School Travel Mode Use: Direct and Indirect Effects through Attitudes and Transport Priorities

Article *in* Transportmetrica · September 2018

DOI: 10.1080/23249935.2018.1529838

3 authors:

Milad Mehdizadeh
Iran University of Science and Technology
13 PUBLICATIONS **31** CITATIONS
SEE PROFILE

Mohsen Fallah Z.
Kharazmi University
17 PUBLICATIONS **65** CITATIONS
SEE PROFILE

Trond Nordfjærn
Norwegian University of Science and Technology
88 PUBLICATIONS **716** CITATIONS
SEE PROFILE

Transportmetrica A: Transport Science

ISSN: 2324-9935 (Print) 2324-9943 (Online) Journal homepage: http://www.tandfonline.com/loi/ttra21

School Travel Mode Use: Direct and Indirect Effects through Parental Attitudes and Transport Priorities

Milad Mehdizadeh, Mohsen Fallah Zavareh & Trond Nordfjaern

To cite this article: Milad Mehdizadeh, Mohsen Fallah Zavareh & Trond Nordfjaern (2018): School Travel Mode Use: Direct and Indirect Effects through Parental Attitudes and Transport Priorities, Transportmetrica A: Transport Science, DOI: 10.1080/23249935.2018.1529838

To link to this article: https://doi.org/10.1080/23249935.2018.1529838

Accepted author version posted online: 27 Sep 2018.

Publisher: Taylor & Francis & Hong Kong Society for Transportation Studies Limited

Journal: *Transportmetrica A: Transport Science*

DOI: 10.1080/23249935.2018.1529838

School Travel Mode Use: Direct and Indirect Effects through Parental Attitudes and Transport Priorities

Milad Mehdizadeh[a*], Mohsen Fallah Zavareh[b], Trond Nordfjaern[c]

[a] *School of Civil Engineering, Iran University of Science and Technology, Tehran, Iran*

[b] *Kharazmi University, Department of Civil Engineering, Faculty of Engineering, Tehran, Iran.*

[c] *Department of Psychology, Norwegian University of Science and Technology (NTNU), Trondheim, Norway.*

***** Corresponding author, Iran University of Science and Technology, School of Civil Engineering, Transportation Planning Department, Tehran, Iran. E-mail addresses: milad_mehdizadeh@ymail.com, milad_mehdizadeh@civileng.iust.ac.ir (M. Mehdizadeh), Phone: +98 9365317045, Fax: +98 9365317045

School Travel Mode Use: Direct and Indirect Effects through Parental Attitudes and Transport Priorities

Abstract

The present study aimed to investigate a complex structural framework linking socioeconomic, built environment and demographic characteristics to parental mode choice for children's school travels. The study examined associations between background variables and behavioural outcome, both directly and indirectly through mediating factors. Parental attitudes towards walking, transport safety and priorities regarding the mode of transportation were considered as mediating latent factors in this study. A total of 1078 questionnaires were distributed among 7–9-year old pupils in nine primary schools who requested their parents to complete the questionnaires (return rate: 80%). Two SEM models were tested to explore how walking and using car could be explained by the exploratory variables. The SEM-analyses highlighted that in addition to direct effects, indirect effects of explanatory variables on travel mode choice identified several previously unexplored relations. Findings showed that higher educated mothers, higher car ownership, less physical exercise, shorter distance to school and lack of access to school services and public transport were both directly and indirectly (through mediating factors) related to the decision of choosing the car as the mode of transportation. The results suggest that enhancing safety knowledge among less-educated parents, those with limited access to public transport and those whose children study in public schools could be related with more walking on school trips. Pull factors aimed at making school transport services more punctual or making sustainable transport modes (e.g. walking and cycling) more attractive for children, could relate to reduced use of private cars in the study area.

Keywords: Indirect effects; car use; walking; school travel; attitudes; transport priorities

1. Introduction

School travels constitute an important share of the total trips undertaken in most cities on a yearly basis. It has been shown that since school travels are mandatory daily travels, they may potentially constitute the basis for the habitual use of a similar mode of transportation in the future when the children are grown up (Verplanken, Aarts, and Van Knippenberg 1997; Verplanken and Orbell 2003; Muromachi 2017). When a behaviour becomes habitual, it turns rather automated and receives less cognitive attention. This may make the behaviour change-resistant and may render interventions, that require deliberate processing, ineffective. It has been widely emphasised that more traffic congestion, higher travel costs and travel time, more environmental degeneration (e.g. in terms of more fuel consumption and more air and noise pollution) and the higher probability of road crashes are among the direct consequences of increased car reliance (OECD 2002; Albertsson and Falkmer 2005). Therefore, it is prudent to investigate factors with potential implications for interventions to reduce car use or promote active travel (e.g. walking) in school travels, particularly in middle-income countries with higher rates of economic growth and car ownership (El-Geneidy et al. 2013) such as Iran.

The rate of motorization (number of passenger vehicles per one thousand inhabitants) is relatively high in MENA (Middle East and North Africa) countries. This rate is rapidly increasing in Iran, a country which had a 185% increase in its motorization rate from 60 in 2001 to 171 in 2011 (Eskafi 2016). Iran is among the four countries with the largest oil and gas reserves in the world. It is also one of the countries in the world with the lowest fuel prices. From a cultural point of view, the country has gender differences in social activities, where females generally have more restrictions in the social arena than in Western societies. In addition, due to the lack of safe and efficient transport facilities (active transport facilities in particular), individuals may also have negative attitudes towards transport safety and active transport. Active modes of transport are slowly developing and the process of modal shift from motorised to active modes is complicated. Promotion of active transport (walking and cycling) and reduction of car use on school travels is believed to be effective in order to alleviate the adverse outcomes outlined above.

The literature on school travels shows that most of the studies have been conducted in western industrialised countries, whereas only a few studies have been

conducted in middle-income countries. Particularly, the authors are aware of very few studies that have examined the relative role of attitudes and transport priorities for transportation mode use on school travels. Further, nearly all studies conducted in this area have focused on detecting the direct effects between the explanatory variables (e.g. demographic characteristics, socioeconomic and built environment factors) and the mode use outcome, without considering possible mediators. In one recent exception, applying a Bayesian Belief Network (BBN) analysis, Kemperman and Timmermans (2014) examined the direct and indirect effects of socio-demographics and physical environmental characteristics on active travel behaviour of children in the Netherlands. The authors found that several social and physical environmental variables have indirect effects on walking and cycling among children.

Considering the preceding arguments and gaps, the research questions of the current study are as follows: (1) Do psychological latent factors mediate the relationships between background variables and school travel mode use? (2) Does considering indirect effects enhance the explanatory power of the models in terms of explained variance of mode use on school travels? (3) What is the size of direct and indirect effects for different explanatory variables on children's car use and walking?

By deploying random sampling among Iranian parents, the current study will advance the literature by focusing on the mediating role of parental attitudes towards walking, attitudes towards transport safety and transport priorities between demographic, socioeconomic and built environment variables and the use of different modes of transport on children's school travels. Using a mediating factor helps to explain the effects of a third variable (mediator) that mediates the relationship between independent and dependent variables. An indirect (mediated) effect indicates the hypothetical effect between an independent variable and a dependent variable through the mediator. In other words, the indirect effect implies that the independent variable is related to the mediator, which in turn influences the dependent variable (Kline 2015; Chiou and Chen 2010; Ma, Chow, and Xu 2017). The direct effect, on the other hand, considers the effect of an independent variable on a dependent variable, without any mediating effects. The current study aimed to investigate a complex structural framework related to the mode of transport used for children's school travels, taking into account all the direct and indirect effects between the explanatory variables and the outcome variable. This type of

structural model could assist policymakers to more effectively consider the complex interrelated associations between the variables that explain mode use.

To illustrate the usefulness of the structural modelling approach, we tested two separate sets of models. First, we only tested the direct effects of background variables on the mode use. Second, using a structural equation modelling (SEM), we tested the hypothesised frameworks including both direct and indirect effects (through mediating factors) of background variables on the mode use. For each set of models, we separately considered both modes of car use and walking.

2. Literature Review

A majority of the extensively used theoretical decision-making frameworks in transport recognise attitudes (individuals' overall subjective evaluation of an object, cognition or behaviour) as an important construct that explains the decision-making process underlying pro-environmental behaviours or choices, such as less car use or more walking (Armitage, Reid, and Spencer 2011; Daziano and Bolduc 2013; Ma, Chow, and Xu 2015). Several studies have examined the role of attitudes on choice and travel mode use. For instance, Abrahamse et al. (2009) found that favourable attitudes towards using cars are directly related to more car use. Mehdizadeh, Mamdoohi, and Nordfjaern (2017) reported a positive role of stronger attitudes towards walking on walking behaviour. Armitage, Reid, and Spencer (2013) found that there is a strong support for the causal effect of attitude on the intention of single-occupancy car use. It has further been reported that favourable attitudes towards public transport could reduce the likelihood of using a car (Lanken et al. 1994).

Attitudes towards transport safety have also been found to be relevant to mode use in the general population (Moen 2008; Rundmo and Moen 2007). Attitudes towards transport safety could influence risk behaviour and transport mode choice (Rundmo et al. 2011). For example, Rundmo et al. (2011) reported that individuals with good 'safety knowledge' (i.e. knowledge about how to take care of one's own safety in transport), were more likely to choose other modes (e.g. walking) than cars in urban travels.

In addition to attitudes, there are various motivations underlying mode use, such as instrumental (e.g. comfort and travel flexibility with private car), affective (e.g.

walking is not pleasurable), symbolic (e.g. social position is expressed through the car) and pro-social (e.g. reducing air pollution) motivations (Şimşekoğlu, Nordfjærn, and Rundmo 2015; Nordlund and Garvill 2003; Steg 2005). It has been argued that transport priorities might be reflected by motivations underlying travel mode choice (Şimşekoğlu, Nordfjærn, and Rundmo 2015). Transport priorities have been investigated in general urban travel mode use on several previous occasions (Nordfjærn and Rundmo 2015; Rundmo, Sigurdson, and Cerasi-Roche 2011; Şimşekoğlu, Nordfjærn, and Rundmo 2015). For example, what an individual prioritises with respect to transport (e.g. traffic safety, travel time, travel flexibility) could influence the travel mode choice (Nordfjærn and Rundmo 2015). Şimşekoğlu, Nordfjærn, and Rundmo (2015) reported that higher priorities of flexibility in scheduling are associated with increased use of private cars. Moreover, priorities of safety as well as security and convenience, could adversely affect the use of environmentally friendly modes, such as public transport and walking.

The above-cited studies are mainly focused on adults' work travels in the general population. In contrast, relatively few studies have been devoted to mechanisms underlying the mode choice on school travels. Travel patterns among elementary school children have been shown to be markedly different than in the general population (Ermagun and Levinson 2016, 2017). The younger pupils have limited freedom to travel alone (Ferreira et al. 2007), and the mode of travel is a matter of parental choice (McMillan 2005; Mehdizadeh, Nordfjaern, and Mamdoohi 2018).

