Direct and indirect effects of background variables on active commuting: mediating roles of satisfaction and attitudes

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This is an Authors' Original Manuscript of an article whose final and definitive form, the Version of Record, has been published in ***Journal of Transport & Health,*** 2021, copyright Elsevier, available online at: https://doi.org/10.1016/j.jth.2021.101054

Abstract

Introduction

Understanding the importance of factors influencing the choice of active transportation modes (i.e. walking/cycling) may be misleading if we only concentrate on the direct and independent impacts of background variables (i.e. demographic, social environment and built environment factors). We hypothesised that background variables not only have a direct effect but also indirectly (through mediating roles of satisfaction with active travel and attitudes) associate with the choice of active mode. Previous studies have overlooked such indirect effects. Our contribution to the literature is to investigate direct and indirect effects of background variables on active commuting in university trips through developing an integrated structural model.

Method

The data were collected through a questionnaire and in-person interviews with 682 students of Isfahan University, Iran. Structural equation modelling (SEM) was applied to test the hypothesized model.

Results

The results of SEM showed that the important psychological aspects of travel (satisfaction and attitudes) mediated the link between background variables and active commuting. SEM-analysis highlighted that students who reported more positive attitudes and were satisfied with walking and cycling were more likely to commute by active modes. Female and working students were more stressed and hurried when commute by active modes, and demonstrated unfavourable attitudes towards walking and cycling, which was associated with diminished choice of active modes. Besides, students who travelled long distances or owned a private car were less likely to walk and ride bicycles.

Conclusions

Policymakers could promote the culture of active travel in the university campus through training and advertising in the mass media or launching attitude campaigns at the university scale to mitigate the current restrictions. Policymakers could also strengthen infrastructure for cycling and walking to improve student satisfaction and attitudes towards active travel modes in the study area.

Keywords: Active travel, Travel Satisfaction, Attitudes, Indirect effects, Walking and cycling

1. Introduction

Social and economic developments have led to the growth of car ownership in metropolitan areas and the rising consumption of fossil fuels. Traditional strategies of traffic management at the city level have been relatively ineffective, thereby encouraging the use of private vehicles and the proliferation of car-oriented cities. This, together with inadequate infrastructure and low quality of active transportation systems, has exacerbated problems such as traffic jams, inactiveness of individuals, greenhouse gas emissions and environmental pollution, especially in developing countries. The growing rate of motor vehicle ownership in Middle Eastern countries, including Iran, has also increased the use of motor vehicles for daily trips (Eskafi 2016). One of the most cost-effective ways to tackle this issue is to promote active transportation modes, i.e. walking and cycling (Gerike et al., 2019; Haustein et al., 2019; Pucher and Buehler, 2012). However, due to gender disparity, sociocultural traditions, and infrastructural issues, women or other demographic groups in the developing world may face restrictions on the use of active transportation modes and are therefore more likely to hold negative attitudes towards walking and cycling or indicate a low level of active travel satisfaction. Thus, while active transportation can constrain the use of private cars and their relevant problems, there are still serious challenges facing the facilitation of active commuting, especially in developing countries. Therefore, it seems that important psychological aspects of travel (attitudes and satisfaction with the use of active modes) may influence the relationships between individual (e.g., age, gender) and socioeconomic-level (e.g. income, car ownership status) with active mode choice.

Despite extensive research on active travel among the general public and pupils, there are few studies among university students in university trips. The importance of student travel modes is that in most cities, transportation to/from the university accounts for a large share of total daily travel (Danaf et al., 2014; Nordfjaern et al., 2019). Besides, habits and style of transportation modes used by students, as a part of the young population, can shape how transportation modes are used in the coming decades (Mehdizadeh et al., 2019a). Hence, it can positively affect student's attitudes and behaviours toward environment (Limanond et al., 2011; Shannon et al., 2006). Universities are also one of the main destinations of daily trips, and appropriate infrastructure is required to support his huge traffic (Lovejoy and Handy, 2011). On the other hand, according to student reports, the high cost of transportation to universities and absence of sufficient stimuli for cheap travel (e.g. cycling) are the main drivers that deter students from continuing their education (Gibbons and Vignoles, 2012; Kenyon, 2011). In addition, due to their irregular class schedules, students have more freedom and flexibility in choosing their travel mode (Limanond et al., 2011), which manifests the specific disparities in the travel behaviour of this group of people.

Moreover, it is not yet clear how individual and socioeconomic factors, in addition to direct effects, could indirectly relate to active mode choice. This research attempted to add to the current knowledge of active travel behaviour in university trips by investigating the indirect effects of background variables (demographic, social environment and built environment factors) on active commuting through mediating roles of important psychological factors (travel satisfaction and attitudes) as well as direct effects. Previous studies have overlooked such indirect effects. The research questions of the present study were as follows: (1) Do travel satisfaction and attitudes towards walking/cycling mediate the relationships between background variables and active travel behaviour? (2) What is the size of the direct and indirect effects of background variables on active travel choice?

Understanding the importance of factors influencing the choice of active modes may be misleading if we only concentrate on the direct and independent impacts of background variables. Therefore, it is necessary to ascertain the mechanism governing the relationship of "background variables", and "travel satisfaction and attitudes" with "active mode choice" in an integrated framework. In other words, using such frameworks may help understand the impact of third variables, which mediate the association between independent and dependent variables. In this context, an indirect effect suggests that an independent variable influences a dependent variable through a mediating one (Kline, 2015; Mehdizadeh et al., 2019b; Shams et al., 2020). On the other hand, the direct effect exhibits the impact of the independent variable on the dependent variable in the absence of a mediating variable. The present study, by demonstrating the interaction of background variables (the independent variable), satisfaction with travel and attitudes (the mediating variables) and the use of active transportation (the dependent variable) could inform policy-making that helps promoting walking and cycling among students.. Developing such a structural model can help policymakers take more effective steps to encourage the use of active modes among different segments of university students.

The remaining of the study is organised as follows. Section 2 reviews the relevant literature and illustrates the study heuristic model based on research gaps and hypotheses. Section 3 describes the methodology including sampling procedure, questionnaire and modelling fundamental. Section 4 reports the results of model estimation. We provide an in-depth discussion of findings in Section 5. We conclude the study and propose some recommendations in Section 6.

2. A review of literature

As for correlates of active mode choice, many studies have only focused on the direct effect of background variables (e.g. demographic, social environment and built environment factors) on the use of active transportation either among the general public or students (Nordfjærn et al.,

2019; Nguyen-Phuoc et al., 2018; Hasan et al., 2019; Nordfjærn and Zavareh, 2017; Buehler, 2020; Leung and Loo, 2020; Passi-Solar et al., 2020) without taking into account possible mediating effects of psychological factors such as attitudes and travel satisfaction. The results of studies in the United States have revealed that active transportation modes are more popular with the youths and adolescents (Moudon et al., 2005; Dill and Voros, 2007; Buehler et al., 2020). Studies in some Arab countries in the Middle East, such as the United Arab Emirates, Qatar, Bahrain and Iraq, have shown that gender may affect the choice of active modes so that women are less eager than men to use active transportation modes (Benjamin and Donnelly, 2013; Hasan et al., 2019). While some studies have manifested that high-income is negatively associated with the use of active transportation on daily trips (Mehdizadeh et al. 2018; Babey., 2009), many studies have shown that people with a higher income are more likely to use active transportation, as walking and cycling in low-income neighbourhoods may often be seen as dangerous, unpleasant, and stressful (Pucher et al., 2011; Buehler et al., 2020). Besides, car ownership is negatively related to active transportation (Buehler and Hamre, 2016; Heinen and Chatterjee, 2015; Buehler et al., 2020). In terms of travel distance, most studies have reported that longer distances are negatively correlated with walking and cycling (e.g. Mehdizadeh and Ermagun, 2018; Zannat et al., 2020).

