Journal of Transport & Health 24 (2022) 101319

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: www.elsevier.com/locate/jth

An integrated model of structural equations with cognitive and environmental factors for the study of active commuting

José A. Ortiz-Sánchez, José M. Ramírez-Hurtado *, I. Contreras

Department of Economics, Quantitative Methods and Economic History, Universidad Pablo de Olavide, Ctra. de Utrera, km. 1, s/n, 41013, Seville, Spain

ARTICLE INFO

Keywords:
Active commuting
Theory of planned behaviour
Health
Environment
Structural model

ABSTRACT

Introduction: The active commuting can be defined as the action of displacement to the educational or work centre by way of any non-motorised means of transport, usually by walking or cycling. The aim of this study is to identify and evaluate cognitive and environmental factors for the active commuting.

Methods: In order to propose a set of beliefs and attitudes that explain the main possible motivations for an individual to carry out the active commuting, a model based on the Theory of Planned Behaviour, health and environment is developed. To compute the results, a structural equations model is proposed instead of another standard regression technique, due to the use of multiple indicators for each latent construct. The proposed model permits to evaluate each of the aspects and to quantify their contribution to the global behavioural intention.

Results: The computation of the structural equations model concludes that, for the intention to practise active commuting, the most influential variable is attitude, followed by health and environmental awareness. It is interesting to see that perceived behavioural control exerts a negative influence on the intention, while the subjective norm has no significant effect.

Conclusions: From the results of this study can be induced that the perceived behavioural control, health, and environmental awareness exert a significant influence on attitude and intention to practice active commuting. Furthermore, the results also show that attitude influences as a precursor to the intention of practicing and permit to rank the relative weight of each aspect: attitude, health and environmental awareness. Hence, political measures that publicise the benefits of active commuting in these particular aspects should have significant results in the promotion of this activity.

1. Introduction

Active commuting can be defined as the action of travelling to the educational or work centre by certain means that involves metabolic expenditure, such as walking or cycling. The fundamental characteristic is to carry out the displacement by way of a non-motorised means of transport (Chillón et al., 2011). It is an effective way to integrate physical activity into a sedentary lifestyle (Rojas-Rueda et al., 2016). Its importance lies in the fact that commuting to the workplace or study centre constitutes an activity that is usually carried out on a daily basis.

* Corresponding author.
E-mail addresses: jaortsan@alu.upo.es (J.A. Ortiz-Sánchez), jmramhur@upo.es (J.M. Ramírez-Hurtado), iconrub@upo.es (I. Contreras).

https://doi.org/10.1016/j.jth.2021.101319
Received 20 July 2021; Received in revised form 15 December 2021; Accepted 16 December 2021
Available online 24 December 2021

In recent years, there has been a major rise in health problems affecting the population, such as obesity and diabetes. Promoting physical activity constitutes one of the priorities of public health policies in many countries (Mueller et al., 2015). In this respect, the practice of active commuting is associated with numerous benefits for both individuals and society as a whole (Hatamzadeh et al., 2020). Improvement in health is found among the benefits at individual level, while environmental improvements appear at the level of society. For example, from a health point of view, people who practise active commuting reduce the causes of mortality, cardiovascular problems, and diabetes (Dinu et al., 2019; Herman and Larouche, 2021). The reduction of stress is another benefit of active commuting (Kroesen, 2014). On the other hand, from an environmental point of view, active commuting can reduce traffic congestion with a consequent reduction in emissions and energy consumption of fossil fuels (Hatamzadeh et al., 2020).

Research into active commuting is characterised by a variety of aspects. First, many studies have focused on environmental factors such as distance, travel time, and road safety, with little emphasis on subjective factors such as attitudes and beliefs towards active commuting (Hatamzadeh et al., 2020). In contrast to previous works, this study specifies a structural model in which both environmental factors and subjective factors are integrated. Featured among the subjective factors studied herein, are the attitude towards the practice of active commuting and the behavioural intention to practise active commuting. These factors are based on the Theory of Planned Behaviour (TPB) (Ajzen, 1991), which provides a suitable model for the study of the possible reasons that lead people to adopt a certain behaviour.

Second, although the TPB has received much empirical support in the literature, other variables should be considered in order to attain a better understanding of the behaviour of individuals towards ecological marketing. It is therefore understood that variables related to the environment, such as environmental awareness and concern for the environment, should be incorporated in order to create an extension of the TPB model for the case of active commuting.

Third, the majority of studies on active commuting have examined only direct effects between variables, without taking into account the possible mediating influences (Hatamzadeh et al., 2020). In this case, we also propose a model of structural equations that allows us to measure the influence of mediating variables.

And fourth, a major limitation in the literature is that the measures employed to assess active commuting have been inconsequential and often show an evident lack of validity or reliability (Chillón et al., 2011). In our case, a structural equation model is specified with numerous statistics related to the reliability and validity of the measures utilised.

These questions need to be answered for the promotion of the benefits of active commuting and to help those responsible for this issue to adopt strategies of a more effective nature. The main objective of this work is therefore to identify the factors that influence the attitude and behaviour towards active commuting. To this end, a structural model is specified with cognitive and environmental variables. Structural equation modelling is a statistical linear modelling technique that has been applied to various studies of commuting behaviour since the 1980s (Shiftan et al., 2008). The data has been collected through a sample of people mainly in the area of Seville, a city in southern Spain, by means of a questionnaire specially designed for this purpose. A total number of 448 responses were obtained.