A review of research on school travel revealed that several studies in North America (e.g. McDonald 2008; Mitra and Buliung 2015; Rothman et al. 2015), Europe (e.g. Westman et al. 2017; Kemperman and Timmermans 2014), Australia and New Zealand (e.g. Carver, Timperio, and Crawford 2013; Collins and Kearns 2010) and Eastern Asia (e.g. Li and Zhao 2015; Nordfjærn and Zavareh 2017) have reported the importance of demographic characteristics (e.g. age, gender), socioeconomic variables (educational attainment of parents, car ownership) and built environment (e.g. distance to school, access to public transit) on mode of transport used by children. A number of recent studies have also analysed the modes of transport used for school travels in the MENA region (e.g. Mehdizadeh, Nordfjaern, and Mamdoohi 2018; Ermagun, Hossein Rashidi, and Ansari Lari 2015, Ermagun, Hossein Rashidi, and Samimi 2015, Ermagun, Samimi, and Hossein Rashidi 2016; Samimi and Ermagun 2012; Hatamzadeh, Habibian, and

Khodaii 2017). These studies consistently found a significant relationship between home-to-school distance and mode use on school travels.

A majority of the above-mentioned studies have only examined the direct effects of demographic, socioeconomic and built environmental factors on travel mode choice. For instance, higher income (Babey et al. 2009; Vovsha and Petersen 2005), greater access to private cars (McDonald et al. 2011; Mehdizadeh, Mamdoohi, and Nordfjaern 2017, Mehdizadeh et al. 2017; Hatamzadeh, Habibian, and Khodaii 2017) and higher parental educational status (DeWeese et al. 2013; Mehdizadeh, Nordfjaern, and Mamdoohi 2018) were found to be positively related to private car use on school trips. More walking travel time or more geographical distance between home and school was also found as important barriers for children to walk to school (Mehdizadeh, Mamdoohi, and Nordfjaern 2017; Ermagun and Samimi 2015; McDonald 2008; Ermagun and Samimi 2017).

The literature review, however, suggests a gap in exploring indirect effects (through latent psychological factors) of explanatory variables on the choice of mode of travel (e.g. car choice and walking choice). Therefore, the current research advances the literature by exploring both the direct and the indirect effects of the background variables on the outcome variable of mode use, using parental priorities in transport, attitudes towards transport safety and attitudes towards walking. In the upcoming section, we further elaborate our hypothesised framework based on the social psychological and travel behaviour literature.

3. Conceptual Model Framework

Attitude as an essential latent construct in several social cognition theories and approaches (e.g. the theory of reasoned action, the theory of planned behaviour, and the prototype willingness model) has been shown to be directly and indirectly related to behaviour (Munro et al. 2007). For instance, based on the theory of planned behaviour (Ajzen 1991) attitude could be used to explain the decision-making processes underlying travel choice behaviours (Domarchi, Tudela, and González 2008; Krueger, Vij, and Hossein Rashidi 2018). Therefore, we assumed in the present study that the attitudes, including attitudes towards safety and walking, may be correlated with parental choice of mode of transport for children's school trips.

A review of the literature on travel behaviour also showed that the background variables (including demographic, socioeconomic and built environment characteristics) could be associated with attitudes (Kim, Rasouli, and Timmermans 2017; Kamargianni and Polydoropoulou 2013) and behaviour (e.g. McDonald 2008; Mehdizadeh, Nordfjaern, and Mamdoohi 2018). For example, Kim, Rasouli, and Timmermans (2017) argued that males tend to have less environmental-friendly attitudes than females. The authors also reported that older people have less privacy-seeking attitudes towards car use. Kamargianni and Polydoropoulou (2013) found that higher levels of parental education were related to greater levels of walking and cycling attitudes among teenagers. On the other hand, several studies found direct effects of background variables on school travel mode use. For instance, higher parental educational status and longer distance from home to school were found to be negatively related to walking to school. Therefore, our first hypothesis can be formulated as follows:

Hypothesis ATT-Indirect: We hypothesised that attitudes could operate as mediating latent factors in relationships between background variables and use of travel modes. For instance, weaker attitudes toward walking and attitudes towards transport safety among households living far from the schools could be hypothesised to be related to more car use.

In addition to attitudes, priorities may also reflect individual motivational tendencies (Steg, Vlek, and Slotegraaf 2001). It has been argued that transport priorities might be reflected by motivations underlying travel mode choice (Şimşekoğlu, Nordfjærn, and Rundmo 2015). For example, what an individual prioritises in transport (e.g. traffic safety, travel time, travel flexibility) could influence the choice (Nordfjærn and Rundmo 2015). Similar to attitudes, transport priorities could also be explained by background variables. Several studies have reported that mothers have more concerns about traffic safety than fathers (Mehdizadeh, Nordfjaern, and Mamdoohi 2018; McMillan 2005). Full-time workers put more priority on travel time when choosing the mode of transport for their children (Vovsha and Bradley 2004). Hence, this can lead to the following hypothesis:

Hypothesis PRI-Indirect: We hypothesised that transport priorities operate as mediating latent factors in relationships between background variables and use of different travel modes. For example, high-income households with a high priority of convenience and high accessibility in transport might have a weaker tendency to allow their children to walk to school.

Based on the above reasoning and hypotheses, Figure 1 shows the conceptual model framework of the present study. As shown, different background variables could also be relevant to latent psychological factors such as parental attitudes (e.g. towards walking and safety) and parental priorities with respect to transport (e.g. travel costs or convenience). This leads to the following hypothesis:

Hypothesis MED-Covariate: It was hypothesised that households with different demographic, socioeconomic and built environment characteristics might have different attitudes and transport priorities, that, in turn, influence their travel mode choice for their children's school trips. In these structured relationships, different background variables were hypothesised to affect mediating factors (attitudes and transport priorities). For example, high-income households might give stronger priorities to convenience and accessibility in transport.

Finally, the last hypothesis of the study is as follows:

Hypothesis BACK-Direct: In addition to indirect effects, direct effects were also hypothesised between the background variables and the mode use outcome variable. For instance, children from households with more owned cars and a higher socioeconomic status were expected to be less likely to participate in walking.

4. Methods and Materials

4.1. Sample

The study area was the city of Rasht. Rasht is the largest city on the Caspian coast within the Iranian borders. The sampling procedure in the current study was a combination of random clustered and stratified sampling methods based on the local data available. The local data resources included census information regarding students and inventories of the schools and the educational facilities. Such information included the student

population, age and gender distribution, the educational institutes and facilities and the geographical distribution. The resources also contained socioeconomic information of the households across different regions of the city.

The city of Rasht has two districts according to the classifications by the education officials. This formed the two clusters used for randomised sampling. Stratification variables for each cluster were mainly selected based on the statistical reports (RDE 2013) that are regularly renewed and published by educational authorities on a yearly basis. School type (public and private) and gender (schools are single-gendered in Iran) were the most important variables of official classifications. We selected the schools at each district on a random basis in such a way that the proportion of each cluster in the sample was similar to that of the population while keeping the schools well-scattered across the city. For each school, the classes and the students who were given the questionnaires were selected at random. In each class, all the students were given the questionnaires and were asked to get their parents to complete them by a due date.

The study area was an old radially shaped city with a network of narrow streets, which are mostly congested during the peak hours. Available transportation modes for school trips in the study area were school service modes, private cars, walking and public transportation (including urban buses and carpooling taxis). Schools usually offer carpooling services (in the form of a 'school service' mode) for the volunteering pupils. However, the school services are not free and the charges have to be paid by the households. The routes of school services are assigned before the schools start, based on the location of the pupils' homes. The number of assigned services for each school is also dependent upon the demand for the school service mode. Services usually pick up the pupils about half an hour before the school starts. School services and private cars share the same roads and therefore the travel time for school services is not significantly different from private cars. However, the overall monetary cost of school travel by cars is higher than that of the school services, while the travel cost is the lowest for walking and public transport. The public transport in the city of Rasht, however, is not well-integrated and scheduled, which may discourage the pupils from using it on school trips.

Since the characteristics of parents and households were both assumed to be related with their children's travel mode use on school trips (McMillan 2005;

Mehdizadeh, Nordfjaern, and Mamdoohi 2018), the survey was designed in a way where the self-administered questionnaires were completed by parents. Overall, a total of 1078 questionnaires were distributed among 7–9-year old pupils in nine public and private schools with a geographical spread across the city. At the start of the questionnaire, the parents were assured about the confidentiality of the data and that the responses would have no effect on the performance evaluation of the children in schools.

Although the schools offered no incentives for participating in the study, the response rate was relatively high (80%, n = 858). More details regarding the sampling procedure and the characteristics have been reported elsewhere (Mehdizadeh, Nordfjaern, and Mamdoohi 2018). Of the total returned questionnaires, 735 were judged as adequately completed to be entered into the analysis of walking as a mode of school travel. In addition, to analyse the car use on school travels, we excluded the cases where the households did not own any private cars (n = 163). This left 572 cases available for car use analysis. Based on power analysis and conventional rules of thumb (Kline 2015) these samples were of adequate size to establish stable models and reliable results.

The most frequently selected mode for each observation in a week before the survey was assumed to be the dominant mode used on school travels. It was also observed that the mode used by children on school travels had no variation during the week before the survey. In other words, the observed mode of school travels does not deviate substantially from the dominant mode decided by the parents. This observation is in line with the assumption that the choice of mode of transport could be a habitual behaviour (Verplanken, Aarts, and Van Knippenberg 1997). In the whole sample (n = 735), which was used to analyse school walking, private car, school service (school bus and carpooling), walking and public transit constituted about 22.2%, 56%, 19% and 2.8% of modes used on school travels, respectively. For the sample used in car use analysis (n = 572), nearly 28.5% of the respondents reported that the household private car was the dominant mode on school travel, while school service, walking and public transit represented 54%, 16% and 1.5% of the modes used, respectively.

4.2. Questionnaire

The questionnaire was given to the respondents in the Persian language. The first section of the questionnaire was composed of questions covering basic background information,

including demographic characteristics, socioeconomic status and built environment variables. Each respondent reported his/her own gender and age, the child's age and gender, the educational attainment of the child's father and mother, current employment and driving license status. This section also included questions regarding the household's car ownership, income level and the level of physical activities (exercise) on a weekly basis. Furthermore, the respondents were asked to report the availability of school services and public transport on the route, as well as an estimate of walking time from home to school. The parents were also asked to report the number of times each travel mode (including private car, school service, walking, and public transport) had been used by the child in the week prior to the survey. This question enabled the authors to identify the dominant mode of school travel for each child.

Parental attitudes towards walking were measured by a validated instrument (Mehdizadeh, Mamdoohi, and Nordfjaern 2017; Transport for London 2011). This 23-item instrument includes statements such as '*Walking is an interesting way to travel'*, '*I don't feel safe walking by myself in my local area*' and '*I enjoy walking where pavements are well-maintained*'. The respondents were asked to rate their level of consent with each statement on a five-point Likert scale from (1): *completely disagree* to (5): *completely agree*. Previous work showed that this measure segmented into three components termed 'comfort and convenience of walking', 'design feasibility for pedestrians' and 'contextual and design preconditions for walking' (Mehdizadeh et al. 2016).

Parental attitudes towards transport safety were measured by a 21-item instrument, which has been validated in previous research (Rundmo et al. 2011). The measure includes statements reflecting the respondents' attitudes towards transport safety, such as '*I feel a personal responsibility for the safety of others in transport*' and '*I have good knowledge about safety in public transport*'. The respondents were asked to rate their level of agreement with each statement, on a five-point Likert scale from (1): *completely disagree* to (5): *completely agree*. Previous studies demonstrated a three-factor structure for this measure named 'personal responsibility', 'priorities of safety versus effectiveness' and 'safety knowledge' (Mehdizadeh et al. 2017; Rundmo et al. 2011).