Although De Vos (2019a) recently suggested a causal (or mutual) framework of relationships between travel satisfaction, attitudes and mode choice, most previous studies investigated direct association (and separate effects) of such factors using cross-sectional data (Sivasubramaniyam et al., 2020; De Vos, 2019b; De Vos et al., 2015; Smith, 2017). As for the direct effect of travel satisfaction on travel mode choice, public transportation users in Belgium are least satisfied and active transportation users have most content with their travel, which is associated with the greater use of active transportation by people (De Vos et al., 2015). Research in the United Kingdom and the United States have shown that while using cars and public transportation is stressful, walking and cycling are relaxing and considered as the best mode of travel, with a higher degree of satisfaction compared to active transportation (LaJeunesse and Rodríguez, 2012; Anable and Gatersleben, 2005). Singleton's research also showed that in big cities, people are more satisfied with active transportation than with motor transport due to issues such as congestion, traffic jam and delays of motor vehicles (Singleton, 2018). Most studies have reported the highest level of satisfaction with active transportation (e.g. Lades et al., 2020; Singleton, 2018). As for correlates of travel satisfaction among background variables, other studies have demonstrated that many people, especially women, are dissatisfied with active travel modes. For example, in Iraq, women find transportation with motor vehicles more efficient

and safer than active transportation (Hasan et al., 2019). In addition, Ye and Titheridge (2019) found that the lower income people reported lower levels of travel satisfaction in China.

Meanwhile, consistent with many theoretical frameworks, it has been shown that attitudes can directly influence people's behaviour (Ajzen, 1991). Many studies argued that people's attitude (a favourable or unfavourable evaluation of the behaviour of interest) plays a key role in their decision-making process (e.g. less use of private cars) (Ajzen, 1991; Arroyo et al., 2020; Egset and Nordfjærn, 2019; Daziano and Bolduc, 2013). So far, several studies have investigated the direct effect of attitudes on the choice of transportation modes. Heinen et al. (2011) reported that attitudes toward the benefits of cycling influence people's decision to ride bikes. Research in the United States, Iran, and Norway has also revealed that a positive attitude toward active transportation (e.g. walking and cycling) enhances the likelihood of its use (Moudon et al., 2005; Mehdizadeh et al., 2017; Kummeneje and Rundmo, 2020; Zavareh et al., 2020). Furthermore, some studies also showed that the background variables could be related to attitudes (Kim et al., 2017; Kamargianni and Polydoropoulou, 2013). For instance, Kamargianni and Polydoropoulou (2013) revealed that higher levels of education were related to greater levels of attitudes towards active travel.

A careful review of previous research indicates that previous studies have mainly focused on the following three categories of relationships (direct effects), separately: (1) studies in the first category have looked into the direct relationship between "background variables" and "active mode choice" (Buehler et al., 2020; Dill and Voros, 2007), (2) the second category of studies have explored the direct effect of "background variables" on "attitudes and satisfaction with travel" (Kim et al., 2017; Kamargianni and Polydoropoulou, 2013; Singleton, 2018; Hasan et al., 2019), and (3) the third group of studies have investigated the direct effect of "attitudes and satisfaction with travel" on "mode choice." (Anable and Gatersleben, 2005). Each of these relationships has been investigated separately, without any attempt for the simultaneous analysis of them. It seems that the background variables not only have a direct effect but also indirectly influence the choice of active modes through mediating roles of attitudes and satisfaction. In the current study, we simultaneously examine all three types of relationships in an integrated model (Figure 1). As shown in Figure 1, we have considered indirect effects of background variables through psychological factors (attitudes and travel satisfaction) (as mediating variables) besides the direct impact of background variables on the choice of active transportation in student’s travels to the university.

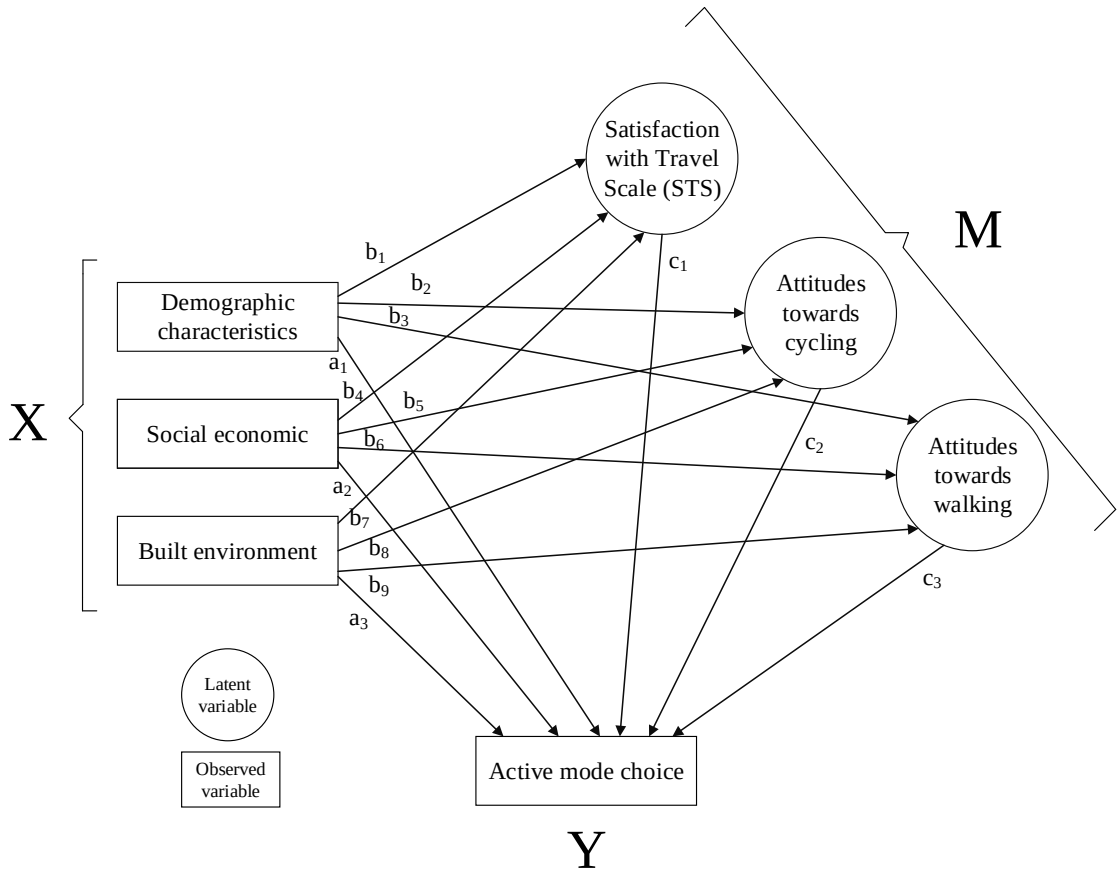


Figure 1. The study heuristic model (X: background variables, M: mediating latent variables, Y: outcome variable), Direct effect= a_i, Indirect effect= $b_i \times c_j$, Total effect= $a_i + (b_i \times c_j)$

3. Methods

3.1. Participants

The study was conducted at the University of Isfahan. Isfahan is the third largest and the most populous city in Iran, and the University of Isfahan, with an area of nearly 300 hectares and 15,171 students, is one of the largest universities in Iran, which is located in the south of Isfahan. Transportation modes available in the study area include private vehicles, active modes (walking and cycling) and public transportation (including buses and taxis). On average, costs of using car, typical bus and metro in the study area were around 0.009 $/km, 0.004 $/km, and 0.005 $/km, respectively. There is a network of bus stops within and outside the university, with the possibility of riding a bicycle because the university is positioned in the city. The data was collected through a questionnaire and in-person interviews with 750 students of the University of Isfahan over two months (February and March 2019). Of 750 respondents, 68 submitted incomplete questionnaires, and 682 answered questions completely. The participation rate was 90%.

The questionnaires were all completed in a face-to-face interview using a convenience sampling method. Twenty civil engineering students were recruited as interviewers and the authors trained them on how to gather data. The interviewers collected the data during normal office hours (09.00 to 17.00). Since the target population was university students who study at the University of Isfahan, the interviewers were justified to exclude non-students from sample recruitment. The participants were informed about the aims of the study and how to fill out the questionnaire before starting the survey. Different locations within and outside the university's facilities were chosen to recruit the participants. The interviewers waited until the respondents completed the form. The survey was anonymous, but to increase the response rate, we informed a gift card for participants that were set to be awarded per drawing. To enter into drawing the participants were asked to enter their contact details at the end of the survey. This process, however, was strictly voluntary. Furthermore, the interviewers waited until the participants completed the questionnaires and their presence had no effects on the responses of the participants.

