' comfort level for allowing children to walk to school on their own may be affected by elements of urban design that relate to safety, but rarely went deeper to recognize the specific physical elements which represent neighbourhood safety (McMillan, 2003; Giles-Corti & Donovan, 2002; McDonald et al., 2010). Studies also showed the actual level of crime in a neighbourhood is not as is perceived by people. Therefore, to achieve a good result, it is necessary to identify physical elements which are related to the neighbourhood safety, as well as parental and children's perception of safety.

A factor repeatedly cited in studies of children's travel to school is safety both personal and traffic. Parents express their concerns about traffic dangers, the risk of abduction or harassment (McMillan, 2005; McMillan, 2003). Research suggests that for younger children (below 11 years old) and girls personal safety factors are more important than traffic safety factors. Studies also declare parental perception of safety is not as the same as reality (Prezza et al., 2005).

Different studies show that improving the built environment and reshaping street space can make the street space safer and be a pleasure in several ways (Saelens et al., 2003). Streets that are in a poor condition or have a poor appearance and have low surveillance may promote a sense of lack of safety to pedestrians in comparison with vital and social places (Appleyard, 1981; Jacobs, 1961; Bean et al., 2008). Changing a neighbourhood's urban form may create an opportunity to supervise pedestrians who are children, and build a sense of safety in the neighbourhood (Holt, et al., 2008).

Jacobs (1961) identified the association between community relationship, personal safety and urban design. She highlighted the importance of the number of people on the street (eyes on the street) who monitor the neighbourhood and increase the perception of personal safety. All variables which are included in this category and

impact on parental decision making about their children walking to school are summarized in below diagram (Figure 2.2):
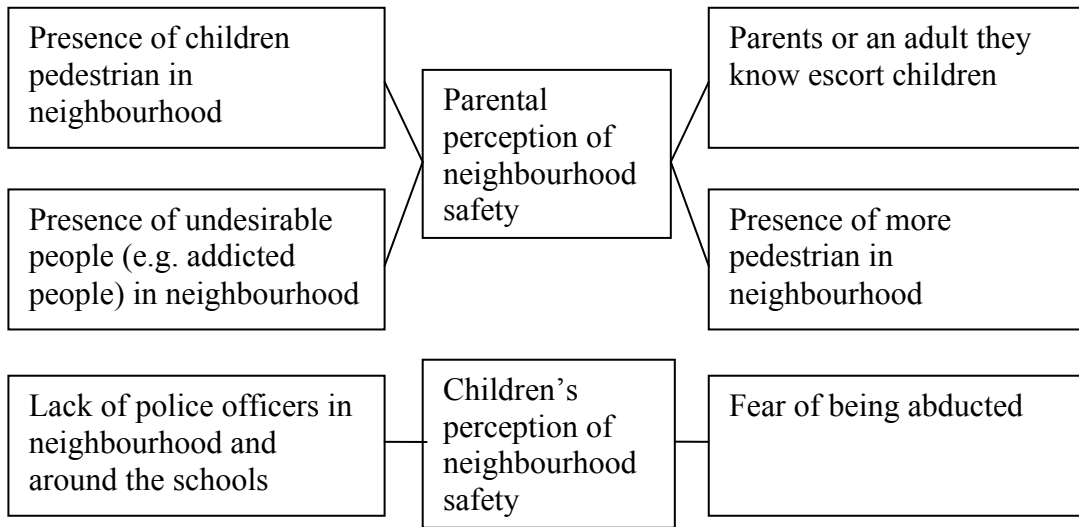
Presence of children pedestrian in neighbourhood		Parental perception of neighbourhood safety		Parents or an adult they know escort children
Presence of undesirable people (e.g. addicted people) in neighbourhood				Presence of more pedestrian in neighbourhood
Lack of police officers in neighbourhood and around the schools		Children's perception of neighbourhood safety		Fear of being abducted

Figure 2.2: Personal safety factors which correlates with walking to and from school