To measure transport priorities, a revised 11-item version of a widely validated and tested instrument was used (Nordfjærn and Rundmo 2015; Şimşekoğlu, Nordfjærn, and Rundmo 2015). The parents were asked to report the level of importance they put into different aspects of transport such as '*safety towards accidents*', '*security against thefts*', '*good availability to the transportation mode (short distance)*', '*punctuality (few or none cancellations and delays)*' and '*travel costs*', when they chose a mode of travel to school, on a five-point Likert scale (1): *Not at all important* to (5): *Very important*. Previous studies have demonstrated a three-component structure for this measure termed 'priorities of convenience and accessibility', 'priorities of safety and security' and 'priorities of speed and costs' (Şimşekoğlu, Nordfjærn, and Rundmo 2015; Mehdizadeh et al. 2017). Further descriptive statistics of background variables in this study are reported in Table 1. Table 2 shows the means and standard deviations for the attitudinal factors and priorities.

[Table 1 about here]

[Table 2 about here]

4.3. Statistical procedures

The dimensionality and internal consistency of parental attitudes towards walking, attitudes towards transport safety and priorities in transport have been demonstrated in previous research (Mehdizadeh, Mamdoohi, and Nordfjaern 2017; Mehdizadeh et al. 2017; Nordfjærn and Rundmo 2015). Therefore, a Confirmatory Factor Analysis (CFA) was performed using IBM SPSS Amos 23.0.0 on each measure to verify the latent constructs developed for those measures. The Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA) and the Tucker-Lewis Index (TLI) were used as fit indices to determine the fit of the data to the specified measurement models. Furthermore, to measure the discrepancies between the observed and the model covariance matrices in each analysis, the chi-square (χ^2) value with the corresponding level of significance was also reported.

Items with statistically significant ($p < 0.01$) factor loadings above 0.32 were considered acceptable for being included in each dimension (Tabachnick and Fidell 2006). Cronbach's α was used as an indicator of internal consistency and reliability for

each factor. Average corrected inter-item total correlations (aiic) were also calculated as indicators of reliability because the alpha tends to be biased when the scales include many or few items (Hair et al. 1998). A cut-off value of 0.30 was used as a threshold for an acceptable aiic.

First, two separate simple path-analysis models were tested to examine the direct effects of background variables on the use of different modes of transport. In the first model ($M_{1\text{-}Car}$), which was based on the sample of respondents whose households owned at least one private car (n = 572), the dependent variable was considered as 1 if the household car was the dominant mode of travel, and zero, otherwise. In the second model ($M_{1\text{-}Walk}$), which was constructed based on the whole sample (n = 735), the dependent variable was set to be 1, if walking was the child's dominant mode of travel to school, and zero otherwise.

Then, to take into account the indirect effects of explanatory variables on car choice, we tested two separate structural equation models (SEM), one for car use and another for the choice of walking. These models were represented by ($M_{2\text{-}Car}$) and ($M_{2\text{-}Walk}$), respectively (as postulated in Figure 1). SEM enabled the authors to test the structural relationship between the latent variables (Kline 2015). For each SEM analysis (M_2 model), we used a two-step SEM (Anderson and Gerbing 1988). First, a measurement model was fitted for each latent variable, and thereafter, the structural relations were added to construct a joint model (including all indicators of the latent variables) to test a full structural equation model. The same fit indices used for the measurement models were also used to test the fit of the full SEM models. For simplicity, however, the reported SEM models included only significant paths at 95% confidence.

As explained earlier, the outcome variables in the two full SEMs were dichotomized variables. It has been shown that the Maximum Likelihood (ML) method of estimation may generate incorrect estimates of parameters and their standard errors when the dependent variable is a dichotomized variable (Brown 2014). Therefore, using M–Plus 7, we applied the weighted least square (WLS) estimation method instead of Maximum Likelihood (ML) estimation to test the complex inter-relationships between variables in our full SEM-analyses.

In the postulated framework of SEM analyses (M_2 model) in Figure 1, background variables were hypothesised to influence the latent variables including walking attitudes, transport safety attitudes and priorities in transport. It was also hypothesised that attitudes and transport priorities would mediate between background variables and parental choice of mode of travel. A direct effect was also postulated from the background variables to the mode use variable (either car use in $M_{2\text{-Car}}$ model or walking in $M_{2\text{-Walk}}$ model). Thereby, model M_2 examined the associations between the background variables (X) and the outcome behaviour (Y) both directly and indirectly.

[Figure 1 about here]

For each indirect effect, the regression coefficient is a multiplication of the two regression weights; namely the regression weight between the explanatory and the mediating variables and the regression weight between the mediator and outcome variables. The regression coefficient of an indirect effect (x) can be interpreted as an increase of x units of standard deviations in the dependent variable, given an increase in the explanatory variable by one unit of standard deviation through the mediating variable.

5. Results

5.1. Confirmatory factor analysis and reliability indices for attitudes towards walking

A three-factor solution (including '*Comfort and convenience of walking*', '*Design feasibility for pedestrians*' and '*Contextual and design preconditions for walking*') was identified for attitudes towards walking (also see Mehdizadeh, Mamdoohi, and Nordfjaern 2017). Items that failed to load consistently in the current analysis were excluded. These were: '*Walking is a method of transport that you would want to be seen using*', '*Walking is enjoyable*', '*Walking makes a difference in improving the environment*', '*Walking gives me time to think*', '*Walking is good for rush hour journeys in Rasht*', '*Rasht is a city for walking*', '*Walking is a good way to get fit*', '*Walking sets a good example to children*', '*Walking is only for people who can't afford other ways of getting there*', '*I don't think there are enough pedestrian information and signposts in my local area*' and '*Information and signs make it easy to find your way around Rasht*'). The three-factor solution (Figure 2) was found to have acceptable fit for both samples (for the sample size = 572; $\chi^2 = 191.59$, df = 51, $p < 0.001$, RMSEA = 0.059, CFI = 0.92, TLI =

0.91 and for the sample size = 735; $\chi^2 = 178.42$, df = 51, $p < 0.001$, RMSEA = 0.052, CFI = 0.92, TLI = 0.92). The Cronbach's α values also reached acceptable levels for each factor in both samples.

[Figure 2 about here]

5.2. Confirmatory factor analysis and reliability indices for attitudes towards transport safety

The analyses of attitudes towards transport safety resulted in a three factor-solution, including '*personal responsibility*', '*priorities of safety vs. effectiveness*' and '*safety knowledge*' (see also Rundmo et al. 2011, Mehdizadeh et al. 2017). In the present study, nine manifest items (out of a total of 21 items) were removed from the analysis because they failed to load significantly on any latent factor in the CFA. The excluded items were: '*I trust the experts when they tell me which transportation modes that are the safest*', '*It is acceptable that those who investigate accidents are withholding information*', '*New technology will solve the problems in the transport section*', '*Transport accidents can only be avoided if human behaviour is radically changed*', '*Laws and regulations about safety are there just so the government have less responsibility when accidents happen*', '*It is first and foremost the authorities responsibility to take care of safety in the transport sector*', '*I feel a personal responsibility in preventing accidents in transport*', '*Transport safety is something I seldom think about*' and '*The most important reason for following the traffic regulations is to avoid fees*'. The current research confirmed the same three-factor solution for the attitudes towards transport safety (for the sample size = 572; $\chi^2 = 135.76$, df = 51, $p < 0.001$, RMSEA = 0.048, CFI = 0.94, TLI = 0.92 and for the sample size = 735; $\chi^2 = 122.83$, df = 51, $p < 0.001$, RMSEA = 0.043, CFI = 0.93, TLI = 0.92) (Figure 3). As shown, the Cronbach's α values reached acceptable levels for each factor based on both samples.

[Figure 3 about here]

5.3. Confirmatory factor analysis and reliability indices for transport priorities

The present study identified '*Priorities of convenience and accessibility*', '*Priorities of safety and security*' and '*Priorities of speed and cost*', as a three-factor solution for priorities in transport (see also Mehdizadeh et al. 2017). After removing three items

including '*Available seats on public transport*', '*Environmentally friendly transport*' and '*Available parking close to station/waiting spot*'), which failed to load significantly in the measurement model, the analysis revealed that the three-factor solution had acceptable fit (Figure 4) (for the sample size = 572; $\chi^2 = 65.76$, df = 17, $p < 0.001$, RMSEA = 0.058, CFI = 0.94, TLI = 0.91 and for the sample size = 735; $\chi^2 = 61.34$, df = 17, $p < 0.001$, RMSEA = 0.051, CFI = 0.93, TLI = 0.91). The Cronbach's α values also reached acceptable levels for each factor on both samples.

[Figure 4 about here]

5.4. Model testing

Table 3 shows the results of the path-analysis models $M_{1\text{-Car}}$ and $M_{1\text{-Walk}}$ that include only the direct effects between the background variables and mode use. The model ($M_{1\text{-Car}}$) had an overall good fit to the data ($\chi^2/df = 2.13$; $p < 0.001$, RMSEA = 0.035, CFI = 0.93, TLI = 0.92). This model, however, accounted for a relatively low proportion (20%) of the variance in the car choice. The model also indicated that eight background variables had significant direct effects on car choice. The model ($M_{1\text{-Walk}}$) also had an overall acceptable fit to the data ($\chi^2/df = 2.37$, $p < 0.001$, RMSEA = 0.042, CFI = 0.94, TLI = 0.92). This model also accounted for a relatively low proportion (23%) of the variance in walking choice. This model showed that five background variables had significant direct effects on walking choice.

[Table 3 about here]

Upon the establishment of the factor structure of mediating variables, we tested the full hypothesised framework postulated in Figure 1 (M_2). All variables used in the SEM were shown to follow a normal distribution. Further, the Shapiro-Wilk (S-W) test for all variables indicated no significant deviations from normality. We tested several models including all potential combinations of direct and indirect effects (i.e. a saturated model) between the variables and finally selected the model that comprised of the highest number of significant relations while controlling for the minimum requirements of the fit indices. The results of testing the $M_{2\text{-Car}}$ and $M_{2\text{-Walk}}$ models are illustrated in Figures 5 and 6, respectively. The findings indicate that the hypothesised full SEM $M_{2\text{-Car}}$ model had an overall good fit to the data ($\chi^2/df = 1.75$; $p < 0.001$, RMSEA = 0.031, CFI = 0.94,

TLI = 0.93). This model accounted for a relatively high proportion (67%) of the variance in the car choice. The model also revealed several significant indirect effects in addition to direct effects between the variables. Therefore, the results suggested that model $M_{2\text{-Car}}$ augmented the first model ($M_{1\text{-Car}}$) by adding the latent mediating factors.

[Figure 6 about here]

Out of the nine mediator factors in model $M_{2\text{-Car}}$, eight latent factors (including 'personal responsibility', 'safety knowledge"' 'comfort and convenience of walking', 'design feasibility for pedestrians', 'contextual and design preconditions for walking', 'priorities of convenience and accessibility', 'priorities of safety and security' and 'priorities of speed and cost') could be explained by the background variables. For instance, increased age of parents, higher educational attainment among mothers and fathers, studying in private (vs. public) schools and access to public transport were related to more 'safety knowledge' in parental attitudes towards safety in transport (Figure 5). Furthermore, all those eight mediating factors were significantly related to car choice.