The article is structured as follows. In the following section, a review of the literature on active commuting is presented. The methodology of this work is subsequently described. Finally, the results are analysed, which provide reliable and valid measures, and conclusions are drawn and implications of the study are presented.

2. Conceptual framework

The literature points to four major classes of behavioural determinants for the adoption of active commuting: psychological/cognitive factors, individual socio-demographic factors, physical environmental factors, and natural environmental factors (Acheampong, 2017). From among these factors, the most important are cognitive factors, which encompass the beliefs and attitudes of individuals towards a certain behaviour and the perceptions regarding a particular behaviour. A theory that has been widely used in the literature to study the motivations of human behaviour is the Theory of Planned Behaviour (TPB) (Ajzen, 1991). The TPB is a cognitive framework found in the psychology literature for the understanding of how attitude, subjective norm, and perceived behavioural control all influence active commuting behaviour (Acheampong, 2017). However, the application of this theory to active commuting remains strictly limited.

The TPB constructs have been applied in various empirical studies on active commuting in several European and North American cities (Bamberg, 2003; Lajunen and Räsänen, 2004; Quine et al., 1998). Studies have provided different results in terms of attitudes, social norm, and perceived behavioural control.

In the behaviour of commuting or travelling there are studies that include a variety of psychological factors that can be considered as attitudes, although they are denominated differently. In these cases, attitude has been used to study the intention to practise active commuting (García et al., 2019).

The subjective norm reflects the influence of the opinions of other people (family, friends, and work colleagues) on the behaviour of the individual (Fishbein and Ajzen, 1975). It is therefore related to the expectations of the social groups to which the subject belongs. Finally, perceived behavioural control refers to the perceived ease or difficulty in developing a certain behaviour (Ajzen, 1991).

Attitudes are formed according to the individual's own beliefs regarding behaviour, while subjective norms are formed from normative beliefs. Finally, perceived behavioural control depends on the control that individuals exert over the actions that they perform and the resources that they possess in order to carry out said behaviour (Ajzen, 1991). Attitude is conceived as an antecedent of behavioural intention in certain studies on commuting or transportation (Chen and Chao, 2011; Murtagh et al., 2016). Nevertheless, attitude appears to constitute a crucial element for the intention to engage in healthy habits, such as active commuting.

Based on the reasoning laid out above, the following hypotheses are defined:

H1. *The social* norm *is an antecedent of the attitude towards practising active commuting.*

H2. *Perceived behavioural control is an antecedent of the attitude towards practising active commuting.*

H5. *Attitude influences the behavioural intention to practise active commuting.*

Physical activity is recognised as one of the most effective and powerful tools to prevent many chronic illnesses and to promote the health and well-being of the population (Lee, 2007). The literature shows that active commuting is associated with a lower presence of cardiovascular diseases and diabetes. There are even studies showing that active commuting reduces the risk for all causes of mortality (Dinu et al., 2019).

It seems that there is clear evidence that cycling and walking would reduce stress levels and discourage a sedentary lifestyle. Thus, the intention to become healthier can be a major factor in being able to practise active commuting. In view of these assumptions, the following hypothesis is defined.

H3. *One's current state of health is an antecedent of the attitude to practise active commuting.*

The literature on active commuting has taken into account certain environmental factors. However, most of these studies have focused on factors such as population density, distance, traffic insecurity, terrain or climate (Chillón et al., 2015; Molina-García et al., 2019).

Several authors consider that increasing the levels of non-motorised transport among the population could not only reduce obesity rates, but also improve the levels of happiness and well-being, and even reduce traffic congestion and attenuate the emission of gases and pollution into the atmosphere (Arazuri et al., 2017; Bungum et al., 2009).

Given these considerations, the following hypothesis is formulated:

H4. *Environmental awareness is an antecedent of the attitude to practise active commuting.*

Based on the hypotheses defined above, the structural model is specified as in Fig. 1.

3. Methodology

3.1. Sample

The principal area under study was Seville (Spain), although other locations were also accepted. The survey was conducted between February and April 2021 in Spain. The target population was formed of people whose main transport mode is walking or cycling. In order to obtain the data, a questionnaire was designed and distributed online. The questionnaire was designed through Google Drive. The link to the questionnaire was distributed through the main social networks, specifically, email, WhatsApp, Twitter, and Facebook. In this way, convenience sampling with snowball effect was used. This method is an appropriate and efficient sampling method for the selection of people who are difficult to reach (Henn et al., 2006). Furthermore, snowball sampling has been used in this study since this technique needs little planning and a smaller workforce compared to other sampling techniques and requires a lower cost per questionnaire administered.