2.4.2 Traffic safety

Parental concerns about traffic danger and personal safety (e.g. abduction or harassment) were repeatedly considered in studies as influential factors in choosing the children's mode of travel to go to school (Prezza et al., 2005). The fear of having a car accident is one of the main reasons that parents mentioned concerning their reluctance to allow their children to walk to school (Gardner & Abraham, 2007; Lee et al., 2008). Some research suggests that parents of children (5-11 years old) are more concerned about these issues. Zargar et al. (2003), in his study, determined that children younger than 11 years old are the most vulnerable to different paediatric injuries. In some countries governments have recommended that children up to the age of 10 years old must be accompanied by an adult near a road/or should always hold an adults hand while crossing the street (Queensland Transport, 2008; Directgov, 2008; National Highway Traffic Safety Administration, 2008).

Traffic danger near schools, high traffic volume and erratic driving behaviour influence modes of children travel to school. The use of motorized modes of travel for school trips lead to increased traffic congestion on the roads as well as at school sites (McMillan, 2003,Giles-Corti et al., 2010, Ewing et al., 2004). Because many parents drop-off their children on their way to work or other destinations, reducing the number of parents who drive their children to school will not impact on overall congestion levels. However, decreasing car trips to school could lead to substantial decrease in congestion around schools. The traffic congestion in immediate environment around schools is one factor parents indicate for not allowing their children to walk to school on their own (Granville et al., 2002). Studies in UK and Israel shows that walking and cycling are more dangerous than car travel in terms of probability of having injuries especially for children who are accompanied by an adult but not holding their hands (Zeedyk & Kelly, 2003; Rosenbloom et al., 2008).

Other studies show that the physical separation of pedestrians from vehicles, pedestrian crossing signs, zebra crossings, and educating people to obey the traffic rules are the most important strategies that can decrease the pedestrian-related injuries (Zeedyk et al., 2002; Zeedyk & Kelly, 2003). Traffic calming is also an important contributing factor in decreasing the risk of injury or death for child pedestrians (Zargar, et al., 2003; Moudon et al., 2002, Napier et al., 2011). However, low speed by itself may not guarantee optimal safety; safety enforcement should be enforce safety by improving the built environment via suitable geometrical street design and avoid the extensive use of signs (Leden, et al., 2006; Selberg, 1996; Miller et al., 2004). Improving pavements is usually restricted to a small area around the school, thus does not seem very important to promote walking. However, it will prove beneficial in the long-term (Granville et al., 2002; Owen et al., 2004).

Objective measures of urban environment, such as busy roads with high speed traffic, streets with more than 4 lanes of traffic discourage parents to allow their children to walk to school (Timperio et al., 2006). Higher traffic volume and traffic speed over 40hkm/hr increase the risk of car injuries near schools and speed more than 30 km/hr along the streets decreases the likelihood of walking to school (Panter et al., 2010). Absence of cross walks and traffic signs also decreases the probability of walking to school (Timperio et al., 2006; Boarnet et al., 2005). Research conducted on public health and physical activity also suggests that physical elements in environment influence travel behaviour. For example, Pooley et al., (2011) found the physical environment (street layout, traffic speed) is as important as cultural norms and attitude towards doing exercise in determining physical activity levels in.

It is far less clear how the urban design of a neighbourhood influences a child's travel. However, there is a strong relationship between neighbourhood physical characteristics and car usage (Pan, et al., 2009; Scheiner, 2010; Giles-Corti et al., 2011). Parents indicate that the existence of suitable pavements is necessary for them to allow their children to walk to and from school, but it is not enough, as the paving is mainly meant for leisure walking (Yeung et al., 2008; McDonald, 2007). Boarnet et al. (2005) and Staunton (2003) revealed that the presence of pavements and crosswalks might increase the rate of children walking to school. McMillan (2003) found that the relationship between the built environment and children's trip to school is indirect. However, her findings might be because of the small number of school sites she studied.

