Public Health 222 (2023) 85–91

Contents lists available at ScienceDirect

Public Health

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

Original Research

Environmental vs psychosocial barriers to active commuting to university: which matters more?

X. Palma-Leal [a, b], D. Camiletti-Moirón [c, d, *], R. Izquierdo-Gómez [c, d], F. Rodríguez-Rodríguez [b], P. Chillón [a]

[a] Department of Physical Education and Sports, Faculty of Sport Sciences, Sport and Health University Research Institute (iMUDS), University of Granada, Granada, Spain
[b] IRyS Group, School of Physical Education, Pontificia Universidad Católica de Valparaíso, Viña del Mar, Chile
[c] GALENO Research Group, Department of Physical Education, Faculty of Education Sciences, University of Cádiz, Avenida República Saharaui s/n, 11519, Puerto Real, Spain
[d] Instituto de Investigación e Innovación Biomédica de Cádiz (INiBICA), Cádiz, Spain

ARTICLE INFO

Article history:
Received 7 March 2023
Received in revised form
30 May 2023
Accepted 28 June 2023
Available online 31 July 2023

Keywords:
Physical activity
Environment
University students
Transportation
Chile
Spain

ABSTRACT

Objectives: The aims of this study were (1) to examine the differences in the mode of commuting and barriers to active commuting to university between the sexes (men and women) and in different countries (Chile and Spain); and (2) to analyse the association between the mode of commuting and the perceived barriers for male and female university students in Chile and Spain.
Study design: This cross-sectional study took place between April 2017 and May 2018 in Chile and Spain.
Methods: The study population included 2269 university students (53.0% women). The mode of commuting and barriers to active commuting to university were assessed by a self-reported questionnaire. Multinomial logistic regression analysis was used to examine the associations.
Results: In both sexes, public and private transport were the main modes of commuting used in Chile and Spain, respectively, followed by active commuting in all participants, except for female students in Spain. Women perceived more environmental and psychosocial barriers compared to men (Chile: $P < 0.001$; Spain: $P = 0.006$). Perceived environmental barriers showed higher significant differences between students in Chile and Spain ($P < 0.05$). Private commuters reported a larger proportion of psychosocial barriers compared to active commuters (Chile: men $P = 0.001$, women $P < 0.001$; Spain: men $P < 0.001$, women $P = 0.036$).
Conclusions: The study findings suggest that the mode of commuting and the barriers to active commuting to university may be influenced by sex and country.

Introduction

There is overwhelming evidence supporting the health benefits of physical activity. Several systematic reviews and meta-analyses have demonstrated a dose–response relationship between physical activity and premature mortality and the primary and secondary prevention of several chronic medical conditions.[1] In addition, according to the current guidelines on physical activity,[2] different activities (e.g. commuting) can increase the total volume of physical activity, thus improving and achieving physical, mental and cognitive health outcomes. Active commuting, such as walking or cycling, provides an opportunity for increased physical activity levels in a simple, inexpensive and easy way to be incorporated into daily routines.[3] In addition, active commuting could be considered a stepping stone for achieving a more sustainable society.[4] Therefore, promoting active commuting to daily destinations (e.g. school, university, work) can have implications for individual and planetary health.

Universities are destinations that have the potential to engage students in physical activity through active commuting,[5] increasing their chances of meeting physical activity recommendations and improving their physical fitness.[6] In addition, universities are considered privileged places to communicate sustainability and to help reshape the transportation patterns of society.[7] Thereby,

* Corresponding author. Faculty of Education Sciences, University of Cádiz, Avenida República Saharaui s/n, 11519, Puerto Real, Spain. Tel.: +34655841392.
E-mail address: daniel.camiletti@uca.es (D. Camiletti-Moirón).

https://doi.org/10.1016/j.puhe.2023.06.039

strategies that encourage university students to actively commute have the potential to not only improve the health of the university community in general and the students in particular but also reduce the impact on the environment. However, active commuting in the university population may be influenced by several barriers, and their identification may provide an empirical basis for interventions.[8]