3.2. Measures

3.2.1. Background variables

In the first part, the information related to demographic characteristics of the population (age, gender, level of education, household income, employment status and car ownership), social environment (feeling embarrassed when cycling/walking and cultural problems) (Hasan et al., 2019), as well as physical structure of the area (such as travel distance and traffic signs and lights for pedestrians and cyclists) were collected (Table 1). Of note, social-environment were measured by two following questions: "does feeling embarrassed when cycling/walking influence your choice of walking/cycling as modes of transport?" and "do cultural problems influence your choice of walking/cycling as modes of transport?" The response scale for answering these two questions was in a form of yes/no.

Concerning gender, 308 respondents were male, and 374 were female students (M=0.55, SD=0.498). Four hundred five participants (59.4%) were in the age group of 19 to 23 years, 170 (24.9%) in the age group of 24 to 28 years and 107 (15.7%) in the age group of 29 to 34 years (M=23.64, SD=4.203). Regarding the distance travelled to arrive at the university, 19 students (2.8%) travelled less than 1 km, 197 (28.9%) travelled 2 to 10 km, 199 (29.2%) travelled 11 to 20 km, and 267 (39.1%) travelled more than 20 km to reach the university.

Table 1. Descriptive statistics for background **and outcome variables (N=682).**

Item	Description	Mean	SD
Demographic characteristics			
Age	Continuous variable (19-34 year)	23.64	4.203
Gender	0=Male, 1=Female	0.55	0.498
Level of education	1=Bachelor , 2=Master of science, 3=Ph.D, 4=Higher	2.00	0.878
Household income per month	1=less than 1.5 million Tomans* (m.T), 2=1.5-2.5 m.T, 3= 2.5-3.5 m.T, 4=more than 3.5 m.T	2.30	.747
Occupation	0=Only Study, 1= work and Study	0.24	0.429
Car ownership	0=No, 1=Yes	0.40	0.491
Social environment			
Social embarrassment while walking/cycling	0=No, 1=Yes	0.35	0.476
Cultural issues	0=No, 1=Yes	0.40	0491
Built environment			
Travel distance (Km)	1=less than 1 Km, 2=1-10 Km, 3=10-20Km, 4= more than 20 Km	3.05	0.889
Cyclist-pedestrian traffic signs and lights	0=No, 1=Yes	0.12	0.315
Active transportation use	0=No, 1=Yes	0.22	0.412

* US$ 1 = Toman 13033 at the February 2019 exchange rate.

3.2.2. The Satisfaction with Travel Scale (STS)

Satisfaction with Travel Scale (STS) is one of the most widely used theoretical frameworks that measures people's feelings and attitude as well as their cognitive assessments of travel (Ettema et al., 2011; Singleton, 2019). It has been extensively used in several studies so far (De Vos et al., 2015: Ettema et al., 2011; De Vos and Witlox, 2017; Singleton, 2019). This 9-item questionnaire consists of two emotional and one cognitive dimensions (Table 2), which are rated on a 7-point Likert scale (-3= minimum / negative emotions or evaluation to +3= maximum / positive emotions or evaluation). The two emotional dimensions of the STS include negative activation / positive deactivation (e.g. stressed / calm) and negative deactivation / positive activation (e.g. bored / enthusiastic). In other words, in this context, people's feelings about travel can run the gamut from negative to positive. As an example, the feeling of boredom can be seen as a negative deactivation, while a feeling of excitement can be perceived as positive activation. Also, the cognitive dimension of STS is measured by the cognitive evaluation factor (e.g. travel was low/ high standard). In all items, a higher score indicates greater satisfaction with the travel (Ettema et al., 2011). It should be noted that in the present study, students answered 9 STS items about active transportation.

Table 2. The Satisfaction with Travel Scale (STS) items for active transportation

Item	Range	Mean	SD
Negative activation/ positive deactivation	(-3= Negative) to (+3= positive)		
Stressed/ Calm (v1)		.470	1.994
Worried/ Confident (v2)		.287	1.832
Hurried/ Relaxed (v3)		.115	1.484
Negative deactivation/ positive activation	(-3= Negative) to (+3= positive)		
Bored/ enthusiastic (v4)		.385	2.030
fed up/engaged (v5)		.761	2.313
tired/alert (v6)		.409	2.036
Cognitive evaluation	(-3= Negative) to (+3= positive)		
Travel was worst/ best I can think of (v7)		.226	2.318
Travel was low/ high standard (v8)		.124	1.423
Travel did not work out/ worked out well (v9)		.296	2.759

3.2.3 The attitudes towards cycling

The attitude towards cycling was evaluated by a valid instrument (Fernández-Heredia et al., 2014). The instrument consists of 11 items (Table 3) and is scored on a 6-point Likert scale (1= not important to 6= essential). The measurement contains four factors of pro-bike (e.g. no fuel expenses, the purchase and maintenance of the bicycle are not costly), physical determinants (e.g. mountainous or hilly areas), convenience (e.g. no time or frequency restrictions) and external restrictions (e.g. need for complementary facilities for personal hygiene) (Fernández-Heredia et al., 2014).

Table 3. The attitudes towards cycling items

Item	Range	Mean	SD
pro-bike	1= not important to 6= essential		
Economical: no fuel expenses, the purchase and maintenance of the bicycle are economical (v10)		4.24	1.466
Fun: some users take pleasure in riding a bicycle (v11)		4.14	1.482
Healthy: it is an active mode of transport that encourages people to exercise (v12)		3.97	1.551
Ecological: does not emit pollutants or greenhouse gases, hardly makes any noise and takes up little space (v13)		4.12	1.571
Physical determinants	1= not important to 6= essential		
Fitness: poor physical condition (v14)		4.32	1.550
Orography: mountainous or hilly topography (v15)		4.36	1.613
Convenience	1= not important to 6= essential		
Flexibility: no time or frequency restrictions (v16)		3.82	1.652
Efficiency: avoids traffic problems such as traffic jams, easy to park, enables door to door transport and is competitive with other modes of transport over certain distances (v17)		3.62	1.761
External restrictions	1= not important to 6= essential		

Facilities: need for complementary facilities for personal hygiene, bicycle parking area at the destination point, to keep the bicycle at home, etc (v18)		3.35	1.879
Vandalism: fear of the bicycle being stolen (v19)		3.75	1.786
Danger: perception of risk in relation to collisions or falls (v20)		3.23	1.862

3.2.4 The attitudes towards walking

The attitude towards walking was measured by a 12-item instrument. The validity of this instrument has been confirmed in previous studies (Mehdizadeh et al., 2017; Mehdizadeh et al., 2018; Transport for London 2011). This measurement includes three factors: comfort and convenience of walking (e.g. I feel more relaxed when I walk to my destination), design facility for pedestrians (e.g. proper design of streets makes walking more enjoyable) and contextual and design preconditions for walking (e.g. dirty and vandalized streets make people dislike walking). The items are scored on a 5-point Likert scale (1=completely disagree to 5=completely agree) (Table 4) (Mehdizadeh et al. 2018).

Table 4. The attitudes towards walking items

Item	Range	Mean	SD
Comfort and Convenience of walking	1=completely disagree to 5=completely agree		
Walking is a method of transport that I would use and/or recommend (v21)		2.72	1.332
Walking is the fastest way to travel for short journeys (v22)		2.66	1.326
Walking is an interesting way to travel (v23)		2.64	1.336
Walking is good for journeys in my local area (v24)		2.49	1.470
I feel more relaxed when i walk to my destination (v25)		2.27	1.381
Walking is a convenient way of getting about (v26)		2.56	1.516
Design feasibility for pedestrians	1=completely disagree to 5=completely agree		
I enjoy walking where pavements are well-maintained (v27)		2.58	1.325
Good design of streets makes walking more enjoyable (v28)		2.49	1.321
Walking for 20 min is something I would happily consider (v29)		2.25	1.340
Contextual and design preconditions for walking	1=completely disagree to 5=completely agree		
Dirty and vandalized streets make people dislike walking (v30)		2.44	1.292
Traffic fumes make people dislike walking on Isfahan streets (v31)		2.54	1.373
I don't feel safe walking by myself in my local area (v32)		2.31	1.307

3.2.5 Active transportation

The use of active transportation by students was assessed by asking the following question: "On a typical week in a semester, do you use active transportation (e.g. walking and cycling) when travelling to/from university?" 1) I do 2) I do not. This variable was added to the model as the dependent variable.