The impact of traffic on parents' perception may vary depending on some demographic, socio-economic or urban form factors. Moreover, traffic safety for children is not the same as for adults. Children have problems in predicting whether or not the car drivers will stop at crosswalks. In addition, they cannot perceive the

direction of moving traffic (Leden, et al., 2006; Miller, et al., 2004). Most of the time, parents prefer to accompany their children in walking to and from school to avoid taking risk. However, studies show that children who are crossing the road with their parents are less safe than those who cross the road alone. This is because parents normally do not teach children how to cross properly but simply cross with them. Teaching traffic safety to children will improve children's behaviour in crossing the street, however, it is inconsequential and need to be repeated (Miller et al., 2004; Zeedyk, 2002). Moreover, pedestrian safety training and using crossing guards have marginal effects on neighbourhood safety because of peer pressure and safety in numbers of pedestrians in a neighbourhood (Miller, et al., 2004).

The presence of pavements, especially on main roads, increases the probability of children walking to school (Alfonzo, 2005; McMillan, 2005). The aesthetics on streets and presence of trees also help to promote walking to school. Napier et al., (2011) found that landscape buffer, trees, and bushes improve parental perceptions of personal safety and make them to let their children to walk to school. Studies also found, the rate of walking to school is higher in neighbourhood with mature trees are more walk. However, results of these studies could not address whether presence of well-connected street networks and shorter distance between desired destinations make older neighbourhoods more walk able or the presence of mature trees. While some studies found that street network connectivity can promote children walking to school, Timperio et al., (2006), showed that a direct road with a lot of intersections decreased likelihood of active transportation to school because more exposed to traffic. Another study in Australia also examined the relationship between neighbourhood walk ability and children walking to school. The result of this study also showed students walk more in neighbourhoods with connected streets if they less expose to traffic.

All variables which are included in this category and impact on parental decision making about their children walking to school are summarized in below diagram (Figure 2.3):
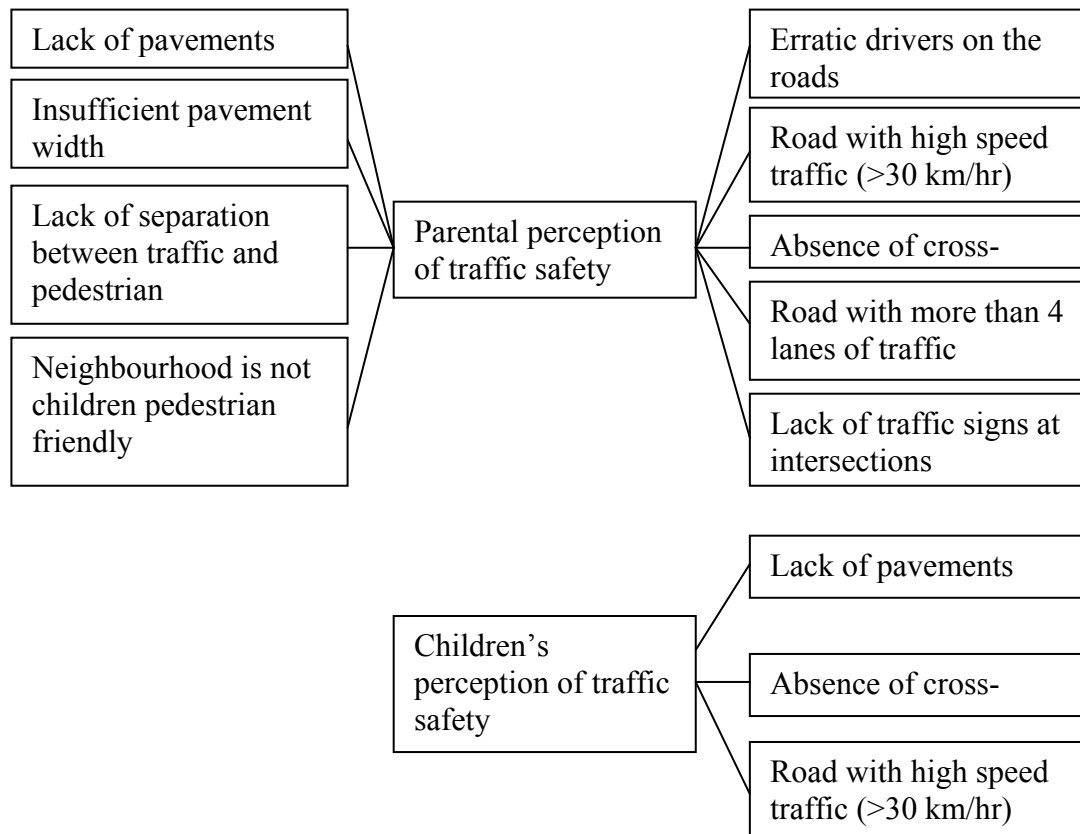