In a similar vein, analysis of the full SEM $M_{2\text{-Walk}}$ model indicated an overall good fit to the data ($\chi^2/df = 1.97$; $p < 0.001$, RMSEA = 0.031, CFI = 0.94, TLI = 0.93). The model also accounted for a relatively high proportion (53%) of the variance in walking choice. This model revealed several significant indirect effects in addition to direct effects between the variables as illustrated in Figure 6. Therefore, the results indicated that in exploring the relations between the variables, the full SEM model ($M_{2\text{-Walk}}$) augmented the first model ($M_{1\text{-Walk}}$) by adding the latent mediating factors.

Based on the frameworks depicted in Figures 5 and 6, the direct, indirect, and total effects of the background variables were summarised in Table 4. All effects were shown to be statistically significant at 95% confidence interval. This table shows the potential role that each variable had in the structural models (in the $M_{2\text{-Car}}$ and the $M_{2\text{-Walk}}$). As illustrated in Table 4, out of 16 background variables, 12 variables (including pupils' gender, parental age, mother's educational attainment, father's educational attainment, father's job status, car ownership, income, physical activity, perceived walking time to school, access to school services, access to public transport and type of school) were significantly related to children's car use ($M_{2\text{-Car}}$) on school travels, indirectly through

the mediating variables of parental attitudes towards transport safety, parental attitudes towards walking and parental priorities in transport. Out of these 12 variables, six variables (i.e. pupils' gender, parental age, father's educational attainment, father's job status, income and type of school) did not reach significance in directly explaining private car use on children's school travels. For the remaining six variables (i.e. mother's educational attainment, car ownership, physical activity, perceived walking time to school, access to school services and access to public transport), both the direct and indirect effects reached significance. These six background variables had consistent indirect effects on car choice through mediating factors. Furthermore, comparing the regression coefficients of indirect effects with the regression coefficients of direct effects (i.e. between the explanatory variables and the outcome), the results showed that the indirect effects were stronger than the direct effects for all those six variables.

[Table 4 about here]

In addition, as Table 4 suggests, out of 16 background variables, 11 variables significantly explained children's walking use ($M_{2\text{-}Walk}$) on school travels, indirectly through the mediating variables. Out of these 11 variables, seven variables did not reach significance when directly explaining the walking choice on children's school travels. For the remaining 4 variables (i.e. mother's educational attainment, car ownership, perceived walking time to school, and access to school services), both the direct and indirect effects reached significance.

6. Discussion

The present study aimed to investigate the direct and indirect effects between the explanatory variables of background characteristics through mediator factors including attitudinal factors and transport priorities, on parental mode choice on children's school travels in an Iranian sample. In most previous studies efforts have been devoted to scrutinising only the direct effects of the background variables, such as socioeconomic characteristics (Mitra 2013; McDonald 2008). In contrast, the findings of the present study answered the research questions of whether the modes of travel used on school travels could be associated with not only the direct effects of background variables but also the indirect effects through the mediating variables of attitudes and transport priorities.

This adds to the previous research in the sense that while some background variables are only directly associated with the outcome variable of mode use, some other background variables are solely indirectly related to travel mode choice. For example, the present study established an indirect relationship between the independent variables of household income, and age and the outcome variable of car use on school travels. In contrast, McDonald (2008) found a direct effect between non-car choice and age of pupils. The author reported that younger children are more likely to choose cars on school travels. Several other studies have also reported the direct effect of higher household income on car choice (Babey et al. 2009; McDonald 2008; Vovsha and Petersen 2005). Findings of the present study, however, supported that compared to the models including only direct effects between background and outcome variables, indirect effects of explanatory variables on travel mode choice could identify several previously unexplored relations between explanatory variables and mode use on school travels. Findings also suggested that the addition of mediator variables could enhance the explanatory power of the models in terms of explaining the variance of mode use on school travels.

For all explanatory variables where both direct and indirect effects reached significance, the current study revealed that the indirect paths had greater coefficients than the direct paths. This implies that more weight might be given to the indirect effects when recommending policies to promote less car use or more active travel modes (e.g. walking) on school travels. In other words, policies and recommendations based on mediation might be more strongly related to walking promotion or car use reduction compared with policies that are established solely on the direct effects. This is also in line with research requirements, where complex structural relationships between the variables are expected when studying the mode choice on school travels.

In addition to indirect effects, the current study revealed a few direct effects between independent variables (e.g. mother educational attainment level and household car ownership and physical activity) and the outcome variables. These findings are consistent with previous literature and support Hypothesis *BACK-Direct*. For example, mothers' higher educational attainment levels were found to be related to less walking or more car use (DeWeese et al. 2013). Pupils from households with higher car ownership levels had a greater probability of car use and less probability to use active transport

modes (Nordfjærn and Zavareh 2017; McDonald et al. 2011). Furthermore, parents with high rates of exercise are less likely to escort their pupils in their private cars (Mehdizadeh, Nordfjaern, and Mamdoohi 2018).

In comparison with previous findings in Iran, the current study highlights the indirect effects of a number of explanatory variables on travel mode choice. For instance, several previous studies have reported that more motorized mode use is related to an increased distance between home and school (Hatamzadeh, Habibian, and Khodaii 2017; Ermagun and Samimi 2017; Mehdizadeh, Mamdoohi, and Nordfjaern 2017). The SEM-analysis in the present study, however, illustrated that the negative relationship between distance and walking choice might be associated with mediating factors such as priorities of cost, preconditions for walking and weaker parental personal responsibilities towards transport safety. Therefore, this results partly support Hypothesis *ATT-Indirect* and Hypothesis *PRI-Indirec*t.

The structural framework in the present study provided insights into how mode use on school travels is associated with background variables through parental attitudinal factors and transport priorities. Such indirect effects may help to identify factors that may be targeted by interventions aimed at reducing car use or promoting walking on school travels. Such interventions may intervene on the mediating variables. The interventions could also target specific groups based on the background characteristics that had a strong correlation with the mediating variables.

In line with the hypotheses of the current study (e.g. *ATT-Indirect* and *PRI-Indirect*) parents with stronger attitudinal factor of safety knowledge (knowledge about how to look after personal or others' safety in transport) were shown to be less likely to choose cars (or more likely to choose walking) on their children's school travels. On the other hand, the findings showed that older parents, more educated mothers and fathers, parents of pupils studying at private schools and households with access to public transport had more safety knowledge. Therefore, interventions targeted to decrease car use on school travels might increase the effectiveness by promoting safety knowledge among younger and less educated parents, parents of students at public schools, and parents of pupils that have less access to public transport.

Individuals for whom the design feasibility is perceived necessary for their walking (e.g. where pavements are well-maintained, or the streets are well-designed), were shown to be less likely to choose cars on children's school travels. Such attitudes were shown to be reversely correlated with the parental level of exercise and mothers with low educational attainment. Hence, providing well-maintained pavements and streets could reduce the share of car use and increase the share of walking on school travels, particularly among children of those groups of parents.

On the other hand, parents with high scores on contextual and design preconditions for walking were shown to be less likely to allow their children to walk to school. In other words, traffic fumes, dirty and vandalized streets might contribute to a negative evaluation of walking by this group of parents. The structural model showed that parents of girl pupils, well-educated parents and people whose homes are in longer distance from schools would encourage favourable contextual and design preconditions for walking. Overall, we conclude that these findings partly support Hypothesis *MED-Covariate*. Therefore, decreasing the probability of encountering unpleasant situations in the streets would be important to encourage those groups to allow their children to walk to school.

Higher priorities of convenience and accessibility to a transportation mode (e.g. punctuality, good availability) were found to be positively related to more car choice. Findings of the current study maintained that more educated mothers, higher income households and more cars owned were associated with stronger priorities of convenience and accessibility. One possible explanation for this relationship comes from the socioeconomic status of these households, as the high-income households are more likely to have more owned cars and may not feel concerned about fuel price or other factors that may restrict car use in daily travels. These people might give more weight to other factors such as less delay, more comfort and punctuality in relation to preferring private cars. Interventions such as limiting easy access of cars to streets and roads could be more effective for these groups of parents. Such policies could be further used in combination with pull factors aimed to make school transport services more punctual, or active school travel (walking and cycling) more attractive for children. This could happen through policies such as providing opportunities for pupils to walk to school with friends in an adult-escorted and well-scheduled manner (Collins and Kearns 2010).

Stronger priorities of safety and security in transport were shown to have a positive effect on more car use and less walking to school. More specifically, this priority was rated higher among parents of girl pupils and pupils studying in public schools, well-educated mothers, and those parents who perceived a long distance from home to school. This finding may help policymakers in facilitating sustainable transport modes through implementing policies, such as providing safe and secure school services, and more safe and secure walking routes, particularly for girl pupils and those children studying in schools far away from their homes or studying in public schools. Increased likelihood of road crashes in active transport modes (e.g. walking) compared to private cars (Mehdizadeh et al. 2017) could justify why priorities of safety and security were positively related to car use. This is also in line with the Protection Motivation Theory, which suggests that a cognitive focus on safety may create a drive to modify behaviour in order to increase comfort and decrease risk perception (Şimşekoğlu, Nordfjærn, and Rundmo 2015).

Furthermore, higher priorities of speed and costs in transport were found to be positively associated with more car use. For example, the households with a longer distance between home and school reported stronger priorities of speed and costs. Policymakers may indirectly reduce the need for rapid transport by scattering the schools' location in all areas across the city.

6.1. Limitations

Since the study was designed as a cross-sectional analysis, inferences of within-person variation with time are limited and therefore the SEM lacks sufficient power for being used with the aim of prediction or policy evaluation. The method, however, could be used as a descriptive tool to explain the outcome variables (Merchant et al. 2013). Hence, it is noted that the recommendations aimed at enhancing walking or reducing car use on school trips should be used with caution, since impact assessment of the findings and in particular, tailoring policies and processes to meet the special case of the transport system in the city of Rasht require prospective/longitudinal data analysis or a before/after study design with interventions, which has not been considered in the present study.

The data were self-reported, which may lead to socially desirable responding. Moreover, based on the power analysis and conventional rules of thumb (Kline 2015) the samples were of adequate size to establish stable models and reliable results. A larger sample size, however, may give more robust conclusions and more thorough discussion of the results in terms of transferability, the generalization of findings and promotion of suggested practices.

The questionnaire in the present study did not contain instruments to measure the parental or children's attitudes towards car use. Moreover, the instrument used to measure parental attitudes towards walking did not directly address children's walking. We assumed that parents with favourable walking attitudes might have weaker tendencies to choose cars for their children or have stronger tendencies to allow them to walk to school.

The inclusion of objective measures of urban form such as network connectivity and accessibility, land use and the physical walking distance between home and school (rather than perceived walking time which we used in this study) in the vicinity of the place where the family resides could lead to an improved model. In addition to the tested variables in the current study, car use might also have other important reasons including parents' busy schedule, motivations underlying car use, habits and climate factors, which could be important avenues for further studies.

7. Conclusion

The suggested conceptual framework examined in this study addressed the direct and indirect relationships between explanatory variables of demographic, socioeconomic and built environment and the outcome variable of mode use (i.e. car use and walking), through mediating latent factors of parental attitudes and transport priorities.