To date, there is limited evidence on the barriers to active commuting to university, and the studies that do exist are mainly concerned with commuting behaviours, such as time, distance and speed. For example, in Australia and Spain, the most frequently reported barrier to active commuting to university was the long distance that the commuters had to travel,[5,9] and in Chile, it was the time spent during active commuting.[10] It is also important to consider that these barriers might be impacted by different factors, such as sex and cultural context, in varying ways. In fact, a study on adults in England suggested that the best strategies to promote active commuting should be linked to the sex of the target participants.[11] Conversely, a study carried out on Chilean children and adolescents from diverse cultural contexts (from Easter Island and the mainland) showed different commuting behaviours.[12] However, little is known about how sex and cultural influences impact the commuting behaviours of university students. Therefore, the main aims of the current study were (1) to examine the differences in the mode of commuting and barriers to active commuting to university between the sexes (men and women) and in different countries (Chile and Spain); and (2) to analyse the association between the mode of commuting and the perceived barriers for male and female university students in Chile and Spain.

Methods

Study design

This cross-sectional study took place between April 2017 and May 2018 in Chile and Spain.

Participants

A total of 2269 university students (1202 women) participated in the present study. In total, 1257 participants were in Chile (659 women), and 1012 participants were in Spain (543 women). The average age of all study participants was 26.8 ± 6.0 years, with men from Chile being the youngest (25.8 ± 5.8 years), followed by women from Chile (27.1 ± 6.1 years), women from Spain (27.0 ± 5.7 years) and men from Spain (27.7 ± 6.3 years), with no significant differences ($P > 0.05$). Participants belonged to diverse faculties and were recruited from the first to the last semester at four different universities located in urban cities in Chile (Valparaíso and Santiago) and Spain (Cádiz).

Procedures

Firstly, a letter with the objectives of the study was sent to the authorities of the selected universities in Chile and Spain, which were chosen by convenience. Once authorisation was obtained, all university students of the teachers interested in this research were invited to voluntarily participate. Participants received information about the project, and those who agreed to take part completed informed consent. The informed consent explained the purpose of the study, the characteristics of the questionnaire and the confidentiality of the results. Participants completed 15–30 min of self-reported paper-based (Chile) or online-based (Spain) questionnaires that were distributed and guided by previously trained volunteer teachers in both countries. All procedures followed the Helsinki protocols and were approved by the Ethics Committee of Pontificia Universidad Católica de Valparaíso (Code: CCF02052017) and by the Ethics Committee for Non-Biomedical Experimentation and Evaluation of Experimentation with Genetically Modified Organisms at the University of Cádiz (Ref. 004/2021).

Measurements

The self-reported questionnaire used for this study ('Questionnaire of mode of commuting and physical activity to the university') was created by expert researchers at the School of Physical Education of the Pontificia Universidad Católica de Valparaíso (Chile). This questionnaire included questions about sociodemographic characteristics, mode of commuting and perceived barriers to active commuting to university.

Sociodemographic characteristics

Participants reported their name, age, sex, type of residence, locality area and distance to the university. The locality area was assessed with the question 'The area where you reside as a student is?'. Answer options were two categories: 'urban' and 'rural'. The type of residence was assessed using the question 'With whom do you live?'. Answer options were divided into two categories: 'family residence' (e.g. parents' home or own house) and 'university residence' (e.g. shared flat with other students or hall of residence), as has been reported in previous studies.[13] The distance to the university was classified into three categories: <2 km, 2–5 km and >5 km.[9]

Mode of commuting

The questions regarding mode of commuting were based on a self-reported questionnaire published elsewhere.[14] The mode of commuting to university showed an almost perfect agreement in both countries (with Kappa coefficient values of 0.882 and 0.822 in Chile[15] and 0.929 and 0.930 in Spain). The questionnaire included two separate questions: (1) 'How do you usually travel to university?'; and (2) 'How do you usually travel from university?'. The answer options were 'walking', 'cycling', 'car', 'motorcycle', 'public bus', 'metro/train', 'other' and 'no travel'. No responses were obtained for the options 'other' means of transport and 'no travel' (both 0%). Therefore, these two responses were not considered. Participants were classified into three categories as follows: 'active commuting' (walking and cycling), 'private transport' (car and motorcycle) and 'public transport' (public bus, metro and train).[16] Students with combined answers (e.g. active + private) were classified in the mode of commuting involving the highest physical activity level. Active commuting involves the highest physical activity levels, followed by public transport, which involves the intermediate level of physical activity (e.g. walking to and from stations and stops) and private transport is assumed to involve the lowest levels of physical activity.[17]