Figure 2.3: Traffic safety factors which correlates with walking to and from school

2.4.3 Travel Distance

Travel distance has a significant impact on the choice of travel mode (Hamed, et al., 2000; McMillan, 2007) and is more important for children below 10 years of age. Increasing distance (>500m) is equal to a decrease in walking (Granville et al., 2002; Yeung et al., 2008). Mixed land use, presence of first floor shops and neighbourhood with human scale decreases the travel distance (Pan, et al., 2009). The street network connectivity also impacts on the distance and promoting walking to school (Schlossberg et al., 2006).

Several studies show that distance is the most important factors to choose active travel modes. Using the median trip distance as a measure of trip costs in a study of Portland area neighbourhoods, Greenwald and Boarnet (2001) revealed that trip distance was a strong predictor of non-work walking behaviour. In a study of commuter patterns; Rodriguez (2004) found that the likelihood of travelling by foot was positively associated with an increase in the percentage of pavement availablity on the shortest route to a destination.

Examining land uses that are considered "New Urbanism", results from several of these studies, indicate that street configurations (thereby land use) may optimize the economics of travel behaviour. This happens by increasing the efficiency of the trip through shorter trip distances and decreasing travel times for the cars as well as the pedestrian (Boarnet & Crane, 2001; Camagni et al., 2002; Muller et al., 2008). These results would suggest that land use policies that locate schools in residential areas could still promote traffic around the school. This is because of trip sharing decisions and the convenience for parents to drop off their children on their way to work (Dissanayake & Morikawa, 2010).

Safe route programmes confirm that building schools within walking distance encourages parents to use their car less. McDonald (2008) found that 1-2 km distance between home and school could potentially increase walking to school. However, it does not show a significant relationship between the built environment and walking to and from school (Boarnet et al., 2005; Black et al., 2001). Moreover, studies show that even students who are living within a reasonable walking distance of the school do not walk to school independently (Dellinger & Leech, 2007). As such, although it reveals there are some other factors contributing to not walking to and from school, travel distance appears as a prime barrier (Beck & Green Span, 2008).

Programs promoting walking to school have to deal with existing situations; school locations and distance between school and home. The programs cannot address the influential factors on distance between home and school and schools' locations. However, research show that the most important predictor of walking to school is distance between home and school. The school policies that deal with choosing school site and size, can impact on distance between home and school. Research has found children are more likely to walk to small neighbourhood schools compared to mega schools in remote areas (Ewing, 2004). These findings emphasize the need for school policy to support smaller neighbourhood schools if encouraging children to walk is a priority. In this study, school location and size is not considered because all schools were involved in the study are small neighbourhood studies according to policies in Tehran.

2.4.4 Socio-Demographic variables

Studies repeatedly show that demographic characteristics of families such as age, gender, parents' occupation (especially the mother's occupation) and the number of children in a family indirectly influence the choice of travel mode by parents (Hamed & Olaywah, 2000; Gardner & Abraham., 2007; Pan et al., 2009).