Findings of the study shed light on the structure of the mechanisms behind the transportation modes used on school travels. In the present study, we explored the indirect effects of background variables on car choice on school travels through an SEM-approach since this analysis allows for investigations of complex theoretical taxonomies. Findings showed that parental attitudes and transport priorities could mediate the relationships between background variables and mode use behaviour on school travels. Compared to studies that simply considered direct effects between the independent and outcome

variables, the structure proposed in the current research may be utilised in recommending interventions for less car use or more active mode use on school travels. For instance, promoting safety knowledge among younger parents, less-educated parents, those with limited access to public transport and those whose children study in public schools may be related to reduced car use on school trips. Pull factors aimed at making school transport services more punctual, or making sustainable transport modes more attractive for children, could decrease the car use in the study area.

Such explored relationships could help policymakers and practitioners in developing more effective policies and interventions with the aim to promote sustainable modes on school travels. However, it should be noted that interventions and recommendations aimed at enhancing walking or reducing car use on school travels should be implemented with caution since identifying associations between factors could be something different than designing actions for implementation in practice.

Acknowledgement

The authors would like to thank the five reviewers for a thorough and critical review of the manuscript. The reviewers' constructive feedback and suggestions assisted the authors in enhancing the quality of the article.

References

[1] Ajzen, Icek. 1991. "The theory of planned behaviour." *Organizational behavior and human decision processes* 50 (2): 179-211.

[2] Abrahamse, Wokje, Linda Steg, Robert Gifford, and Charles Vlek. 2009. "Factors influencing car use for commuting and the intention to reduce it: A question of self-interest or morality?." *Transportation Research Part F: Traffic Psychology and Behaviour* 12 (4): 317-324.

[3] Albertsson, Pontus, and Torbjörn Falkmer. 2005. "Is there a pattern in European bus and coach incidents? A literature analysis with special focus on injury causation and injury mechanisms." *Accident Analysis & Prevention* 37 (2): 225-233.

[4] Anderson, James C., and David W. Gerbing. 1988. "Structural equation modeling in practice: A review and recommended two-step approach." *Psychological bulletin* 103 (3): 411.

[5] Armitage, Christopher J., John C. Reid, and Christopher P. Spencer. 2011. "Evidence that implementation intentions reduce single-occupancy car use in a rural population: moderating effects of compliance with instructions." *Transportmetrica* 7 (6): 455-466.

[6] Armitage, Christopher J., John C. Reid, and Christopher P. Spencer. 2013. "Changes in cognition and behaviour: A causal analysis of single-occupancy car use in a rural community." *Transportmetrica A: Transport Science* 9 (1): 1-10.

[7] Babey, Susan H., Theresa A. Hastert, Winnie Huang, and E. Richard Brown. 2009. "Sociodemographic, family, and environmental factors associated with active commuting to school among US adolescents." *Journal of public health policy* 30 (1): S203-S220.

[8] Brown, Timothy A. 2014. "*Confirmatory factor analysis for applied research"*. Guilford Publications.

[9] Carver, Alison, Anna Timperio, and David Crawford. 2013. "Parental chauffeurs: what drives their transport choice?." *Journal of Transport Geography* 26: 72-77.

[10] Chiou, Yu-Chiun, and Tai-Chieh Chen. 2010. "Direct and indirect factors affecting emissions of cars and motorcycles in Taiwan." *Transportmetrica* 6 (3): 215-233.

[11] Collins, Damian, and Robin A. Kearns. 2010. "Walking school buses in the Auckland region: A longitudinal assessment." *Transport Policy* 17 (1): 1-8.

[12] Daziano, Ricardo A., and Denis Bolduc. 2013. "Incorporating pro-environmental preferences towards green automobile technologies through a Bayesian hybrid choice model." *Transportmetrica A: Transport Science* 9 (1): 74-106.

[13] DeWeese, Robin S., Michael J. Yedidia, David L. Tulloch, and Punam Ohri-Vachaspati. 2013. "Neighborhood perceptions and active school commuting in low-income cities." *American journal of preventive medicine* 45 (4): 393-400.

[14] Domarchi, Cristian, Alejandro Tudela, and Angélica González. 2008. "Effect of attitudes, habit and affective appraisal on mode choice: an application to university workers." *Transportation* 35 (5): 585-599.

[15] El-Geneidy, Ahmed, Ehab Diab, Cynthia Jacques, and Anais Mathez. 2013. "Sustainable urban mobility in the Middle East and North Africa." *Global Report on Human Settlements*: 3-6.

[16] Ermagun, Alireza, Taha Hossein Rashidi, and Zahra Ansari Lari. 2015. "Mode choice for school trips: long-term planning and impact of modal specification on policy assessments." *Transportation Research Record: Journal of the Transportation Research Board* 2513: 97-105.

[17] Ermagun, Alireza, Taha Hossein Rashidi, and Amir Samimi. 2015. "A joint model for mode choice and escort decisions of school trips." *Transportmetrica A: transport science* 11 (3): 270-289.

[18] Ermagun, Alireza, and Amir Samimi. 2015. "Promoting active transportation modes in school trips." *Transport policy* 37: 203-211.

[19] Ermagun, Alireza, Amir Samimi, and Taha Hossein Rashidi. 2016. "How far is too far? Providing safe and comfortable walking environments." *Transportation Research Record: Journal of the Transportation Research Board* 2586: 72-82.

[20] Ermagun, Alireza, and David Levinson. 2016. "Intra-household bargaining for school trip accompaniment of children: A group decision approach." *Transportation Research Part A: Policy and Practice* 94: 222-234.

[21] Ermagun, Alireza, and David Levinson. 2017. "Public transit, active travel, and the journey to school: a cross-nested logit analysis." *Transportmetrica A: Transport Science* 13 (1): 24-37.

[22] Ermagun, Alireza, and Amir Samimi. 2017. "Mode choice and travel distance joint models in school trips." *Transportation*: 1-27.

[23] Eskafi, Fardin. 2016. "Comparative Analysis of European Union and Iranian CO2 Reduction Policies in Transportation Sector." PhD diss., Freie Universität Berlin.

[24] Ferreira, Isabel, Klazine Van Der Horst, Wanda Wendel-Vos, Stef Kremers, Frank J. Van Lenthe, and Johannes Brug. 2007. "Environmental correlates of physical activity in youth–a review and update." *Obesity reviews* 8 (2): 129-154.

[25] Hair, Joseph F., Rolph E. Anderson, Ronald L. Tatham, and William C. Black. 1998. "Multivariate data analysis." 207-219.

[26] Hatamzadeh, Yaser, Meeghat Habibian, and Ali Khodaii. 2017. "Walking behavior across genders in school trips, a case study of Rasht, Iran." *Journal of Transport & Health* 5: 42-54.

[27] Kamargianni, Maria, and Amalia Polydoropoulou. 2013. "Hybrid choice model to investigate effects of teenagers' attitudes toward walking and cycling on mode choice behavior." *Transportation Research Record: Journal of the Transportation Research Board* 2382: 151-161.

[28] Kemperman, Astrid, and Harry Timmermans. 2014. "Environmental correlates of active travel behavior of children." *Environment and Behavior* 46 (5): 583-608.

[29] Kim, Jinhee, Soora Rasouli, and Harry JP Timmermans. 2017. "The effects of activity-travel context and individual attitudes on car-sharing decisions under travel time uncertainty: A hybrid choice modeling approach." *Transportation Research Part D: Transport and Environment* 56: 189-202.

[30] Kline, Rex B. 2015. *Principles and practice of structural equation modeling*. Guilford publications.

[31] Krueger, Rico, Akshay Vij, and Taha H. Rashidi. 2018. "Normative beliefs and modality styles: a latent class and latent variable model of travel behaviour." *Transportation* 45 (3): 789-825.

[32] Lanken, Bas, Henk Aarts, Ad Van Knippenberg, and Carina van Knippenberg. 1994. "Attitude Versus General Habit: Antecedents of Travel Mode Choice 1." *Journal of Applied Social Psychology* 24 (4): 285-300.

[33] Li, Shengxiao, and Pengjun Zhao. 2015. "The determinants of commuting mode choice among school children in Beijing." *Journal of transport geography* 46: 112-121.

[34] Ma, Tai-Yu, Philippe Gerber, Samuel Carpentier, and Sylvain Klein. 2015. "Mode choice with latent preference heterogeneity: a case study for employees of the EU institutions in Luxembourg." *Transportmetrica A: transport science* 11 (5): 441-463.

[35] Ma, Tai-Yu, Joseph YJ Chow, and Jia Xu. 2017. "Causal structure learning for travel mode choice using structural restrictions and model averaging algorithm." *Transportmetrica A: Transport Science* 13 (4): 299-325.

[36] McDonald, Noreen C. 2008. "Children's mode choice for the school trip: the role of distance and school location in walking to school." *Transportation* 35 (1): 23-35.

[37] McDonald, Noreen C., Austin L. Brown, Lauren M. Marchetti, and Margo S. Pedroso. 2011. "US school travel, 2009: an assessment of trends." *American journal of preventive medicine* 41 (2): 146-151.

[38] McMillan, Tracy E. 2005. "Urban form and a child's trip to school: the current literature and a framework for future research." *Journal of Planning Literature* 19 (4): 440-456.

[39] Mehdizadeh, Milad, Trond Nordfjaern, and AmirReza Mamdoohi. 2018. "The role of socio-economic, built environment and psychological factors in parental mode choice for their children in an Iranian setting." *Transportation* 45 (2): 523-543.

[40] Mehdizadeh, Milad, Amir Reza Mamdoohi, Mohsen Fallah Zavareh, and Trond Nordfjærn. 2016. "The Role of Parental Attitudes towards Walking on Children Walking to Schools." *Journal of Traffic and Logistics Engineering Vol* 4 (2).

[41] Mehdizadeh, Milad, AmirReza Mamdoohi, and Trond Nordfjaern. 2017. "Walking time to school, children's active school travel and their related factors." *Journal of Transport & Health* 6: 313-326.

[42] Mehdizadeh, Milad, Trond Nordfjaern, Amir Reza Mamdoohi, and Afshin Shariat Mohaymany. 2017. "The role of parental risk judgements, transport safety attitudes, transport priorities and accident experiences on pupils' walking to school." *Accident Analysis & Prevention* 102: 60-71.

[43] Merchant, William R., Jian Li, Aryn C. Karpinski, and Phillip D. Rumrill Jr. 2013. "A conceptual overview of structural equation modeling (SEM) in rehabilitation research." *Work* 45 (3): 407-415.

[44] Mitra, Raktim. 2013. "Independent mobility and mode choice for school transportation: a review and framework for future research." *Transport reviews* 33 (1): 21-43.

[45] Mitra, Raktim, and Ron N. Buliung. 2015. "Exploring differences in school travel mode choice behaviour between children and youth." *Transport Policy* 42: 4-11.

[46] Moen, Bjørg-Elin. 2008. "Risk perception, priority of safety and demand for risk mitigation in transport."

[47] Munro, Salla, Simon Lewin, Tanya Swart, and Jimmy Volmink. 2007. "A review of health behaviour theories: how useful are these for developing interventions to promote long-term medication adherence for TB and HIV/AIDS?." *BMC public health* 7 (1): 104.

[48] Muromachi, Yasunori. 2017. "Experiences of past school travel modes by university students and their intention of future car purchase." *Transportation Research Part A: Policy and Practice* 104: 209-220.

[49] Nordfjærn, Trond, and Torbjørn Rundmo. 2015. "Environmental norms, transport priorities and resistance to change associated with acceptance of push measures in transport." *Transport Policy* 44: 1-8.