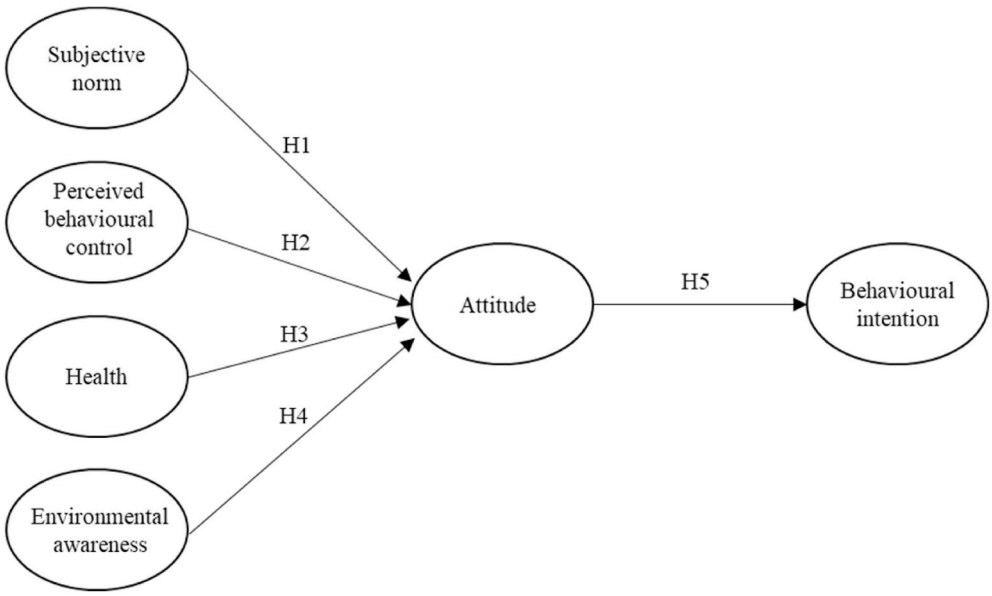

Fig. 1. Proposed research model.

The sample size was calculated while bearing in mind the proportion of people walking or cycling in Spain. The target population was taken as being infinite since it is unknown. Given a level of confidence of 95%, considering the worst case (p=q=0.5) and assuming the margin of error of 5%, the sample size consisted of 385 responses. Since 448 responses were obtained, the final sample size betters the minimum size of 385 responses. This number far exceeds the minimum number of sample cases suggested by certain authors for structural equation models (Hair et al., 2014a,b; Stevens, 2009).

3.2. Instruments and variables

The questionnaire was designed with socio-demographic variables, cognitive variables, and environmental variables. All the variables have been adapted from a variety of research in the literature (Table 1). The observable variables have been measured on a Likert scale of 1–5 points, where 1 means “totally disagree”, and 5 ″totally agree".

The data was analysed with AMOS software.

4. Results

This section presents the analysis of the results obtained in the empirical study. This begins with a discussion of the socio-demographic characteristics of the participants in the study. The results show that a large proportion of the participants are between 30 and 50 years old (48.2%). Regarding gender, the sample is made up of a greater number of women. Most of the interviewees tend to have higher or secondary education, and they are usually employed. Finally, the majority of the individuals in the sample use the mode of walking to carry out active commuting (87.5%).

In this study, a structural equation model was utilised instead of another standard regression technique due to the use of multiple indicators for each latent construct. Following the suggestion of several authors (Frash and Blose, 2019; Hair et al., 2014a,b; Pinky Pawaskar and Goel, 2016), an exploratory factor analysis (EFA) was carried out as a preliminary step before conducting the structural model. The EFA was carried out with SPSS and with varimax rotation, in order to identify the underlying dimensions of the constructs and/or factors. The initial EFA showed that two items were loading on the wrong factors. These constructs were *perceived behavioural control* (PBC1) and *attitude* (AT1). Therefore, these items were deleted because they were largely unrelated to their hypothetical factors. The results of the EFA supported the configuration of factors shown from the original instrument. Subsequent to the exploratory analysis of the data, we proceeded to the development of the structural model.

For the estimation of the structural model, multivariate normality must first be studied through the Mardia test. The multivariate normality hypothesis is rejected because the Mardia test value is 149,659 (>5.99 at a significance level of 5%), thereby yielding a critical ratio greater than 1.96. Nevertheless, given that the sample size is sufficiently large, it is decided to opt for the maximum likelihood estimation method since this method is capable of facilitating the convergence of the estimates even in the absence of multivariate normality (Lèvy et al., 2006).

A two-stage approach has been adopted for the evaluation of the model, as proposed by several authors (Bollen, 2014; Rindskopf and Rose, 1988). The reliability of the items is measured by ensuring that the standardised factor loadings are greater than 0.7, so that the shared variance between the construct and its indicator are greater than the error variance (Fornell and Larcker, 1981; Hair et al.,

Table 1
Constructs and observable variables in the model.

Construct		Observable variable
SN	Subjective norm (Pang et al., 2017; Paul et al., 2016)	SN1. Many people who are important to me think that I should commute on foot or by bike. SN2. Many people I appreciate feel that I should use active commuting. SN3. The positive opinion of my friends regarding active commuting influences me in choosing this form of commuting.
PBC	Perceived behavioural control (Li et al., 2013; Shiftan et al., 2008)	PBC1. Stress-free commuting is more important than reaching a destination quickly. PBC2. On rainy days I prefer the car or the bus rather than walking or cycling. PBC3. In summer/winter I prefer a means of transport with air conditioning/heating.
HE	Health (Hatamzadeh et al., 2020)	HE1. Active commuting is healthy. HE2. Active commuting will be good for my health. HE3. Active commuting will keep me fit. HE4. Active commuting will maintain my vitality and a good quality of life.
EA	Environmental awareness (Li et al., 2013; Minton and Rose, 1997; Paul et al., 2016)	EA1. Cars are one of the main causes of environmental pollution. EA2. I prefer to change my mode of transport if it contributes negatively to the environment EA3. More political and social changes are necessary to protect the environment. EA4. I believe we are doing little to save scarce natural resources. EA5. I feel angry and frustrated when I think about the damage incurred by pollution to plant and animal life.
AT	Attitude (Acheampong, 2017; Pang et al., 2017)	AT1. Active commuting is agreeable. AT2. Active commuting is enjoyable. AT3. Active commuting is fun.
BI	Behavioural intention (Acheampong, 2017)	BI1. I try to use active commuting at least three times a week throughout the year. BI2. I will consider active commuting at least three times a week next year.