Child's age and gender are important in determining children's travel. Several studies show that age is one of the most important factors in allowing children to walk to and from school independently because the younger the child, the less streetwise they are (Miller et al., 2004; Yeung et al., 2008; Timperio et al., 2006). Kerr et al. (2006) found that parents of children aged 12-18 had significant fewer concerns about their children's safety while walking to school.

Gender may also affect the parents' decision-making about children's trips to school. Parents are usually more concerned about their female children (Granville et al.,

2002; Fyhri & Hjorthol, 2009; McDonald, 2011). A study of Toronto children showed that suburban boys were allowed to travel farther than girls (Buliung et al., 2009). However, studies which conducted in urban areas did not show any difference in geographic range. It shows the fact that desired destinations are generally closer in cities than in suburbs, so there were fewer reasons for parents to limit their female children's travel in the city (Gallinore et al., 2011). More recent studies continue to show gender differences in children's travel to and from school, particularly among primary aged school children (Børrestad et al., 2011; Bere at al., 2008; Muller et al., 2008; Ben & Greespan, 2008). Research on the travel behaviour across income groups suggests ethnicity is a mediating factor in a relationship between age, gender, and travel freedom (McDonald et al., 2004).

The number of children in the family also affects parental decisions about their children school travel patterns (Ahlport et al., 2008). Families with more than one primary-age child prefer to use motorized modes of transportation to and from school. The presence of young children (below 5 years old) also makes parents choose motorized modes of transportation for their children, or if car is not available to them, they have to allow their child to walk to and from school independently. While it might be convenient to drop off one child at school, it is much more time consuming to do the same with three children. However, if all three children go to the same school, it will be more convenient for their parents to drive them to school. These simple examples show that household characteristics is strongly influence children's travel patterns (Weigand, 2008). In addition, children are less likely to walk to school when household has more licensed drivers to provide rides (McMillan, 2006).

Parents' work schedule, car ownership in a household, number of children in a household, presence of younger siblings in household, mother's occupation and father's

work travel mode. Studies revealed parents who drove their children to school combined this trip with their work travel. Research in US and UK showed that the presence of younger children in a household makes parents' trip chains more complicated and encouraged them to drive their own car (Yarlagadda & Srinivasan, 2007; Granville et al., 2002).

Yarlagadda & Srinivasan (2007) found that parents work schedules, make them more or less available to transport their children and it is different for trip to and from school. Mothers who are housewives are more likely to walk with their children (McDonald, 2005; McDonald, 2008). Mothers are more likely to travel with their children to school either drive them or walk with them (McDonald, 2008). Therefore, mothers' occupation affect on children's modes of travel to and from school and their freedom to travel on their own, but needs to examine more. They found mothers who worked part-time were more likely to escort their children to school (on foot) compared to both full-time mothers and house wives. Additionally, parents have some control over when children begin to use independent modes of travel, e.g. autonomous walking to and from school, and it also depends on their availability and work commitments.

All variables which are included in this category and impact on parental decision making about their children walking to school are summarized in below diagram (Figure 2.4):
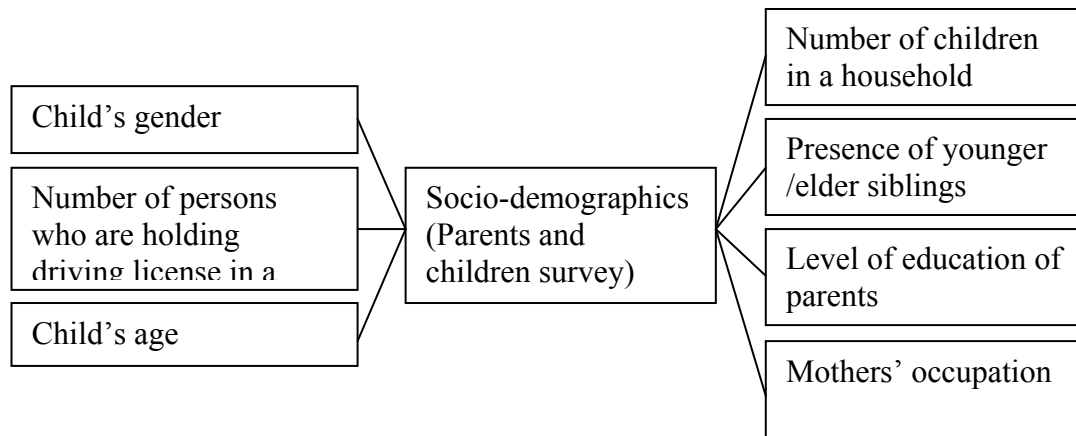
Figure 2.4 Socio-demographic factors which correlates with walking to and from school