[50] Nordfjærn, Trond, and Mohsen Fallah Zavareh. 2017. "Does the value-belief-norm theory predict acceptance of disincentives to driving and active mode choice preferences for children's school travels among Chinese parents?." *Journal of Environmental Psychology* 53: 31-39.

[51] Nordlund, Annika M., and Jörgen Garvill. 2003. "Effects of values, problem awareness, and personal norm on willingness to reduce personal car use." *Journal of environmental psychology* 23 (4): 339-347.

[52] OECD. 2002. OECD: Environmental outlook 2002. http://www.oecd.org/dataoecd/51/6/2088589.pdf>.

[53] RDE (Rasht department of education), Statistical report (2013)

[54] Rothman, Linda, Ron Buliung, Teresa To, Colin Macarthur, Alison Macpherson, and Andrew Howard. 2015. "Associations between parents′ perception of traffic danger, the built environment and walking to school." *Journal of Transport & Health* 2 (3): 327-335.

[55] Rundmo, T., and B. E. Moen. 2007. "Risk sensitivity and priority of safety." *Risk, Reliability and Societal Safety* 2: 1623-1629.

[56] Rundmo, T., J. Foss Sigurdson, and I. Cerasi-Roche. 2011. "Travel mode use, transportation priorities, and risk perception." *Perception of transport risk and urban travel mode use* 92: 9-29.

[57] Rundmo, Torbjørn, Trond Nordfjærn, Hilde Hestad Iversen, Sigve Oltedal, and Stig H. Jørgensen. 2011. "The role of risk perception and other risk-related judgements in transportation mode use." *Safety science* 49 (2): 226-235.

[58] Samimi, Amir, and Alireza Ermagun. 2012. "Students' tendency to walk to school: case study of Tehran." *Journal of Urban Planning and Development* 139 (2): 144-152.

[59] Şimşekoğlu, Özlem, Trond Nordfjærn, and Torbjørn Rundmo. 2015. "The role of attitudes, transport priorities, and car use habit for travel mode use and intentions to use public transportation in an urban Norwegian public." *Transport Policy* 42: 113-120.

[60] Steg, Linda, Charles Vlek, and Goos Slotegraaf. 2001. "Instrumental-reasoned and symbolic-affective motives for using a motor car." *Transportation Research Part F: Traffic Psychology and Behaviour* 4 (3): 151-169.

[61] Steg, Linda. 2005. "Car use: lust and must. Instrumental, symbolic and affective motives for car use." *Transportation Research Part A: Policy and Practice* 39 (2-3): 147-162.

[62] Tabachnick, Barbara G., and Linda S. Fidell. 2007. *Using multivariate statistics*. Allyn & Bacon/Pearson Education.

[63] Transport for London. 2011. "Attitudes towards walking." Retrieved from http:// content.tfl.gov.uk/attitudes-to-walking-2011-report.pdf.

[64] Verplanken, Bas, Henk Aarts, and Ad Van Knippenberg. 1997. "Habit, information acquisition, and the process of making travel mode choices." *European journal of social psychology* 27 (5): 539-560.

[65] Verplanken, Bas, and Sheina Orbell. "Reflections on Past Behavior: A Self-Report Index of Habit Strength 1. 2003. " *Journal of applied social psychology* 33 (6): 1313-1330.

[66] Vovsha, Peter, and Mark Bradley. 2004. "Hybrid discrete choice departure-time and duration model for scheduling travel tours." *Transportation Research Record: Journal of the Transportation Research Board* 1894: 46-56.

[67] Vovsha, Peter, and Eric Petersen. 2005. "Escorting children to school: statistical analysis and applied modeling approach." *Transportation Research Record* 1921 (1): 131-140.

[68] Westman, Jessica, Lars E. Olsson, Tommy Gärling, and Margareta Friman. 2017. "Children's travel to school: satisfaction, current mood, and cognitive performance." *Transportation* 44 (6): 1365-1382.

Table 1. Descriptive statistics of variables used in the SEM-analysis among households which had at least one car (n=735) and the whole sample (n=572).

Domain	Variable	Description	n=735		n=572			
			Mean	SD	Mean	SD	Min	Max
Demographic	Child's school grade	One=1, two=2, three=3	1.90	0.84	1.90	0.83	1	3
	Child' gender	Boy=1, girl=0	0.50	0.50	0.50	0.49	0	1
	Respondent's age*	Continuous	35.34	6.74	32.35	6.90	18	59
Socioecomomic	Mother's educational background	High or university educational background=1, otherwise =0	0.30	0.46	0.29	0.45	0	1
	Father's educational background	High or university educational background=1, otherwise =0	0.31	0.48	0.30	0.46	0	1
	Mother's driving license status	Yes=1, no=0	0.67	0.47	0.76	0.43	0	1
	Father's driving license status	Yes=1, no=0	0.93	0.25	0.98	0.10	0	1
	Mother's job status	Full time=1, otherwise=0	0.11	0.32	0.12	0.39	0	1
	Father's job status	Full time=1, otherwise=0	0.60	0.50	0.60	0.49	0	1
	Travel party	Number of household's children (1, 2, 3, 4, 5 or more)	1.64	0.70	1.62	0.68	1	5
	Number of cars owned by households	1, 2, 3, …	0.89	0.58	1.15	0.38	1	3
	Income	More than one million Tomans** (monetary unit)=1, otherwise=0	0.15	0.30	0.18	0.39	0	1
	The number of hours of parental exercise in a week	No exercise=0, Less than 1 hour=1, Between 1 and 2 hours=2, Between 2 and 3 hours=3, More than 3 hours=4	1.41	1.29	1.44	1.29	0	4
Built environment	Distance or perceived walking time to school	Continuous (in minutes)	25.08	20.71	25.06	20.78	1	120
	Access to school service	Yes=1, no=0	0.91	0.29	0.91	0.28	0	1
	Access to public transport	Yes=1, no=0	0.53	0.50	0.53	0.50	0	1
	Type of school	Public=1, private=0	0.79	0.41	0.75	0.43	0	1
Mode use	Car choice	Car use is dominant=1, other modes are dominant=0	-	-	0.28	0.45	0	1
	Walking choice	Walking is dominant=1, other modes are dominant=0	0.19	0.39	-	-	0	1

-: SD: Standard deviation. Min: Minimum, Max: Maximum

* The respondent was either mother or father of child.

** One Euro is 3496 Tomans (August 2017)

Table 2. Means and standard deviations for items of attitudinal factors and priorities (n=735 and n=572).

			N=735		N=572		Min	Max
			Mean	SD	Mean	SD		
Transport safety attitudes	Personal Responsibility	Likert scale variable with a range of 1 ("completely disagree") to 5 ("completely agree")						
	-To avoid accidents is something that is very important to me		4.56	0.60	4.58	0.58	1	5
	-I feel a personal responsibility for the safety of others in transport		4.25	0.66	4.27	0.83	1	5
	-Safety is something that others should take responsibility for		4.54	0.79	4.56	0.71	1	5
	-I think it is important to take care of safety at all times		4.46	0.67	4.44	0.64	1	5
	-It is worth an extra effort to take care of my own safety		4.22	0.78	4.23	0.77	1	5
	-I think it is important to encourage other people to behave safely		4.47	0.69	4.48	0.68	1	5
	Priorities of Safety vs Effectiveness	Likert scale variable with a range of 1 ("completely disagree") to 5 ("completely agree")						
	-Safety is important, but the most important is to reach the destination		1.85	1.21	1.91	1.12	1	5
	-If we should follow all the safety regulations in transport society would stop		1.79	1.12	1.93	0.94	1	5
	-In order to prioritize business, the transport companies must priorities economy before safety		1.98	1.18	1.97	1.17	1	5
	-It is not smart to point out violations on safety regulations done by others		2.50	1.15	2.15	1.15	1	5
	Safety Knowledge	Likert scale variable with a range of 1 ("completely disagree") to 5 ("completely agree")						
	-I have good knowledge about safety in public transport		3.53	0.82	3.92	0.86	1	5
	-I know very well how to take care of my own safety when I use public transport		3.90	0.87	3.51	0.82	1	5
Walking attitudes	Comfort and Convenience of walking	Likert scale variable with a range of 1 ("completely disagree") to 5 ("completely agree")						
	-Walking is a method of transport that i would use and/or recommend		3.07	1.15	3.40	1.14	1	5
	-Walking is the fastest way to travel for short journeys		3.81	0.96	3.71	0.96	1	5
	-Walking is an interesting way to travel		4.01	0.91	3.82	0.89	1	5
	-Walking is good for journeys in my local area		3.32	1.26	3.64	1.22	1	5
	-I feel more relaxed when i walk to my destination		3.52	1.10	3.48	1.11	1	5
	-Walking is a convenient way of getting about		4.07	0.88	3.71	0.88	1	5
	Design feasibility for pedestrians	Likert scale variable with a range of 1 ("completely disagree") to 5 ("completely agree")						
	-I enjoy walking where pavements are well-maintained		4.31	0.82	4.33	0.89	1	5
	-Good design of streets makes walking more enjoyable		4.65	0.53	4.56	0.51	1	5
	-Walking for 20 min is something I would happily consider		3.99	0.94	4.09	0.95	1	5

	Contextual and design preconditions for walking	Likert scale variable with a range of 1 (“completely disagree”) to 5 (“completely agree”)						
	-Dirty and vandalized streets make people dislike walking		3.72	1.10	3.40	1.07	1	5
	-Traffic fumes make people dislike walking on Rasht streets		4.45	0.72	3.61	0.71	1	5
	-I don’t feel safe walking by myself in my local area		2.87	1.01	3.20	1.02	1	5
Transport	Priorities of Convenience and Accessibility	Likert scale variable with a range of 1 (“not at all important”) to 5 (“very important”)						
priorities	-Comfort		4.59	0.69	4.67	0.55	1	5
	-Good availability to the transportation mode (short distance)		4.48	0.73	4.59	0.98	1	5
	-Punctuality (few or none cancellations and delays)		4.36	0.59	4.55	1.12	1	5
	Priorities of Safety and Security	Likert scale variable with a range of 1 (“not at all important”) to 5 (“very important”)						
	-Security against thefts		4.83	0.54	4.58	0.98	1	5
	-Safety towards accidents		4.76	0.68	4.66	1.02	1	5
	-Safety towards personal accidents and injuries		4.83	0.61	4.90	0.78	1	5
	Priorities of Speed and Cost	Likert scale variable with a range of 1 (“not at all important”) to 5 (“very important”)						
	-Fast transport		3.03	1.29	3.36	0.91	1	5
	-Travel cost		3.90	1.05	3.58	0.87	1	5

-: SD: Standard deviation. Min: Minimum, Max: Maximum

-: Only items with significant CFA loading factors were listed.