3.3 Statistical analysis

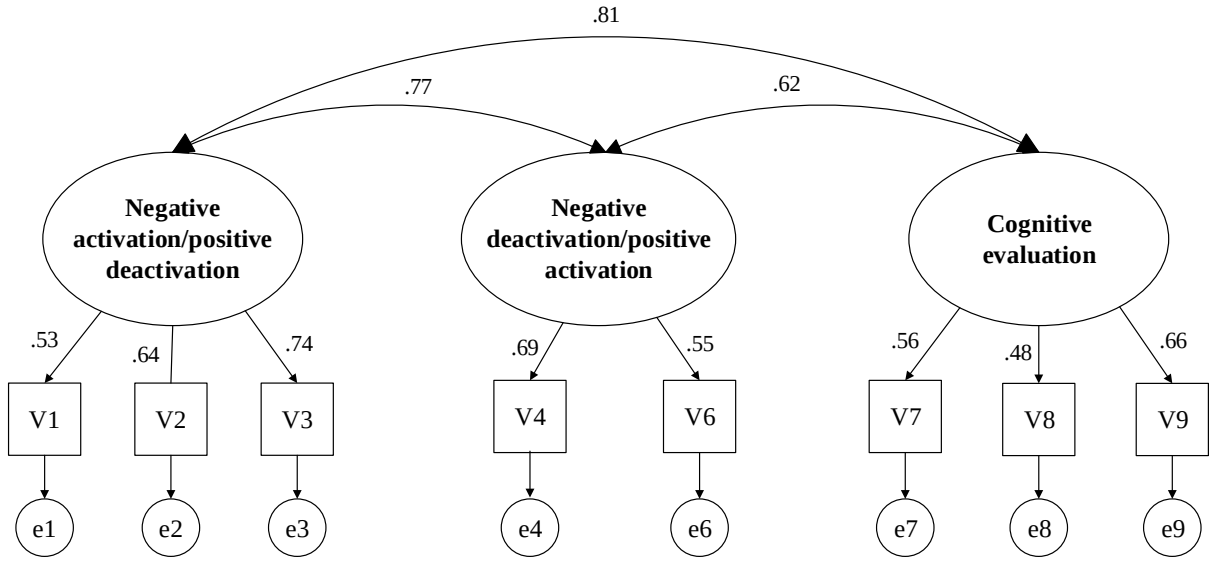
The dimensions and number of factors in STS, attitudes towards cycling and attitudes towards walking have been confirmed in some previous research (Ettema et al., 2011; Fernández-Heredia et al., 2014; Mehdizadeh et al., 2018). Therefore, in this study, the confirmatory factor analysis (CFA) was utilised to assess the internal consistency of the items in this instrument. The Normed Fit Index (NFI), and the Comparative Fit Index (CFI) were used to evaluate the fit of the hypothesised model. In these indices, values greater than 0.9 (Ho, 2006) indicate that the model is fit. We also used the Root Mean Square Error of Approximation (RMSEA) where values less than 0.06 are desirable (Kline, 2015). The value of chi-square and the level of significance were also reported. To check the reliability of the questionnaire, Cronbach's alpha was used. Items that were not statistically significant in the CFA ($p > 0.001$), and their factor loading was less than 0.4 were removed from the model due to their poor loading (Ho, 2006).

Although multiple regression can be used to analyse direct relationships between independent and dependent variables, its application is restricted to the analysis of variables that can only be observed or measured directly. At the same time, structural equation modelling (SEM) is a multivariate technique that can simultaneously examine the set of structural relationships between independent, mediating, and dependent variables. Considering the model hypothesised in this study (Figure 1), the direct and indirect relationships and latent variables, we used the SEM model. It should be noted that goodness-of-fit indices in the SEM model resemble those in the CFA. In this study, IBM SPSS Amos version 24.00 software was used to analyse the CFA and test the SEM model.

4. Results

4.1 Confirmatory factor analysis for STS

The separation of STS items into three factors, "negative activation / positive deactivation" (e.g. hurried / relaxed), "negative deactivation / positive activation" (e.g. tired / alert) and "cognitive dimension" (e.g. travel was worst / best I can think of), was confirmed in the present study. Item (v5: fed up / engaged), which was not statistically significant in the CFA ($p > 0.001$, factor loading < 0.4), was removed in subsequent calculations. After omitting this item, an acceptable fit for the model was obtained ($\chi^2/df = 2.508, p < 0.001, CFI = 0.984, TLI = 0.974, RMSEA = 0.047$). The results of the CFA for the "STS" are shown in Fig. 2.

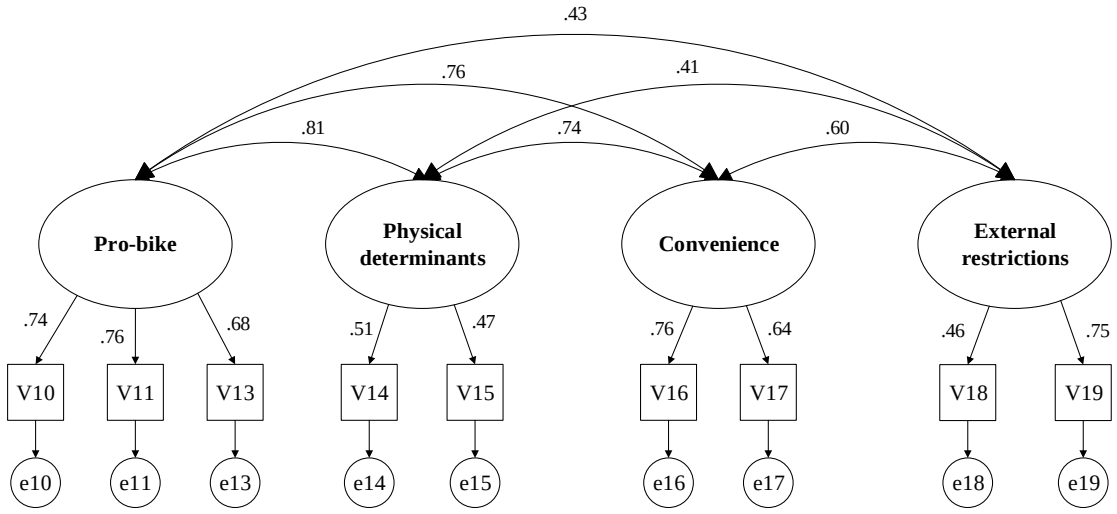


$\chi^2/df = 2.508, p < 0.001, CFI = 0.984, TLI = 0.974, RMSEA = 0.047$

Figure 2. Three-factor solution of STS

4.2. Confirmatory factor analysis for attitudes towards cycling

The results of the CFA verified the four-factor structure of the "attitude towards cycling". These four factors consist of convenience, pro-bike aspects, external restrictions, and physical determinants. Items ("v12: it is an active mode of transport that encourages people to exercise" and "v20: the perception of risk concerning collisions or falls"), which were not statistically significant in the CFA ($p > 0.001$, Factor Loading < 0.4), were excluded from subsequent calculations. After omitting these items, an acceptable fit for the CFA model was obtained ($\chi^2/df = 2.526, p < 0.001, CFI = 0.965, TLI = 0.957, RMSEA = 0.046$). The results of the CFA for the "attitudes towards cycling" are shown in Fig. 3.