2.4.5 Socio-economic variables

Not only individual characteristics important to explain children's school travel patterns, transportation alternatives and economic status of family also matter. According to the policies that encourage people to walk, such as Smart Growth, and Safe Routes to School (as a specific policy to encourage children to walk to school), strategies adopted should target both the physical development of urban regions and people's attitudes via providing transport alternatives (Scott, 2007). Although traffic safety and neighbourhood safety are associated with the decision-making concerning the travel mode to school, factors such as access to an automobile or the number of cars in a household may affect the decision-making (Granville et al., 2002). Travel cost and time are very important in choosing travel mode, and travel time should be as short as possible. However, sometimes the relationship between the number of cars in a household and transit trips is greater than that of the travel time and cost. This is because the use of car can decrease the travel time and seems less expensive (Banister 2008; Granville et al., 2002; Gardner & Abraham., 2007; McDonald, 2008).

Most previous studies of transportation for adults and children examine travel choice according to monthly household income and household car ownership (Kerr et al., 2006; McDonald, 2008; Ewing et al., 2004). Income affects travel needs and

choices, because it is correlated with the number of household cars that directly determine the transportation option available to family. Other research confirms that as income increases, people are more likely to use cars for both work and non-work activities because it is more convenient for them (Pan et al., 2009; Gardner & Abraham, 2007).

Concern about the socio-economic status of neighbourhoods in transportation studies started in the 1920s. There are two prominent approaches to understanding the influence of the neighbourhood on travel behaviour. The first relies on indicators of different socio-economic status areas such as the percentage of poor households and households with single parents measured from the Census or block group level. Their results indicated that the neighbourhoods, and particularly the presence of rich neighbours, affect the child's development, and that it varies by income and race. However, it failed to explain how these effects occur (Weigand, 2008; Martinez et al., 2008; Hume et al., 2009).

The research with the second approach focused on theorizing the spatial social processes in the neighbourhood to explain the influences of neighbourhood on travel behaviour. The research showed that three aspects of neighbourhoods created collective efficacy for children:

1- The connection between the adults and children in a community (e.g. if parents know their children's friend; parents in neighbourhood know each other and local children) provides social support for children (it is positively related to rich neighbourhoods).

2- Adult interaction concerning bringing up children (it increases in stable and rich neighbourhoods with low population density).

3- Informal social control (more likely to be in rich neighbourhoods).

In conclusion, parents allow their children to travel independently if they trust their neighbours to act on behalf of their children to protect them against violence and control their bad behaviour (Ahlport et al., 2008).