2014a,b). However, certain authors consider that a factor load greater than 0.5 is also acceptable (Chau, 1997). In Table 2, it can be observed that all the standardised factor loads are greater than 0.7, except for the variables SN3, EA1, and EA3, which remain, nevertheless, greater than 0.5. Therefore, the reliability of the measurement model is indicated.

For the reliability of the constructs or latent variables, Cronbach's α coefficient and the composite reliability (CR) coefficient are analysed. Table 2 shows that all Cronbach's α coefficients are greater than 0.7. Likewise, the CR coefficient values are all greater than 0.7, thereby verifying the composite reliability. These coefficients therefore allow us to verify the reliability of each construct.

In relation to validity, both convergent validity and discriminant validity have been studied. For the measurement of convergent validity, the average variance extracted (AVE) has been analysed. Values greater than 0.5 confirm that convergent validity exists (Byrne, 1994; Fornell and Larcker, 1981). In Table 2, it can be observed that all AVE values are greater than 0.5, and hence we can affirm that convergent validity is fulfilled.

With regard to discriminant validity, the correlation matrix between the constructs has been calculated and it has been found that the correlations are less than the square root of the AVE. Values greater than 0.5 indicate that discriminant validity is attained (Bagozzi and Yi, 1988). In Table 3, it can be observed that all the correlations between constructs are lower than the corresponding AVE values for each construct, and it can therefore be confirmed that the factors are measuring different concepts. Hence, it can be concluded that all the measures have strong and suitable validity.

On the other hand, the evaluation of the structural model has been carried out in two ways: first, by analysing the value of the determination coefficient for each dependent or endogenous construct. This involves determining how much variance of the dependent constructs is explained by the constructs that predict it. Values greater than 0.3 are considered sufficient for this requirement to be met (Chin, 1998). In this case, the values obtained from the coefficient of determination are greater than 0.3. Second, the significance of the paths or relationships between the constructs has also been analysed. Table 4 shows that all the paths between constructs are significant, except for that corresponding to the relationship between social norm and attitude. Therefore, we can affirm that the structural model presents high predictive capacity.

Table 4 also shows the estimates of the unstandardised and standardised factor loads. It can be observed that they are all significant, except for the aforementioned estimate. In the case of the PBC and AT relationship, a negative factorial load is observed, which means that there is an inverse relationship between these two variables, since the items of the PBC variable are negatively defined. Higher values in the PBC variable therefore imply a less positive attitude towards the practice of active commuting.

Finally, a series of measurements have been obtained for analysing the goodness of fit of the estimated model. All the measurements also take values within the limits that allow us to affirm an acceptable fit of the data (χ^2/df=3.984; GFI=0.893; AGFI=0.848; CFI=0.954; RMSEA=0.079; NFI=0.940; NNFI=0.941; PNFI=0.736; TLI=0.955; SRMR=0.074). Although the values of certain indices fail to reach the thresholds for a model of good fit, they do reach the thresholds for an acceptable fit, following the suggestion of several authors (Baumgartner and Homburg, 1996; Bentler and Bonett, 1980; Doll et al., 1994; Hu and Bentler, 1995).

Given the previous results, the model that appears in Fig. 2 has been obtained. It can be observed in this figure that all the hypotheses raised in the initial model are verified, except for Hypothesis H1.

Table 2
Standardised estimations for observable indicators, Cronbach's α values, reliability assessment, and convergent validity.

Latent variables and their indicators			λ	Cronbach's α	CR (Composite Reliability)	AVE (Average variance extracted)
Subjective norm				0.853	0.863	0.685
SN1	←-	SN	0.942			
SN2	←-	SN	0.900			
SN3	←-	SN	0.597			
Perceived behavioural control				0.755	0.711	0.552
PBC2	←-	PBC	0.727			
PBC3	←-	PBC	0.758			
Health				0.976	0.975	0.906
HE1	←-	HE	0.982			
HE2	←-	HE	0.983			
HE3	←-	HE	0.910			
HE4	←-	HE	0.930			
Environmental awareness				0.871	0.835	0.505
EA1	←-	EA	0.637			
EA2	←-	EA	0.776			
EA3	←-	EA	0.619			
EA4	←-	EC	0.721			
EA5	←-	EC	0.783			
Attitude				0.947	0.925	0.805
AT2	←-	AT	0.952			
AT3	←-	AT	0.934			
AT4	←-	AT	0.797			
Behavioural intention				0.943	0.938	0.884
BI1	←-	BI	0.950			
BI2	←-	BI	0.930			

Table 3
Discriminant validity of constructs.

	SN	PBC	HE	EA	AT	BI
SN	0.827					
PBC	0.000	**0.743**				
HE	0.000	0.000	**0.952**			
EA	0.000	0.000	0.000	**0.710**		
AT	0.026	−0.117	0.752	0.307	**0.897**	
BI	0.018	−0.079	0.505	0.206	0.672	**0.940**

Note: Data appearing on the main diagonal are the square roots of the *average variance extracted* (AVE) of the variables. The remaining data represents the correlations between constructs.

Table 4
Parameter estimates.