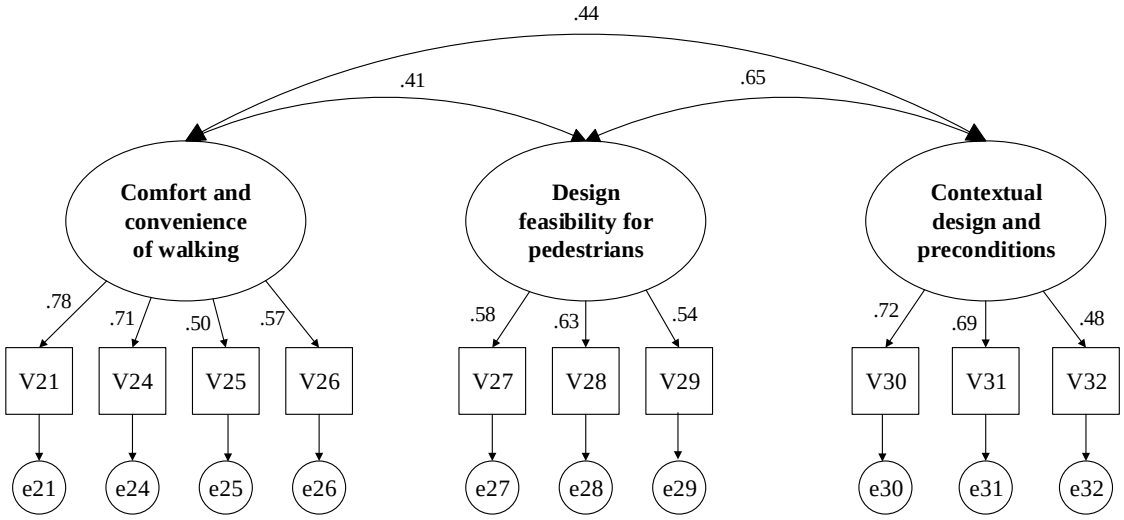


$\chi^2/df = 2.526, p < 0.001, CFI = 0.965, TLI = 0.957, RMSEA = 0.046$

Figure 3. Four-factor solution attitudes towards cycling

4.3. Confirmatory factor analysis for attitudes towards walking

In the present study, the three-factor structure (comfort and convenience of walking, design of facilities for pedestrians and contextual and design preconditions for walking) was confirmed for the attitudes towards walking. Items ("v22: Walking is the fastest way to travel for short journeys" and "v23: Walking is an interesting way to travel), which were not statistically significant in the CFA ($p > 0.001$, factor loading < 0.4), were excluded from subsequent calculations. After omitting these items, an acceptable fit for the model was obtained ($\chi^2/df = 2.948, p < 0.001, CFI = 0.937, TLI = 0.911, RMSEA = 0.057$). The results of the CFA for the "attitudes towards walking" are shown in Fig. 4.



$\chi^2/df = 2.948, p < 0.001, CFI = 0.937, TLI = 0.911, RMSEA = 0.057$

Figure 4. Tree-factor solution of attitudes towards walking

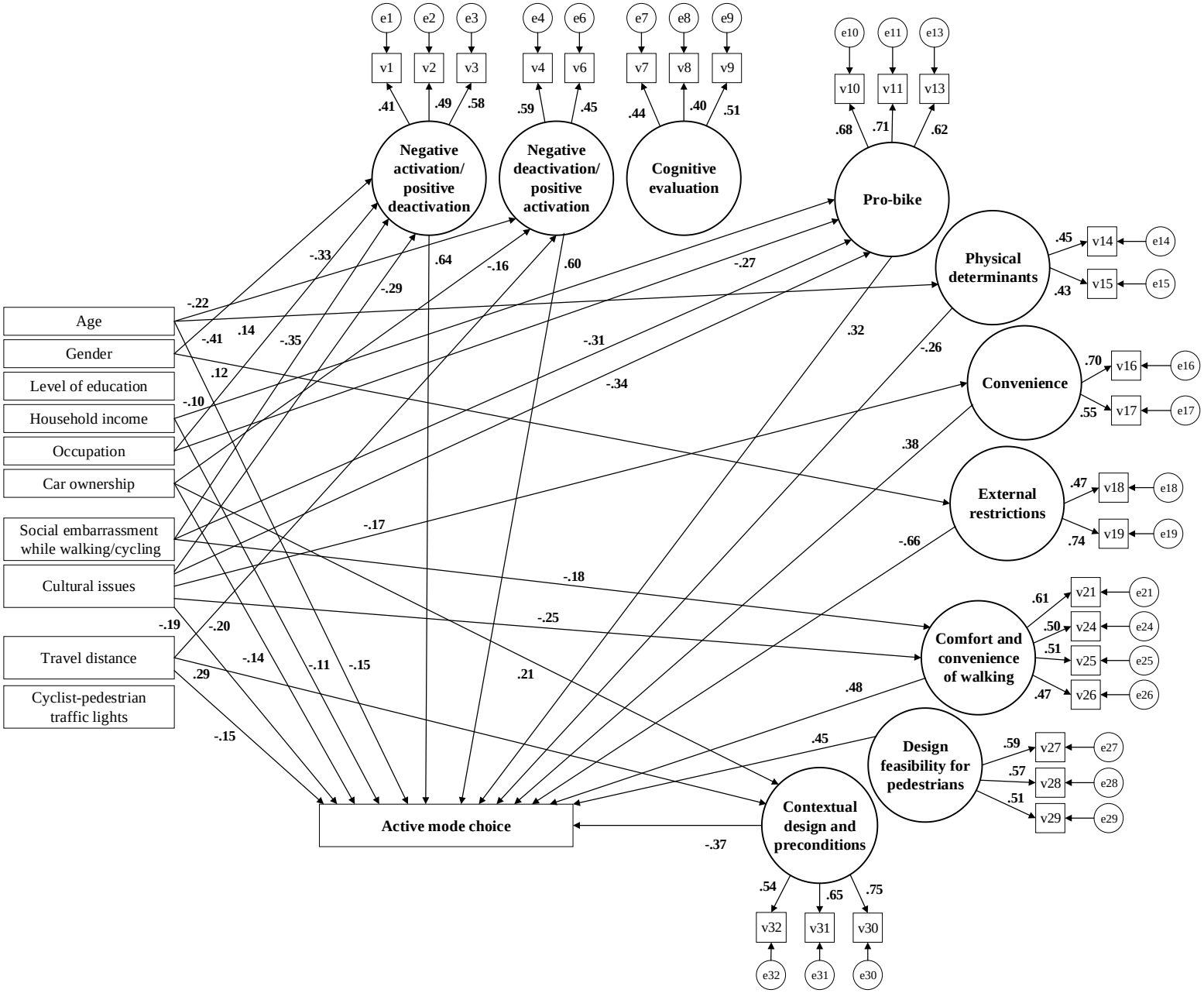
4.4 Model testing

The results of the SEM model are reported in Figure 5. Before testing the final SEM model shown in Figure 5, several models, including all possible combinations of direct and indirect effects, were examined for latent and observed variables. Finally, the model that had the highest number of significant relationships was selected. For the sake of simplicity, only paths with significant coefficients at the 99% confidence interval are displayed. The results of the model estimate reveal that this model has a good fit ($\chi^2/df = 2.74, p < 0.001, CFI = 0.954, TLI = 0.933, RMSEA = 0.041$).

According to the results of the present study, among the ten observed variables, five variables (age, household income, car ownership, cultural issues and travel distance), not only had a direct effect but also exerted an indirect effect on "the use of active transportation". A comparison of direct effects with indirect impacts suggested that the indirect effects of most of these variables were stronger than their direct effects on "the use of active transportation ". Also, three variables (gender, job status, and social embarrassment while walking/cycling) were only indirectly related to the use of active transportation (through mediating variables).