Some other studies also examined the differences in travel making decisions across different socio-economic status areas. The majority of these studies also focused on household car ownership and household average of income as the most popular variables that influence the travel making decision. Household car ownership is considered as an important barrier to children to walk to school because it increased the probability of parental trip sharing with their children (Scheiner, 2010; Dissanayake & Marikawa, 2010; Dissanayake et al., 2009; Pont et al., 2009; Hine, 2009). Studies show that the rate of walking is the highest among low-income people. Lower income groups tend to live nearer to facilities (e.g. shops, schools) to avoid travel cost. In addition, car is not available to all low-income households, so they have limited travel options to choose (Zhang, 2006; Lotfi & Koohsari, 2009; McDonald, 2008). Cooper et al. (2005) found that children from low-income areas also are more likely to walk to school.One study in Iran also explored walking among low-income groups,of measuring objective accessibility to neighbourhood facilities and concluded that poor households use the nearest facilities to avoid the travel cost (e.g. primary schools) and rich households prefer to stay away from the crowded areas (Lotfi & Koohsari, 2009). It confirmed the findings of other studies that showed people from low-income areas are more likely to walk or be physically active than those who live in high income areas (Franzini et al., 2010; Hine, 2009). This can support the results from other studies that showed physical-activity-related facilities are not always worse in low income neighbourhoods (Cradock et al., 2009; Ellaway & Macintyre, 2007; Fairburn et al., 2005, Van Dyck et al., 2009).

The majority of studies conducted on walking across income groups only compared the physical environmental elements across different neighbourhoods, and did not assess the influence of socio-demographics (e.g. traveller age or gender) on travel decision-making or the level of physical activity (Franzini et al., 2010). A study in Australia examined children's independent mobility in low and high socio-economic status areas in Melbourne (Timperio et al., 2006). The study concluded that aspects of social and physical factors in different neighbourhoods may influence children's active commuting, however, only a limited range of these factors (i.e. age, peer pressure, busy road, neighbourhood terrain and crossing walks) were assessed.

Studies repeatedly showed that choosing the mode of travel, in general, and children's mode of transportation to school, in particular, is associated with a wide range of socio-economic characteristics of the neighbourhood. However, they rarely examined the specific factors that contributed in this matter (Hamed & Olaywah, 2000; McDonald, 2008). Moreover, people's desires, perceptions and travel habits may vary across different neighbourhoods and especially the desires of children whose voices are seldom heard.

Focus groups and social approach studies built an argument that walking and driving cannot be understood simply as behaviours facilitated by urban form, they have social meanings and travel patterns that may vary across different socio-economic status areas (Bean et al., 2008). It is important to identify whether the differences are because of the demographic characteristics of the inhabitants of that particular neighbourhood or because of the difference in the urban design of the neighbourhoods. Facilitators or barriers in lower socio-economic areas may be different from high-economic areas (Falb et al., 2007).

2.4.6 Culture norms and individual attitude

This section outlines the parental attitude and cultural norms impact on children's travel to and from school. Parents are critical to study children's travel to and from school because they may directly determine children's travel patterns by acting as the chauffeur or the permission-giver. Additionally, household trip interdependencies, especially the connection between travel to school and work (Black et al., 2001) often play an important role in the decision. For example, in a study in US, when parents were asked about the reason they drive their children to school, more than 40% of them indicated the ease of dropping off the child on the way to work (Schlossberg et al., 2006).

There are limited studies on children's perception and attitudes, because especially at younger ages, their parents choose mode of travel to school for them. One study conducted in Australia, 19 primary school were involved, examined both parents and children's perceptions of safety related to children's walking to school. The researchers found that, parental perception of traffic safety and personal safety in neighbourhoods was so different from children's perceptions. Parents were more negative about the neighbourhoods and although children were aware of their parents' view, they were disagree (Timperio et al., 2003). Therefore, parental education could increase cycling and walking to school.

The influence of children's own travel preferences on their school travel patterns is not well understood. The existing research on this matter suggest that travel represent important socializing time for many children and enhance social interaction between them and it impact on their travel mode preferences (Hume et al., 2005; Fyhri et al., 2011). It appears that socializing with friends on the school bus, or the desire to avoid chatting with classmates affect school travel mode preference for children (Xypolia,

2003; Hume et al., 2005). This finding show that travel is not only a derived demand, but also relate to individuals' comfort and attitude. The opportunity for children to interact with their friends and classmates on the way to and from school is s less prominent for parents. However, some parents consider interaction between children while deciding about children's school travel modes (McDonald, 2006).