			Estimate	SE	CR	Standardised estimate	P
AT	←-	SN	0.020	0.024	0.839	0.026	0,401
AT	←-	PBC	−0.114	0.036	−3.128	−0.117	**
AT	←-	HE	0.685	0.029	23.399	0.752	***
AT	←-	EA	0.457	0.054	8.480	0.307	***
BI	←-	AT	0.768	0.047	16.428	0.672	***
SN1	←-	SN	1.000			0.942	
SN2	←-	SN	0.949	0.044	21.362	0.900	***
SN3	←-	SN	0.617	0.044	13.948	0.597	***
PBC2	←-	PBC	1.000			0.727	
PBC3	←-	PBC	1.070	0.219	4.878	0.758	***
HE1	←-	HE	1.000			0.982	
HE2	←-	HE	1.010	0.014	73.728	0.983	***
HE3	←-	HE	0.942	0.022	42.155	0.910	***
HE4	←-	HE	0.959	0.023	42.429	0.930	***
EA1	←-	EA	1.000			0.637	
EA2	←-	EA	1.460	0.107	13.663	0.776	***
EA3	←-	EA	0.934	0.067	13.881	0.619	***
EA4	←-	EA	1.387	0.111	12.502	0.721	***
EA5	←-	EA	1.523	0.107	14.291	0.783	***
AT2	←-	AT	1.000			0.952	
AT3	←-	AT	1.004	0.028	36.173	0.934	***
AT4	←-	AT	0.879	0.037	23.594	0.797	***
BI1	←-	BI	1.000			0.950	
BI2	←-	BI	0.992	0.034	29.395	0.930	***

***Significance level: 0.001.
**Significance level: 0.01.

5. Discussion and implications

This work contributes towards the improvement of knowledge regarding active commuting by integrating various elements of the TPB, such as the subjective norm, the perceived behavioural control, attitude, health, and environmental awareness, into a structural model.

The results of this work lead to the affirmation that the perceived behavioural control, health, and environmental awareness exert a significant influence on attitude. Similarly, the results of the work also indicate that attitude influences as a precursor to the intention to practise active commuting. From the global analysis of the model, it can therefore be deduced that perceived behavioural control, health, and environmental awareness constitute factors that affect the intention to practise active commuting, but are conditioned by the mediating variable attitude.

The analysis of the total effects enables us to affirm that the variable that most influences the intention to practise active commuting is attitude. This result corroborates that achieved in other similar studies (Chen and Chao, 2011; Murtagh et al., 2016). Attitude is an underlying disposition that contributes towards the performance of a certain behaviour. Having a positive attitude, such as considering active commuting agreeable, fun, and enjoyable, is crucial for this type of commuting.

The factor that has the second-highest effect on the intention to practise active commuting is that of health. This result is in line with those achieved in other studies that consider health as one of the main motivations for the practice of active commuting (Dinu et al., 2019; Merom et al., 2006). Establishing healthy lifestyle habits, such as active commuting, prevents the appearance of many diseases, and causes an increase in the well-being of users and in their quality of life.

The subsequent factor that exerts the most influence on the intention to practise active commuting is that of environmental awareness. Other similar studies also corroborate this result (Bungum et al., 2009; Sanz Arazuri et al., 2017). Environmental awareness enables commuting to be converted into activities to contribute towards the improvement of the environment. Furthermore, the results

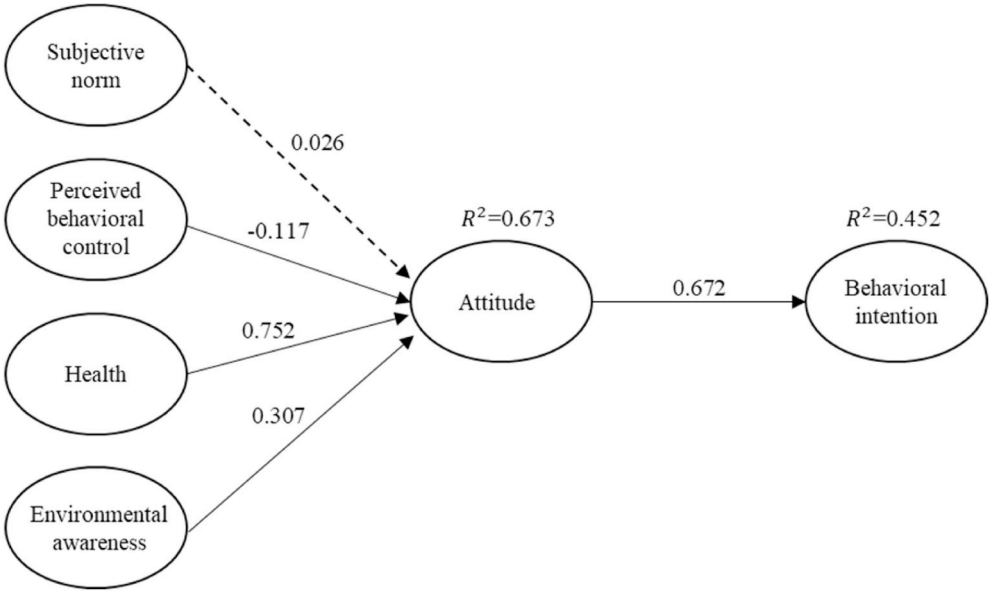

Fig. 2. Structural equation model for active commuting.

of the study confirm that people who are aware of the damage that pollution causes to plant and animal life are those who show a greater intention to practise active commuting.

Finally, the last factor to influence the intention to practise active commuting is that of perceived behavioural control. The items of this construct are defined inversely to the intention of practising active commuting, and hence the factorial load obtained is negative. This means that a higher level of perceived behavioural control negatively or inversely influences the intention to practise active commuting.