According to Figure 5, out of 10 mediating factors, six factors of "negative activation / positive deactivation", "negative deactivation / positive activation", "pro-bike aspects", "convenience", "comfort and convenience of walking" and "design facilities for pedestrians" were positively correlated with active transportation use. For example, designing more facilities for pedestrians was associated with the greater use of active transportation. Also, three factors of "physical determinants", "external restrictions" and "design preconditions for walking" had a negative

relationship with active transportation. Besides, "cognitive dimension" was not significantly linked to active transportation. Table 5 shows direct and indirect path effects, along with the total effect. For example, age had both a direct (β = -.15) and an indirect effect (β = -.17) through the mediating variables of "negative deactivation / positive activation" and "physical determinants" on the use of active transportation" (Total effect = -.32).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Negative activation/ positive deactivation
Negative deactivation/ positive activation
Cognitive evaluation
Pro-bike
Physical determinants
Convenience
External restrictions
Comfort and convenience of walking
Design feasibility for pedestrians
Contextual design and preconditions
Active mode choice
Age
Gender
Level of education
Household income
Occupation
Car ownership
Social embarrassment while walking/cycling
Cultural issues
Travel distance
Cyclist-pedestrian traffic lights
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$\chi^2/df = 2.74, p < 0.001, CFI = 0.954, TLI = 0.933, RMSEA = 0.041$

Fig. 5. Standardized coefficients of the full-SEM-analysis

Table 5. Standardized direct, indirect, and total effects of background variables and mediators

Background and latent variables	Direct effect	Indirect effect	Total effect
Age	-0.15	-0.17	-0.32
Gender	0.00	-0.34	-0.34
Level of education	0.00	0.00	0.00
Household income per month	-0.11	-0.03	-0.14
Occupation	0.00	-0.30	-0.30
Car ownership	-0.14	-0.17	-0.31
Social embarrassment while walking/cycling	0.00	-0.41	-0.41
Cultural issues	-0.19	-0.48	-0.67
Travel distance (Km)	-0.15	-0.23	-0.38
Cyclist-pedestrian traffic signs and lights	0.00	0.00	0.00
Negative activation/positive deactivation	0.64	0.00	0.64
Negative deactivation/positive activation	0.60	0.00	0.60
Cognitive evaluation	0.00	0.00	0.00
Pro-bike	0.32	0.00	0.32
Physical determinants	-0.26	0.00	-0.26
Convenience	0.38	0.00	0.38
External restrictions	-0.66	0.00	-0.66
Comfort and convenience of walking	0.48	0.00	0.48
Design feasibility for pedestrians	0.45	0.00	0.45
Contextual design and preconditions	-0.37	0.00	-0.37

5. Discussion

The structural framework of the present study shed light on the association between the use of active transportation for travelling to the university and background variables through mediating variable of satisfaction with travel and attitude towards active travel. In general, previous studies have only investigated the direct effect of demographic, social, and built environment attributes on active travel behaviour (Hasan et al., 2019: Buehler et al., 2020), while this study showed that these variables are also indirectly associated with "the use of active transportation" through mediating variables of satisfaction with travel and attitudes. The following section discusses how these effects work.

The findings of previous studies have separately demonstrated that either background variables (e.g. gender) or "negative activation / positive deactivation" factor (e.g. stressed/ calm) are directly related to active transport choice. While the findings of this study showed that students' stress, anxiety and hurry may be exacerbated by background factors (e.g. female gender, employment, social embarrassment and cultural issues), this association can affect students' choice of active travel modes. This finding can be explained in terms of the impact of social, environmental and cultural factors and the existence of gender gaps, especially in Muslim countries like Iran, concerning the use of active transportation by women. In keeping with previous studies, in most Muslim countries like Saudi Arabia and Yemen, women are not allowed to walk alone without the company of a male family member. Hence, they feel more

stressed than men when walking, which is rooted in their culture and social traditions (Benjamin and Donnelly, 2013; Hasan et al., 2019).

Our findings highlight gender differences in cycling behaviour in the study area. Due to social and cultural issues, females in some Islamic countries are only allowed to cycle in recreational places such as parks (Ramdani, 2013). Some revolutions and cultural changes should be taken into account to promote the share of cycling as a sustainable transport mode among females in such countries. Additionally, women's stress and anxiety are likely to probably provoked by the fear of mugging, privacy threats, and lower security when using active transportation (e.g. cycling) compared to motor vehicles (Singleton, 2018; Singleton and Wang, 2014). This stress and anxiety at the time of walking may be associated with a lower tendency to use active transportation. Besides, we found that time constraints of working students to commute to the university and workplace may be linked to the greater hurry and stress, which constrains the use of active transportation. Policymakers can partially address fears and concerns regarding the use of active transport by female students by organising Walking Campus Bus for females and creating a culture of group cycling.

Unlike previous studies that have demonstrated the direct effect of background variables on the choice of active transportation (Buehler et al., 2020; Mehdizadeh and Ermagun, 2018), the findings of the present study manifested that these variables can also indirectly (through negative deactivation / positive activation factor including Bored/enthusiastic) affect the choice of active transportation. For instance, the possession of a private car and longer travel distances were connected to a lower tendency of using active modes and more significant fatigue of students, which subsequently related to the reduced use of walking and cycling. It could be justified in that longer distances consume more energy and are more exhausting (Milakis et al., 2015). Also, students with a private car often believed that it is the most comfortable and convenient mode of transport. As a result, this group of students were less interested in using active transportation. Therefore, implementing policies such as increasing the cost of parking on campus for private cars and setting up stations to rent bicycles in the city could help promote the use of active transportation.

Students who care about the positive aspects of cycling (e.g. no fuel expenses, the purchase and maintenance of the bicycle are economical) seem to be more likely to use active transportation. On the other hand, working students, students with high household incomes, students who faced cultural issues in their place of residence or felt socially embarrassed while riding a bicycle were less influenced by the positive aspects of cycling. These findings are in line with previous research according to which the importance of time management for working students (Kaplan et

al., 2015), cultural issues such as negative attitude towards cycling, especially for women, and the sense of embarrassment when cycling are linked to disregard for positive aspects of cycling and therefore a lower tendency to ride a bike (Kaplan et al., 2015; Benjamin and Donnelly, 2013; Hasan et al., 2019). In general, critical findings derived from the literature review suggest that in cities where a set of strategies are executed simultaneously to support the use of active transportation modes, the impact will be more sustainable than a series of independent actions (Pucher et al., 2010). These strategies should be tailored to social norms, provider organisations, and desired objectives. For example, according to a study by Savan et al., 2017, training to change attitude will be effective when the convenient use of private cars is restricted as much as possible. Therefore, organizing programs such as educational workshops or social rides such as We Bike NYC in New York (to provide a safe environment for the community of female cyclists) and Belles on Bikes in Scotland (a network of women's cycling groups that urge other women to ride in a friendly and peaceful environment), coupled with policies such as restricted use of private cars may help mitigate students' sense of embarrassment and misconception regarding the use of bicycle as a mode of transportation in the study area.

Physical determinants such as mountainous or hilly topography are inversely related to the use of active transportation (e.g. walking, and cycling). The results of the present study also showed that physical determinants, such as land features or improper cycling infrastructure, were of paramount importance for older students. Therefore, creating special routes with proper infrastructure for cycling may contribute to the accelerated use of the bike, especially among more former students. Moreover, the convenience of using a bicycle, such as lack of time limit, traffic jam, or parking space problem, was associated with a greater tendency to use active transportation (e.g. cycling). This finding also confirms previous studies according to which cycling convenience encourages people to use further bicycles (Li et al., 2013). This factor also may reflect cultural issues. Culture is a crucial factor influencing the choice of transportation modes in Muslim countries (Francesco, 2013; Hasan et al., 2019). According to previous studies, cultural issues and misconceptions about women's cycling and walking in Arab countries have contributed to the greater reliance on motor vehicles (Elias et al., 2015; Hasan et al., 2019). Given that in Iran, as in many Islamic countries, culture and traditions have a huge bearing on the choice of transportation modes, it can be argued that less emphasis on the convenience of using bicycles is rooted in cultural issues.

External restrictions concerning cycling were also inversely related to the choice of active transportation (e.g. cycling). In other words, the absence of complementary facilities for cyclists such as safe parking at the destination and apprehension about bicycle theft were associated with a lower tendency of students to use bicycles. The results of some previous studies have exhibited

that external restrictions, such as unsafe infrastructure, the risk of collisions, or bicycle theft, which are beyond the user's control, play an important role in the lower use of bicycles (Kummeneje and Rundmo, 2020; Fernández-Heredia et al. 2014; Goldsmith, 1992). Besides, the present study revealed that external restrictions were more important for female students. It can be attributed to the fact that women are more risk-averse than men (Kummeneje et al., 2019), so they were more concerned about the potential hazards of cycling, such as bicycle theft. Therefore, providing suitable infrastructure and safe parking for cyclists to reduce potential hazards such as theft might encourage students (especially females) to ride a bike.

According to the findings of the present study, designing more favourable facilities for walking (e.g. proper street design) may stimulate students to use active transportation modes. Students who gained a higher score in contextual and design preconditions for walking were less likely than other students to choose walking as a means of travelling to the college. Probably, vehicle emissions and dirty and vandalised streets were linked to the negative attitudes of students who used private cars, and students whose place of residence was distant from the university. The structural model of the present study showed that optimal design preconditions for walking and decreased likelihood of encountering unpleasant situations on the streets could prompt this group of students to choose walking.