Studies on walking to school and the importance of social interaction in US and Australia found that children will walk to school more if their parents value social interactions (McMillan, 2006; Timperio et al., 2006). Another study in US also found social interaction influenced the decision to walk, especially for distance less than 1.6 km (McDonald, 2007). This emphasizes parents are more likely to let children walk when they trust and know their neighbours. Parents will allow their children to walk to and from school autonomously depends on their trust of their neighbours to act on behalf of their children for their safety as well as control their bad behaviour. Therefore, parental education could increase walking and cycling to school. All variables which are included in this category and impact on parental decision making about their children walking to school are summarized in below diagram (Figure 2.5):
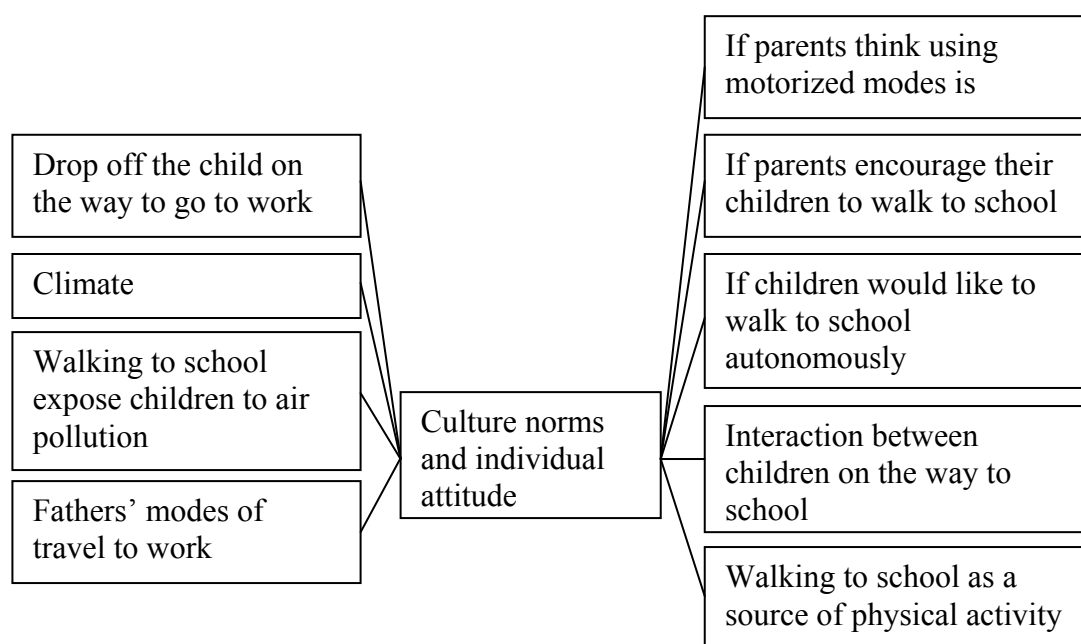

Figure 2.5: Culture norms and parental attitude which correlates with walking to and from school

2.5 Conclusion

Although in recent decade many research conducted on children's travel to school, limited literatures have studied trip to and from school separately and examined influential factors across income groups. Some studies looked at effects of built environment on decision making about children's travel. Some other studies examined the influence of neighbourhood design on parental decision about their children's travel to school. Urban sociology studies considered the relationship between socio-demographic factors, personal safety and children's modes of travel to school. An analytical framework with socio-ecological approach that is appropriate to achieve the objectives of this study requires a deep understanding of the effects of the factors at different levels. As such, there is a need to measure the physical environment at a different scale (e.g. neighbourhood scale, region) as well as identifying the relationship between physical, social factors, socio-demographics, socio-economic factors, and cultural norms with each other and with walking to school. It helps to examine the direct and indirect relationships and interactions between variables more carefully. The models and the frameworks will discuss more in chapter (4), however, the review in this chapter provides guidance in outlining these relationships.