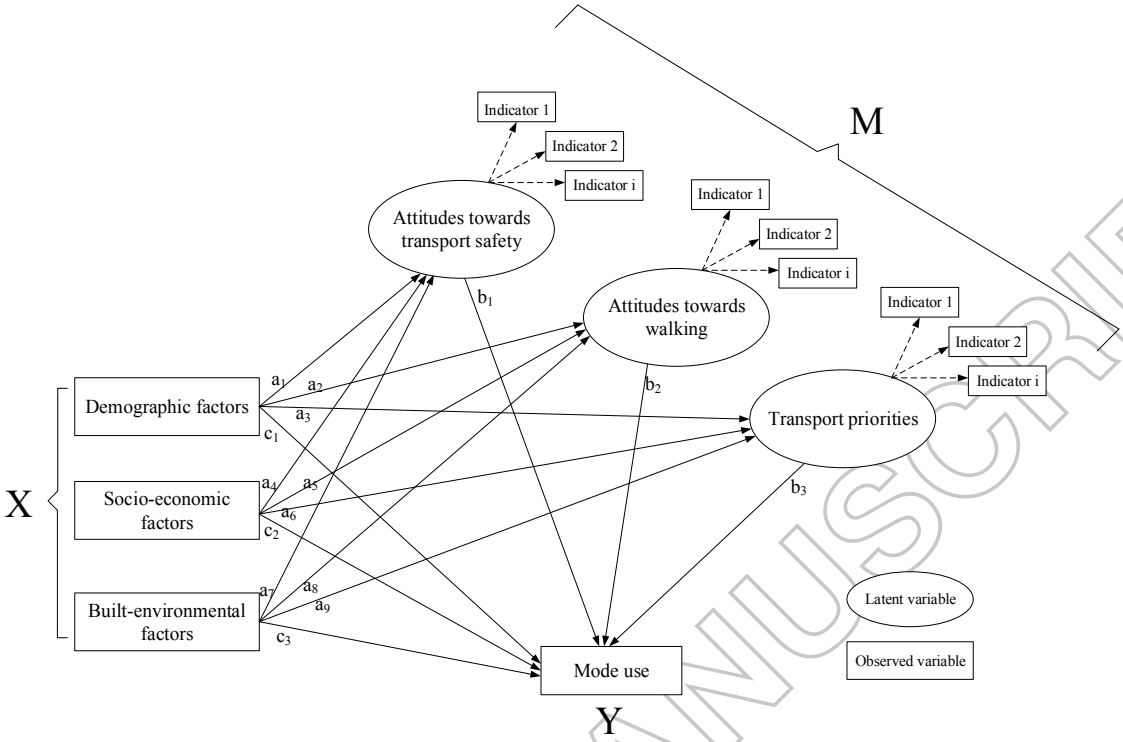

Figure 1. Framework of the heuristic model (X: background variables, M: mediating latent variables, Y: outcome variable). Direct effect= c_i, Indirect effect= $a_i \times b_j$, Total effect= $c_i + (a_i \times b_j)$

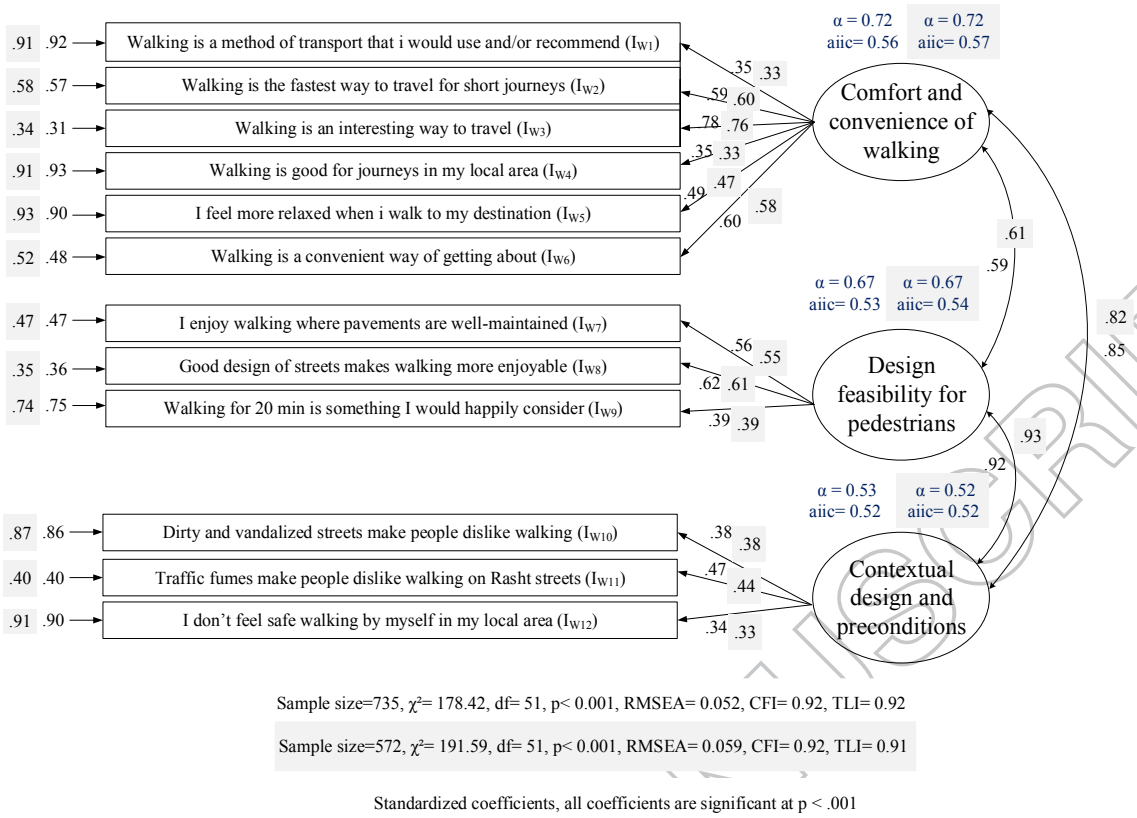

Figure 2. Three-factor solution of attitudes towards walking

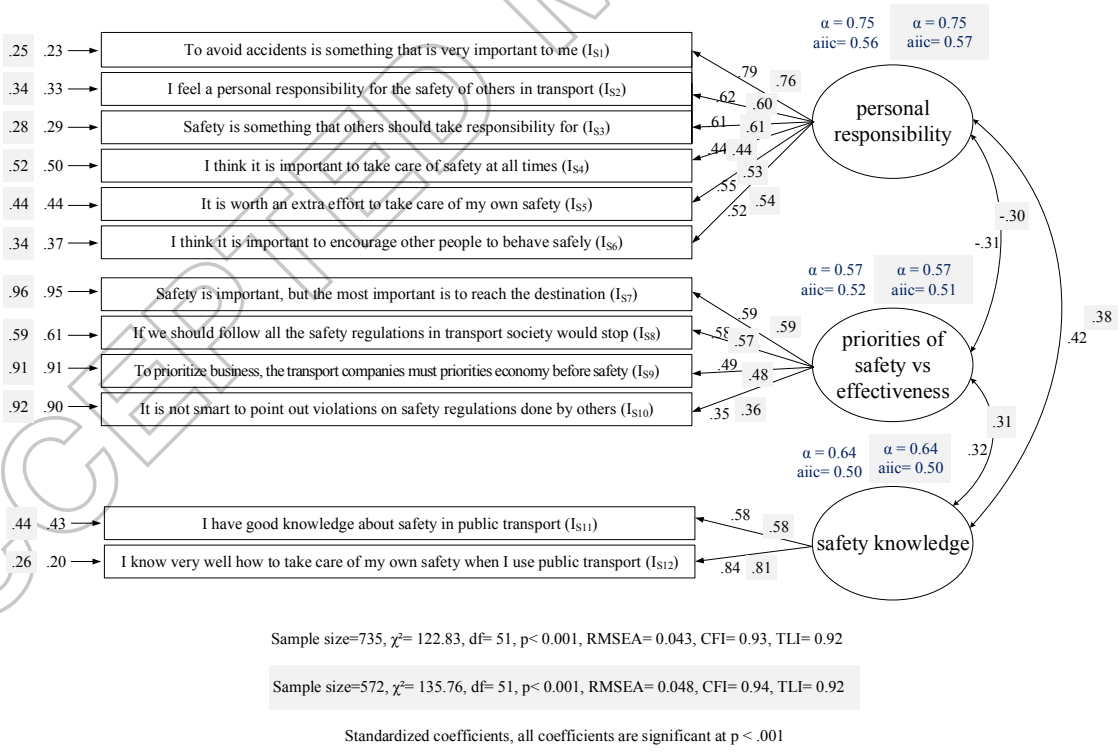

Figure 3. Three-factor solution of attitudes towards transport safety

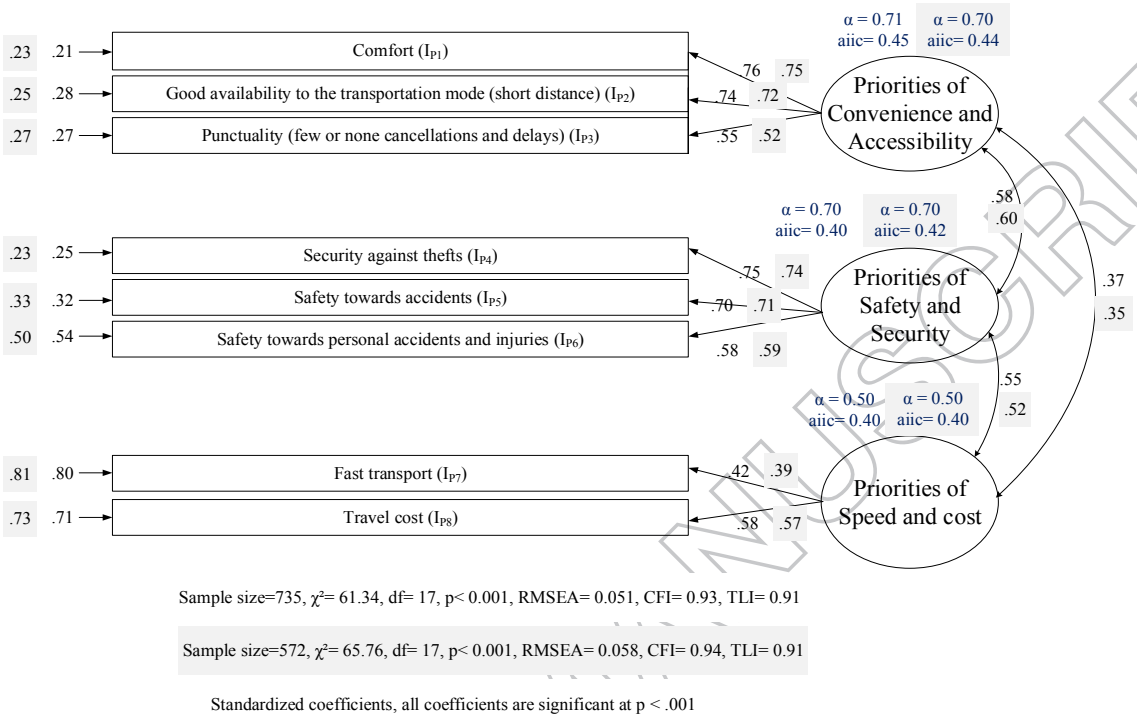

Figure 4. Three-factor solution of priorities in transport

Table 3. Standardized regression weights of path analysis ($M_{1\text{-}Car}$ and $M_{1\text{-}Walk}$) including sole direct effects of background variables on the parental car and walking choice

Domain	Background variable	$M_{1\text{-}Car}$		$M_{1\text{-}Walk}$	
		Coefficient	t-test	Coefficient	t-test
Demographic	Pupil's grade	__	n.s	__	n.s
	Pupils' gender	__	n.s	__	n.s
	Parental age	__	n.s	__	n.s
Socioeconomic	Mother's educational attainment	0.09	4.57	-0.13	-3.57
	Father's educational attainment	__	n.s	__	n.s
	Mother's driving license status	0.27	3.82	-0.06	-2.67
	Father's driving license status	0.15	6.12	__	n.s
	Mother's job status	__	n.s	__	n.s
	Father's job status	__	n.s	__	n.s
	Car ownership	0.33	4.38	-0.61	-3.52
	Income	__	n.s	__	n.s
	Physical activity	-0.10	-3.94	__	n.s
	Travel party	__	n.s	__	n.s
Built environment	Walking time to school; distance	0.11	5.40	-0.82	-4.88
	Access to school services	-0.20	-3.56	-0.34	-2.98
	Access to public transport	-0.13	-2.94	__	n.s
	Type of school	__	n.s	__	n.s