In line with the previous studies, in this study, attitudes and satisfaction with travel were found to have a direct relationship with the use of active transportation (De Vos et al., 2015; Mehdizadeh et al. 2018), so that negative attitudes and dissatisfaction with active travel can discourage walking and cycling among students. Besides, among the three factors of the STS, the "cognitive dimension" was not significantly related to walking and cycling on university trips. At the same time "negative activation/positive inactivity" (e.g. stressed/ calm) had the greatest impact on active transport use. Also, among four factors of "attitude towards cycling", the variable of "external restrictions" and among three factors of "attitude towards walking", the variable of "comfort and convenience of walking" had the greatest effect on the use of active travel modes.

6. Conclusions

In this study, the indirect effects of background variables (demographic, social environment and built environment factors) through psychological factors such as attitudes and travel satisfaction (as mediating variables) were investigated in student travels to university besides the direct effects of background variables on the choice of active transportation.

The results of the present study revealed that background variables not only have a direct effect but can indirectly influence the choice of active transportation modes through attitudes and travel

satisfaction. The results of the structural equation model revealed that females, working students and cultural issues were associated with unfavourable attitudes, high stress and hurry during walking and cycling and a lower tendency to use active transportation. Thus, promoting the culture of cycling and advertising in the mass media as well as holding workshops at the university to encourage female students to use active travel modes can help quell fears and concerns of female students about the use of active transportation modes. As asserted by previous research (e.g. Telfer et al., 2006; Savan et al., 2017; Hasan et al., 2019) launching attitudinal and behavioural change campaigns could promote active commuting among students. It may be also helpful to incorporate educational programs in order to shape positive attitudes towards walking and cycling in university environment. Other measures such as group cycling culture should be taken to ease worries of fear and negative image perception.

In addition, the possession of a private car, old age, and longer travel distance may be associated with unwillingness or fatigue of students, which diminish the use of walking and cycling as means of transportation. Therefore, policies such as reducing cars on the streets, creating a suitable infrastructure for cycling and walking, and setting up stations to rent bikes in different parts of the city could help promote the use of active transportation modes compared to motorised modes among university students.

The following limitations provide more avenues for future research. First, we only recorded active mode use of students in university trips, and the current modal share of students was not asked from the participants. Understanding the current travel mode choice of respondents could reflect more knowledge about travel patterns of students. Future studies should investigate the association between the current modal share of students and satisfaction with different travel modes. Second, the STS (De Vos et al., 2015), cycling attitudes (Fernández-Heredia et al., 2014), and walking attitudes (Mehdizadeh et al. 2017) were measured by a 7-point, 6-point, and 5-point Likert scale, respectively. Such inconsistencies and switching between scales might affect the answers of the respondents. Future studies should also keep the same Likert scale for such psychological instruments in the analysis process.

7. References

Ajzen, I. 1991. "The theory of planned behaviour." Organizational behavior and human decision processes. 50 (2), 179-211.

Anable, J., Gatersleben, B. 2005. All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes. Transportation Research Part A. 39, 163–181.

Arroyo, R., Ruiz, T., Mars, L., Rasouli, S., & Timmermans, H. (2020). Influence of values, attitudes towards transport modes and companions on travel behavior. Transportation research part F: traffic psychology and behaviour, 71, 8-22.

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.

Benjamin, K., Donnelly, T.T. 2013. Barriers and facilitators influencing the physical activity of Arabic adults: a literature review. Avicenna, 1–16. (2220-2749).

Buehler, R., Hamre, A. 2016. An examination of recent trends in multimodal travel behavior among American motorists. Int. J. Sustainable Transportation, 10 (4), 354‑364.

Buehler, R., Pucher, J., Bauman, A. 2020. Physical activity from walking and cycling for daily travel in the United States, 2001–2017: Demographic, socioeconomic, and geographic variation. Journal of Transport & Health. 16, 1008-11.

Danaf, M., Abou-Zeid, M., Kaysi, I. 2014. Modeling travel choices of students at a private, urban university: insights and policy implications. Case Stud. Transport Policy. 2 (3), 142‑152.

Daziano, Ricardo A., 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.

De Vos, J., Schwanen, T., Van Acker, V., Witlox, F. 2015. How satisfying is the Scale for Travel Satisfaction?. Transportation Research Part F. 29, 121–130.

De Vos, J., Witlox, F., 2017. Travel satisfaction revisited. On the pivotal role of travel satisfaction in conceptualising a travel behaviour process. Transp. Res. Part A: Policy Pract. 106, 364–373.

De Vos, J. (2019a). Satisfaction-induced travel behaviour. Transportation research part F: traffic psychology and behaviour, 63, 12-21.

De Vos, J. (2019b). Analysing the effect of trip satisfaction on satisfaction with the leisure activity at the destination of the trip, in relationship with life satisfaction. Transportation, 46(3), 623-645.

Dill, J., Voros, K., 2007. Factors affecting bicycling demand: initial survey findings from the Portland, Oregon, Region. Transp. Res. Rec.: J. Transp. Res. Board. 2031, 9–17.

Donnelly, T.T., Al-thani, A.M., Benjamin, K., Al-khater, H., Fung, T.S., Ahmedna, M., Welch, A., 2018. Arab Female and Male Perceptions of Factors Facilitating and Inhibiting Their Physical Activity : Findings from a Qualitative Study in the Middle East. 1–28.

Egset, K. S., & Nordfjærn, T. (2019). The role of transport priorities, transport attitudes and situational factors for sustainable transport mode use in wintertime. Transportation research part F: traffic psychology and behaviour, 62, 473-482.

Elias, W., Benjamin, J., Shiftan, Y. 2015. Gender differences in activity and travel behavior in the Arab world. Transport Pol. 44, 19–27.

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

576 Ettema, D., Garling, T., Eriksson, L., Friman, M., E. Olsson, L., Fujii, S. 2011. Satisfaction with
577 travel and subjective well-being: Development and test of a measurement tool. Transportation
578 Research Part F. 14,167–175.

579 Fernández-Heredia, Á., Monzón, A., Jara-Díaz, S. 2014. Understanding cyclists' perceptions,
580 keys for a successful bicycle promotion. Transportation Research Part A. 63, 1–11.

581 Francesco, S. 2013. Cycling towards Sustainability: the Path Runs through Malmö. Malmo
582 University.

583 Gerike, R., de Nazelle, A., Wittwer, R., Parkin, J., eds. 2019. Special Issue: Walking and Cycling
584 for Better Transport, Health, and the Environment. Transportation Research Part A: Policy and
585 Practice. 123, 1-304.

586 Gibbons, S., Vignoles, A. 2012. Geography, choice and participation in higher education in
587 England. Regional Science and Urban Economics. 42, 98–113.

588 Goldsmith S. (1992). The National Bicycling and Walking Study Case Study No. 1: Reasons
589 Why Bicycling and Walking are Not Being Used More Extensively as Travel Modes. Web
590 Resource. Available at: https://safety.fhwa.dot.gov/ped_bike/docs/case1.pdf.

591 Hasan, R.A., Abbas, A.H., Kwayu, K.M., Oh, J.S. 2019. Role of social dimensions on active
592 transportation and environmental protection: A survey at the University of Samarra, Iraq. Journal
593 of Transport & Health. 14, 1005-64.

594 Haustein, S., Jensen, A. F., & Nielsen, T. A. S. (2019). Active transport modes. Transforming
595 Urban Mobility, 39.

596 Heinen, E. Maat, K. Wee, B. 2011. The role of attitudes toward characteristics of bicycle
597 commuting on the choice to cycle to work over various distances Transportation Research Part D
598 16, 102–109.

599 Heinen, E., Chatterjee, K. 2015. The same mode again? An exploration of mode choice
600 variability in Great Britain using the national travel survey. Transportation Res. Part A: Policy
601 Practice. 78, 266‑282.

602 Ho, R. (2006). HANDBOOK OF UNIVARIATE AND MULTIVARIATE DATA ANALYSIS
603 AND INTERPRETATION WITH SPSS.

604 Kamargianni, M, Polydoropoulou, A. 2013. Hybrid choice model to investigate effects of
605 teenagers' attitudes toward walking and cycling on mode choice behavior. Transportation
606 Research Record: Journal of the Transportation Research Board. 2382: 151-161.