The results of this study also allow us to deduce that there is no significant effect between the social norm and the attitude towards practising active commuting. Therefore, the influence of other people, such as family, friends, work colleagues, and classmates, incurs no effect on the behaviour of the individual to practise active commuting. Thus, the motivation of the individuals towards practising active commuting arises more from their own will than from the possible incidence of third parties.

5.1. Implications

The first theoretical implication of this study is that it contributes to the literature on active commuting by confirming the relationships established in the proposed structural model, with the exception of the relationship between the social norm and the attitude towards practising active commuting.

The literature shows that most articles on active commuting have focused on the analysis of the commute between home and school. In this respect, there is a major volume of documentation that shows that young people fail to meet the recommendations on daily physical activity (WHO, 2021). According to the WHO, young people should spend at least an average of 60 min a day in moderate to intense physical activity. Hence, many political authorities strive to promote active commuting as a way to satisfy this WHO recommendation.

In addition to striving to achieve this WHO recommendation, this promotion also tries to create healthy habits from the adolescence of the population that can be maintained throughout their lifetime. Not only will these healthy habits bring benefits for physical health but they will also benefit psychological health (Ruiz-Ariza et al., 2015). Psychological health is a mental state composed of multiple factors, among which feature well-being, happiness, and one's own body image (Padilla-Moledo et al., 2012). Enjoying good psychological health during adolescence can prevent future health problems and can even act as a predictor of mortality (Ortega et al., 2010). For this reason, it is important to promote the practice of active commuting from an early age in order to create a habit for the future.

On the other hand, it can be deduced from this work that environmental awareness is a precursor to attaining a positive attitude towards the practice of active commuting. It is therefore essential to increase the environmental awareness of citizens.

Nevertheless, we must not forget that although the practice of active commuting can bring major benefits for health and the environment, there are also certain elements that can act as barriers, thereby limiting this behaviour. These barriers include neighbourhood danger, the lack of support from parents or colleagues, accessibility to the destination, the type of roads involved, the distance to travel, and time limitations (Burgueño et al., 2020; Hatamzadeh et al., 2020; Pang et al., 2017).

5.2. Limitations and future research directions

Like other papers, this study has its own limitations. The data has been obtained mainly from the geographical area of Seville. This can cause the data to present a certain bias because the users are subject to very similar environmental conditions. The authors recommend that data be collected from a variety of geographic areas in order to capture heterogeneity and to avoid any bias that may exist. On the other hand, the sample was largely dominated by individuals who were employed. It would have been appropriate to seek a better balance between the occupation levels of the interviewees. The sample of this study is mainly formed of employed people with higher or secondary education. This issue could have a significant influence on the factors studied. Therefore, this finding must be taken into account as a limitation of this study. At the same time, this issue should be treated in future research.

Another limitation of the sample corresponds to the medium used for active commuting. A very high percentage of the individuals expressed walking as the principal active mode of active commuting. In this respect, it would be interesting to test in new studies whether this situation is a consequence of the survey process or indeed reflects the current reality of active transport.

On the other hand, although the responses were collected during the period February–April 2021, the Covid event might have played an important role in people's attitudes toward active commuting. This issue should therefore be taken into account as a limitation since the pandemic could have conditioned people's responses.

As for other future lines of research, we can include the replication of this same study in different settings to ascertain whether there are differences in the practice of active commuting that are largely due to different environmental factors. Along these lines, it would also be of interest to study the differences between countries arising from the various cultures existing therein. Finally, other factors, such as distance, travel time, and the environment, could be taken into account in the specification of alternative models for the practice of active commuting.

Financial disclosure

This work was partially supported with funds from the FEDER Projects /Ministry for Science and Innovation, ECO2017-89452-R, and PGC2018-095786-B-I00, Spain. Funders were not involved in the study design; collection, analysis and interpretation of data; the writing of the manuscript; and the decision to submit the manuscript for publication. Views expressed are solely those of the authors and do not represent the views of the funders. Funding for open access publishing: Universidad Pablo de Olavide/CBUA.

Author statement

José A. Ortiz-Sánchez: Term, Conceptualization, Data curation. José M. Ramírez-Hurtado: Writing- Original draft preparation, Methodology, Formal Analysis. Ignacio Contreras: Visualization, Supervision, Writing- Reviewing and Editing.

References

Acheampong, R.A., 2017. Towards sustainable urban transportation in Ghana: exploring adults' intention to adopt cycling to work using theory of planned behaviour and structural equation modelling. Transport. Develop. Econ. 3 (2) https://doi.org/10.1007/s40890-017-0047-8.

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

Arazuri, E.S., De León Elizondo, A.P., Vale, R.F., 2017. Adolescents' active commutes to school and family functioning. Apunts. Educacion Fisica y Deportes 128 (2), 36–47. https://doi.org/10.5672/APUNTS.2014-0983.ES.(2017/2).128.02.

Bagozzi, R.P., Yi, Y., 1988. On the evaluation of structural equation models. J. Acad. Market. Sci. 16 (1), 74–94. https://doi.org/10.1007/BF02723327.

Bamberg, S., 2003. How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. J. Environ. Psychol. 23 (1), 21–32. https://doi.org/10.1016/S0272-4944(02)00078-6.

Baumgartner, H., Homburg, C., 1996. Applications of structural equation modeling in marketing and consumer research: a review. Int. J. Res. Market. 13 (2), 139–161.