Model summary of $M_{1\text{-}Car}$: R^2=0.20, $\chi^2/df = 2.13$, $p< 0.001$, RMSEA= 0.035, CFI= 0.93, TLI= 0.92; Model summary of $M_{1\text{-}Walk}$: R^2=0.23, $\chi^2/df = 2.37$, $p< 0.001$, RMSEA= 0.042, CFI= 0.94, TLI= 0.92.

n.s: Not significant

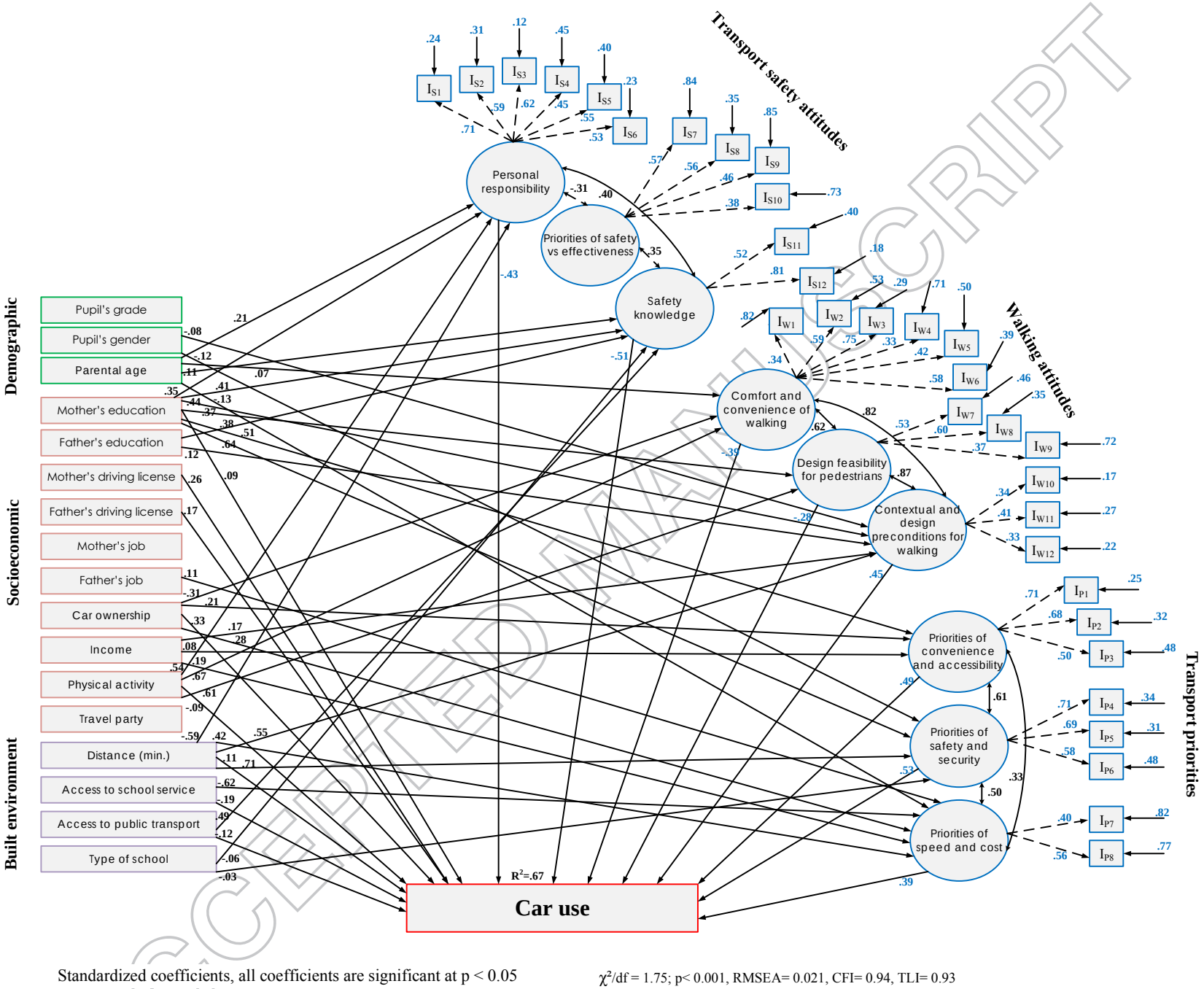

Figure 5. Standardized regression weights of the direct and indirect effects on parental car choice ($M_{2\text{-}Car}$) in children's school travel (only paths with significant ($p < 0.05$) regression weights are shown. Consult Table 1 and Table 2 for the definition of variables)

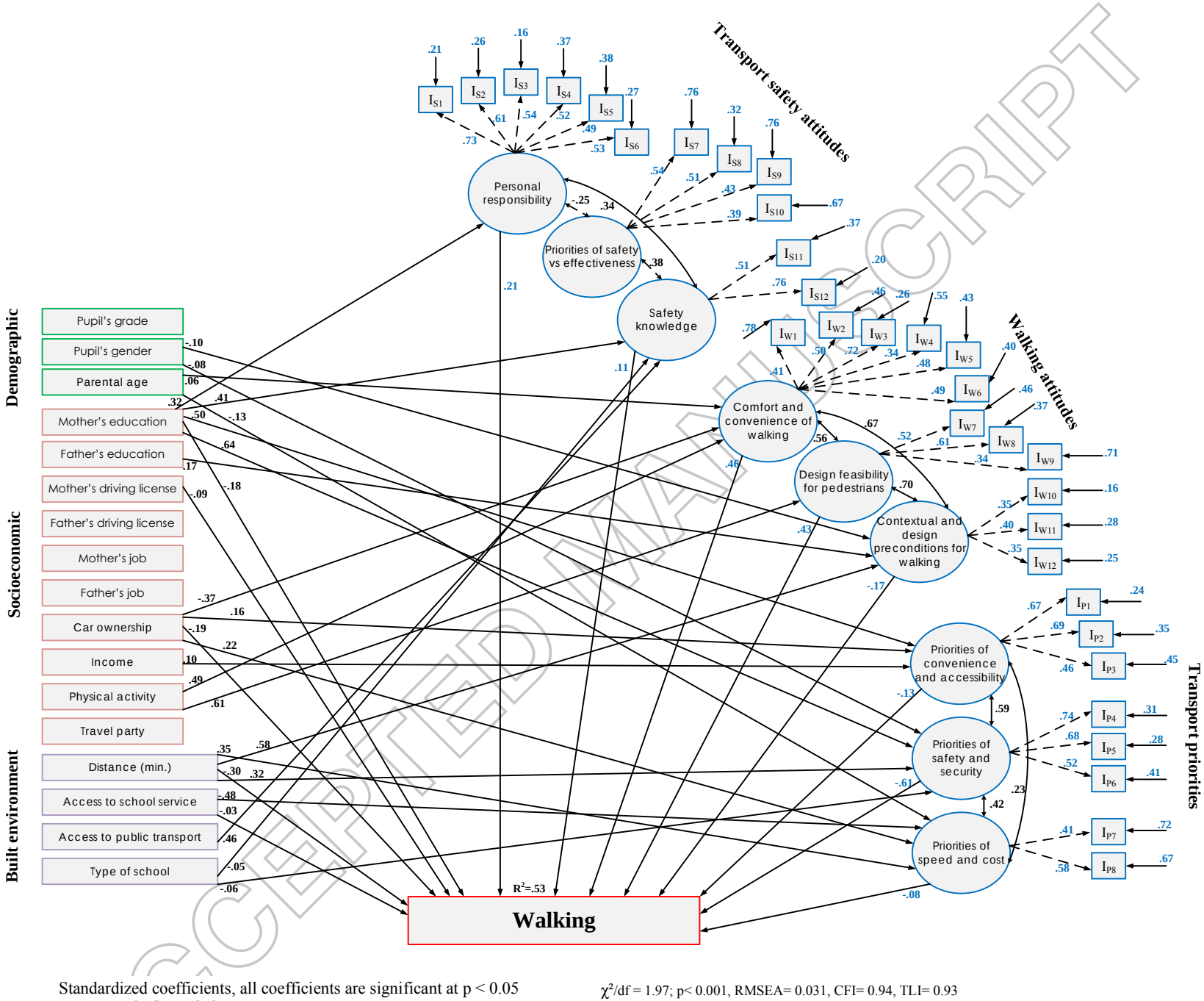

Figure 6. Standardized regression weights of the direct and indirect effects on parental walking choice ($M_{2\text{-}Walk}$) in children's school travel (only paths with significant ($p < 0.05$) regression weights are shown. Consult Table 1 and Table 2 for the definition of variables)

Table 4. Standardized direct, indirect, and total effects of background and mediators on car choice ($M_{2\text{-Car}}$) and walking choice ($M_{2\text{-Walk}}$) in school trips

Background and latent variables	$M_{2\text{-Car}}$			$M_{2\text{-Walk}}$		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Pupil's grade	0.00	0.00	0.00	0	0	0
Pupils' gender	0.00	-0.42	-0.42	0	0.06	0.06
Parental age	0.00	-0.22	-0.22	0	0.04	0.04
Mother's educational attainment	0.09	0.32	0.32	-0.18	-0.34	-0.52
Father's educational attainment	0.00	-0.14	-0.14	0	-0.03	-0.03
Mother's driving license status	0.26	0.00	0.26	0	0	0
Father's driving license status	0.17	0.00	0.17	0	0	0
Mother's job status	0.00	0.00	0.00	0	0	0
Father's job status	0.00	0.04	0.04	0	0	0
Car ownership	0.33	0.34	0.67	-0.19	-0.21	-0.40
Income	0.00	0.19	0.19	0	-0.01	-0.01
Physical activity	-0.09	-0.66	-0.75	0	0.49	0.49
Travel party	0.00	0.00	0.00	0	0	0
Perceived walking time to school	0.11	1.04	1.15	-0.30	-0.32	-0.62
Access to school services	-0.19	-0.24	-0.43	-0.03	0.04	0.01
Access to public transport	-0.12	-0.25	-0.37	0	0.05	0.05
Type of school	0.00	0.01	0.01	0	0.03	0.03
Personal responsibility	-0.43	0.00	-0.43	0.21	0	0.21
Priorities of safety vs effectiveness	0.00	0.00	0.00	0	0	0
safety knowledge	-0.51	0.00	-0.51	0.11	0	0.11
Comfort and convenience of walking	-0.39	0.00	-0.39	0.46	0	0.46
Design feasibility for pedestrians	-0.28	0.00	-0.28	0.43	0	0.43
Contextual and design preconditions for walking	0.45	0.00	0.45	-0.17	0	-0.17
Priorities of convenience and accessibility	0.49	0.00	0.49	-0.13	0	-0.13
Priorities of safety and security	0.53	0.00	0.53	-0.61	0	-0.61
Priorities of speed and cost	0.39	0.00	0.39	-0.08	0	-0.08