607 Kaplan, D.H. 2015. Transportation sustainability on a university campus. International Journal of
608 Sustainability in Higher Education, 16, 173–186.

609 Kenyon, S. 2011. Transport and social exclusion: Access to higher education in the UK policy
610 context. Journal of Transport Geography, 19, 763–771.

611 Kim, Jinhee, Soora Rasouli, and Harry JP Timmermans. 2017. "The effects of activity travel
612 context and individual attitudes on car-sharing decisions under travel time uncertainty: A hybrid
613 choice modeling approach." Transportation Research Part D: Transport and Environment. 56,
614 189-202.

615 Kline, R. B. 2015. Principles and practice of structural equation modeling. Guilford publications.

Kummeneje, A. M., & Rundmo, T. (2020). Attitudes, risk perception and risk-taking behaviour among regular cyclists in Norway. Transportation research part F: traffic psychology and behaviour, 69, 135-150.

Kummeneje, A-M., Ryeng, E.M., Rundmo, T. 2019. Seasonal variation in risk perception and travel behaviour among cyclists in a Norwegian urban area. Accident Analysis and Prevention. 124, 40‑49.

LaJeunesse, S., A. Rodríguez, D. 2012. Mindfulness, time affluence, and journey-based affect: Exploring relationships. Transportation Research Part F. 15, 196–205.

Leung, K. Y., & Loo, B. P. (2020). Determinants of children's active travel to school: A case study in Hong Kong. Travel Behaviour and Society, 21, 79-89.

Limanond, T., Butsingkorn, T., and Chermkhunthod, C. 2011. Travel behavior of university students who live on campus: A case study of a rural university in Asia. Transport Policy. 18, 163–171.

Li, Z., Wang, W., Yang, C., Ragland, D.R. 2013. Bicycle commuting market analysis using attitudinal market segmentation approach. Transportation Research Part A. 47, 56–68.

Lovejoy, K., Handy, S.L., 2011. Mixed methods of bike counting for better cycling statistics: the example of bicycle use, abandonment, and theft on the UC Davis campus. 90th Annual Meeting of the Transportation Research Board, Washington, DC. <http://www.docstoc.com/docs/139481191/Mixed-Methodsof- Bike-Counting-for-Better-Cycling>. Mackett, R.L., 2003. Why do people use their.

Mehdizadeh, M., Mamdoohi, A., & Nordfjaern, T. (2017). Walking time to school, children's active school travel and their related factors. Journal of Transport & Health, 6, 313-326.

Mehdizadeh, M., Ermagun, A., 2018. "I' ll never stop driving my child to school": on multimodal and monomodal car users. Transportation. 1‑32. https://doi.org/10.1007/s11116-018-9949-5

Mehdizadeh, M., Fallah Zavareh, M., Nordfjaern, T. 2019a. Mono- and multimodal green transport use on university trips during winter and summer: Hybrid choice models on the norm activation theory. Transportation Research Part A. 130, 317‑332.

Mehdizadeh, M., Fallah Zavareh, M., Nordfjaern, T., 2019b, School travel mode use: direct and indirect effects through parental attitudes and transport priorities. Transportmetrica A: Transport Science. 15(2), 749-775.

Milakis, D., Cervero, R., Wee, BV., Maat, K. 2015. Do people consider an acceptable travel time? Evidence from Berkeley, CA. Journal of Transport Geography. 44, 76–86.

Moudon, A.V., Lee, C., Cheadle, A.D., Collier, C.W., Johnson, D., Schmid, T.L., Weather, R.D., 2005. Cycling and the built environment, a US perspective. Transp. Res. Part D: Transp. Environ. 10, 245–261.

Nguyen-Phuoc, D. Q., Amoh-Gyimah, R., Tran, A. T. P., & Phan, C. T. (2018). Mode choice among university students to school in Danang, Vietnam. Travel behaviour and society, 13, 1-10.

Nordfjærn, T., 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.

Nordfjaern, T., Egset, K.S., Mehdizadeh, M., 2019. "Winter is coming": Psychological and situational factors affecting transportation mode use among university students. Transport Policy.

Lades, L. K., Kelly, A., & Kelleher, L. (2020). Why is active travel more satisfying than motorized travel? Evidence from Dublin. Transportation research part A: policy and practice, 136, 318-333.

Passi-Solar, A., Margozzini, P., Cortinez-O'Ryan, P., C. Mu~noz, J., S. Mindell, J. 2020. Nutritional and metabolic benefits associated with active and public transport: Results from the Chilean National Health Survey, ENS 2016–2017. Journal of Transport & Health. 17, 100819.

Pucher, J., Dill, J., Handy S. 2010. Infrastructure, programs and policies to increase bicycling. Preventive Medicine. 50, 5106–5125.

Pucher, J., Buehler, R., Merom, D., Bauman, A., 2011. Walking and cycling in the United States, 2001-2009: evidence from the NHTS. Am. J. Public Health. 101.

Pucher, Buehler (Eds.). 2012. City Cycling. MIT Press, Cambridge, MA. Cervero, R., Sarmiento, O.L., Jacoby, E., Gomez, L.F., Neiman, A., 2009. Influences of built environments on walking and cycling: lessons from Bogota. Int. J. Sustainable Transportation. 3 (4), 203‑226.

Ramdani, N. 2013. Saudi women are allowed to cycle – but only around in circles (Life and style) the Guardian. [WWW Document]. Guardian. https://www.theguardian.com/lifeandstyle/the-womens-blog-with-jane-martinson/2013/apr/03/saudi-women-allowed-to-cycle

Savan, B., Cohlmeyer, E., Ledsham, T. 2017. Integrated strategies to accelerate the adoption of cycling for Transportation. Transportation Research Part F. 46, 236–249.

Savan, B., Cohlmeyer, E., Ledsham, T. 2017. Integrated strategies to accelerate the adoption of cycling for transportation. Transportation Research Part F. 46, 236–249.

Shams, Z., Mehdizadeh, M., & Sanij, H. K. (2020). "I neither sleep well nor drive cautiously": How does sleep quality relate to crash involvement directly and indirectly?. Journal of Transport & Health, 18, 100907.

Shannon, T., Giles-Corti, B., Pikora, T., Bulsara, M., Shilton, T., and Bull, F. 2006. Active commuting in a university setting: Assessing commuting habits and potential for modal change. Transport Policy. 13, 240–253.

Singleton, P., Wang, L., 2014. Safety and security in discretionary travel decision making: focus on active travel mode and destination choice. Transp. Res. Record: J. Transp. Res. Board 2430, 47–58.

Singleton, P.A. 2018. Walking (and cycling) to well-being: Modal and other determinants of subjective well-being during the commute. Travel Behaviour and Society.

Singleton, P.A. 2019. Validating the Satisfaction with Travel Scale as a measure of hedonic subjective well-being for commuting in a U.S. city. Transportation Research Part F. 60, 399–414.

694 Sivasubramaniyam, R. D., Charlton, S. G., & Sargisson, R. J. (2020). Mode choice and mode
695 commitment in commuters. Travel Behaviour and Society, 19, 20-32.

696 Smith, O., 2017. Commute well-being differences by mode: evidence from Portland, Oregon,
697 USA. J. Transport and Health. 4, 246–254.

698 Telfer, B., Rissel, C., Bindon, J., & Bosch, T. 2006. Encouraging cycling through a pilot cycling
699 proficiency training program among adults in central Sydney. Journal of Science and Medicine
700 in Sport. 9, 151–156.Ye, R., & Titheridge, H. (2019). The determinants of commuting
701 satisfaction in low-income population: A case study of Xi'an, China. Travel Behaviour and
702 Society, 16, 272-283.

703 Zannat, K.E., Gani Adnan, MS., Dewan, A. 2020. A GIS-based approach to evaluating
704 environmental influences on active and public transport accessibility of university students.
705 Journal of Urban Management. 9, 331-346.

706 Zavareh, M. F., Mehdizadeh, M., & Nordfjærn, T. (2020). Active travel as a pro-environmental
707 behaviour: An integrated framework. Transportation Research Part D: Transport and
708 Environment, 84, 102356.

709

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