Bentler, P.M., Bonett, D.G., 1980. Significance tests and goodness of fit in the analysis of covariance structures. Psychol. Bull. 88 (3), 588–606. https://doi.org/10.1037/0033-2909.88.3.588.

Bollen, K.A., 2014. Structural equations with latent variables. In: Structural Equations with Latent Variables. wiley. https://doi.org/10.1002/9781118619179.

Bungum, T.J., Lounsbery, M., Moonie, S., Gast, J., 2009. Prevalence and correlates of walking and biking to school among adolescents. J. Community Health 34 (2), 129–134. https://doi.org/10.1007/S10900-008-9135-3, 2008 34:2.

Burgueño, R., González-Cutre, D., Sevil-Serrano, J., Herrador-Colmenero, M., Segura-Díaz, J.M., Medina-Casaubón, J., Chillon, P., 2020. Validation of the basic psychological need satisfaction in active commuting to and from school (BPNS-ACS) scale in Spanish young people. J. Transport Health 16. https://doi.org/10.1016/j.jth.2020.100825.

Byrne, B.M., 1994. Structural Equation Modeling with EQS and EQS/WINDOWS. SAGE Publications, Inc.

Chau, P.Y.K., 1997. Reexamining a model for evaluating information center success using a structural equation modeling approach. Decis. Sci. J. 28 (2), 309–334. https://doi.org/10.1111/j.1540-5915.1997.tb01313.x.

Chen, C.F., Chao, W.H., 2011. Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit. Transport. Res. F Traffic Psychol. Behav. 14 (2), 128–137. https://doi.org/10.1016/J.TRF.2010.11.006.

Chillón, P., Evenson, K.R., Vaughn, A., Ward, D.S., 2011. A systematic review of interventions for promoting active transportation to school. Int. J. Behav. Nutr. Phys. Activ. 8 https://doi.org/10.1186/1479-5868-8-10.

Chillón, P., Panter, J., Corder, K., Jones, A.P., Van Sluijs, E.M., 2015. A longitudinal study of the distance that young people walk to school. Health Place 31, 133–137. https://doi.org/10.1016/J.HEALTHPLACE.2014.10.013.

Chin, W.W., 1998. The partial least squares approach to structural equation modeling. In: Modern Methods for Business Research. G.A. Marco, pp. 295–336.

Dinu, M., Pagliai, G., Macchi, C., Sofi, F., 2019. Active commuting and multiple health outcomes: a systematic review and meta-analysis. Sports Med. 49, 437–452. https://doi.org/10.1007/s40279-018-1023-0.

Doll, W.J., Xia, W., Torkzadeh, G., 1994. A confirmatory factor Analysis of the end-user computing satisfaction instrument, 18 (4), 453–461.

Fishbein, M.A., Ajzen, I., 1975. Belief, Attitude, Intention and Behaviour: an Introduction to Theory and Research. Reading, MA.

Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Market. Res. 18 (1), 39. https://doi.org/10.2307/3151312.

Frash, R.E., Blose, J.E., 2019. Serious leisure as a predictor of travel intentions and flow in motorcycle tourism. Tour. Recreat. Res. 44 (4), 516–531. https://doi.org/10.1080/02508281.2019.1626118.
García, J., Arroyo, R., Mars, L., Ruiz, T., 2019. The influence of attitudes towards cycling and walking on travel intentions and actual behavior. Sustainability 11 (9). https://doi.org/10.3390/su11092554.
Hair, J.F.J., Hult, G.T.M., Ringle, C.M., Sarstedt, M., 2014a. A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). SAGE Publications.
Hair, J.F.J., Sarstedt, M., Hopkins, L., Kuppelwieser, V.G., 2014b. Partial least squares structural equation modeling (PLS-SEM): an emerging tool in business research. Eur. Bus. Rev. 26 (2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128.
Hatamzadeh, Y., Habibian, M., Khodaii, A., 2020. Measuring walking behaviour in commuting to work: investigating the role of subjective, environmental and socioeconomic factors in a structural model. Int. J. Unity Sci. 24 (2), 173–188. https://doi.org/10.1080/12265934.2019.1661273.
Henn, M., Weinstein, M., Foard, N., 2006. A Short Introduction to Social Research. Sage Publications Ltd.
Herman, K.M., Larouche, R., 2021. Active commuting to work or school : associations with subjective well-being and work-life balance. J. Transport Health 22 (July), 101118. https://doi.org/10.1016/j.jth.2021.101118.
Hu, L.T., Bentler, P.M., 1995. Evaluating model fit. In: Hoyle, R.H. (Ed.), Structural Equation Modelling. Concepts, Issues, and Applications. SAGE Publications.
Kroesen, M., 2014. Assessing mediators in the relationship between commute time and subjective weil-being: structural equation analysis. In: Transportation Research Record, 2452. National Research Council, pp. 114–123. https://doi.org/10.3141/2452-14.
Lajunen, T., Räsänen, M., 2004. Can social psychological models be used to promote bicycle helmet use among teenagers? A comparison of the Health Belief Model, Theory of Planned Behavior and the Locus of Control. J. Saf. Res. 35 (1), 115–123. https://doi.org/10.1016/J.JSR.2003.09.020.
Lee, C., 2007. Environment and active living: the roles of health risk and economic factors. Health Promoting Commun. Des. 21 (4), 293–304.
Lèvy, J.P.M., Martín, M., Román, M., 2006. Optimización según estructuras de covarianzas. In: Varela Mallo, J., Lèvy, J.P.M. (Eds.), Modelización con estructuras de covarianzas en ciencias sociales: temas esenciales, avanzados y aportaciones especiales.
Li, Z., Wang, W., Yang, C., Raglad, D.R., 2013. Bicycle commuting market analysis using attitudinal market segmentation approach. Transport. Res. Pol. Pract. 47, 56–68. https://doi.org/10.1016/j.tra.2012.10.017.
Merom, D., Tudor- Locke, C., Bauman, A., Rissel, C., 2006. Active commuting to school among NSW primary school children: implications for public health. Health Place 12 (4), 678–687. https://doi.org/10.1016/j.healthplace.2005.09.003.
Minton, A.P., Rose, R.L., 1997. The effects of environmental concern on environmentally friendly consumer behavior: an exploratory study. J. Bus. Res. 40 (1), 37–48. https://doi.org/10.1016/S0148-2963(96)00209-3.
Molina-García, J., García-Massó, X., Estevan, I., Queralt, A., 2019. Built environment, psychosocial factors and active commuting to school in adolescents: clustering a self-organizing map analysis. Int. J. Environ. Res. Publ. Health 16 (1). https://doi.org/10.3390/ijerph16010083.
Mueller, N., Rojas-Rueda, D., Cole-Hunter, T., de Nazelle, A., Dons, E., Gerike, R., Götschi, T., Int Panis, L., Kahlmeier, S., Nieuwenhuijsen, M., 2015. Health impact assessment of active transportation: a systematic review. Prev. Med. 76, 103–114. https://doi.org/10.1016/j.ypmed.2015.04.010.
Murtagh, E.M., Dempster, M., Murphy, M.H., 2016. Determinants of uptake and maintenance of active commuting to school. Health Place 40, 9–14. https://doi.org/10.1016/J.HEALTHPLACE.2016.04.009.
Ortega, F.B., Lee, D.C., Sui, X., Kubzansky, L.D., Ruiz, J.R., Baruth, M., Castillo, M.J., Blair, S.N., 2010. Psychological well-being, cardiorespiratory fitness, and long-term survival. Am. J. Prev. Med. 39 (5), 440–448. https://doi.org/10.1016/J.AMEPRE.2010.07.015.
Padilla-Moledo, C., Castro-Piñero, J., Ortega, F.B., Mora, J., Márquez, S., Sjöström, M., Ruiz, J.R., 2012. Positive health, cardiorespiratory fitness and fatness in children and adolescents. Eur. J. Publ. Health 22 (1), 52–56. https://doi.org/10.1093/EURPUB/CKR005.
Pang, B., Rundle-Thiele, S.R., Kubacki, K., 2017. An empirical examination of the ecological and cognitive active commuting framework: a social marketing formative research study. Health Educ. 117 (6), 581–598. https://doi.org/10.1108/HE-12-2016-0066.
Paul, J., Modi, A., Patel, J., 2016. Predicting green product consumption using theory of planned behavior and reasoned action. J. Retailing Consum. Serv. 29, 123–134. https://doi.org/10.1016/j.jretconser.2015.11.006.
Pinky Pawaskar, R., Goel, M., 2016. Improving the efficacy of destination marketing strategies: a structural equation model for leisure travel. Indian J. Sci. Technol. 9 (15) https://doi.org/10.17485/ijst/2016/v9i15/92154.
Quine, L., Rutter, D.R., Arnold, L., 1998. Predicting and understanding safety helmet use among schoolboy cyclists: a comparison of the theory of planned behaviour and the health belief model. Psychol. Health 13 (2), 251–269. https://doi.org/10.1080/08870449808406750.
Rindskopf, D., Rose, T., 1988. Some theory and applications of confirmatory second-order factor Analysis. Multivariate Behav. Res. 23 (1), 51–67. https://doi.org/10.1207/s15327906mbr2301_3.
Rojas-Rueda, D., Nazelle, A. de, Andersen, Z.J., Braun-Fahrländer, C., Bruha, J., Bruhova-Foltynova, H., Desqueyroux, H., Praznoczy, C., Ragettli, M.S., Tainio, M., Nieuwenhuijsen, M.J., 2016. Health impacts of active transportation in europe. PLoS One 11 (3), e0149990. https://doi.org/10.1371/JOURNAL.PONE.0149990.
Ruiz-Ariza, A., de la Torre-Cruz, M.J., Redecillas-Peiró, M.T., Martínez-López, E.J., 2015. Influencia del desplazamiento activo sobre la felicidad, el bienestar, la angustia psicológica y la imagen corporal en adolescentes. Gac. Sanit. 29 (6), 454–457. https://doi.org/10.1016/j.gaceta.2015.06.002.
Sanz Arazuri, E., Ponce de León Elizondo, A., Fraguela Vale, R., 2017. Desplazamiento activo de los adolescentes al centro de estudios y funcionamiento familiar. Apunts Educación Física y Deportes 128 (128), 36–47. https://doi.org/10.5672/apunts.2014-0983.es.(2017/2).128.02.
Shiftan, Y., Outwater, M.L., Zhou, Y., 2008. Transit market research using structural equation modeling and attitudinal market segmentation. Transport Pol. 15 (3), 186–195. https://doi.org/10.1016/j.tranpol.2008.03.002.
Stevens, J.P., 2009. Applied Multivariate Statistics for the Social Sciences (Fifth Edit). Routledge.
WHO, 2021. Physical activity. https://www.who.int/news-room/fact-sheets/detail/physical-activity.