Perceived barriers to active commuting to university

Barriers to active commuting were assessed using the 'Barriers to Active Commuting to University Scale', which is a validated and reliable self-reported questionnaire in the Spanish university population.[8] The scale included 14 items referring to the barriers to active commuting to university in relation to 'environment/safety' and 'planning/psychosocial'. These barriers have appropriate reliability in Chilean university students.[18] Answers were structured on the four-point Likert scale as 'strongly disagree = 1', 'disagree = 2', 'agree = 3' and 'strongly agree = 4'. To allow for

detailed description and analysis, the answers were grouped into disagreeing (disagree/strongly disagree) and agreeing (agree/strongly agree). Subsequently, in order to obtain an overview, three absolute frequency barrier averages were calculated. Firstly, by adding the 7 environment/safety barriers; secondly, by adding the 7 planning/psychosocial barriers; and finally, by adding the total of the 14 barriers. In all three averages, the responses were recoded according to the same criteria previously stated.

Statistical analyses

Descriptive characteristics (e.g. locality area, type of residence and distance to the university), modes of commuting (e.g. active, public and private) and perceived barriers to active commuting were reported as frequencies and percentages. The differences in the modes of commuting and the perceived barriers to active commuting among sex (e.g. men vs women) and country (e.g. Chile vs Spain) were analysed using the chi-squared test. Additionally, a *post-hoc* analysis with Bonferroni's correction was used to ascertain differences between groups (e.g. men vs women in Chile, men vs women in Spain, men in Chile vs men in Spain and women in Chile vs women in Spain). Finally, associations between the mode of commuting and the perceived barriers to active commuting to university were studied using multinominal logistic regression analysis, adjusted by distance to the university. Mode of commuting was included in the model as the dependent variable, where active commuting was established as a reference, and the perceived barriers to active commuting to university were included as independent variables in separate models, where disagreement was established as a reference. All multinominal logistic regression analyses were adjusted for the distance to the university and separated by sex and country. The level of significance in all analyses was set to $P < 0.05$. The statistical analyses were conducted using IBM SPSS Statistics (v. 25.0 for Windows, Chicago, IL, USA).

Results

Sociodemographic characteristics by sex and country are shown in Table 1. Most of the study population lived in urban areas (>95%). The majority of students in Spain lived in family residences (69.3% of men and 66.7% of women); for students in Chile, men lived mostly in family residences (61.4%), but women lived primarily in university residences (80.0%). More than half (>51%) of all study participants indicated that the distance to the university was >5 km.

The modes of commuting to and from university by sex and country are shown in Table 2. For students in Chile, the main mode of commuting to and from university was public transport, and it was higher in women than men ($P < 0.001$); the second most frequently used mode of commuting was active commuting, which was higher in men than women ($P < 0.001$). For students in Spain, the main mode of commuting to and from university was private transport, which was higher in men than women, but not significantly ($P = 0.086$), followed by active commuting for men and public transport for women. According to sex and country variables, significant differences were observed when comparing men in Chile and men in Spain for active commuting and public and private transport (all, $P < 0.001$). When comparing women in Chile with women in Spain, there were significant differences in the public and private modes of commuting to university ($P < 0.001$).

Perceived barriers to active commuting to university by sex and country are shown in Table 3. Women in Chile showed significant differences in the perception of five environment/safety barriers and four planning/psychosocial barriers to active commuting to university compared with men in Chile (all, $P < 0.05$). For women in Spain, significant differences in the perception of one environment/safety barrier and four planning/psychosocial barriers to active commuting to university were observed compared with men in Spain (all, $P < 0.05$).

In addition, there were significant differences in the environment/safety barriers between countries (men in Chile vs men in Spain, and women in Chile vs women in Spain). Men and women in Chile agreed more frequently with five of the environment/safety barriers (with the exception of the barriers 'usually bike lanes are occupied by pedestrians' and 'there is nowhere to leave a bike safely') to active commuting than men and women in Spain (all, $P < 0.05$). In the case of the planning/psychosocial barriers, only two barriers ('I get too hot and sweaty to walk or bike' and 'it is easier for me to travel by my car or motorbike') showed significant statistical differences ($P < 0.05$), where men and women in Spain agreed more frequently with these perceived barriers to active commuting than men and women in Chile.

The mode of commuting associated with the perceived barriers to active commuting for students in Chile by sex is presented in Table 4. Regarding environment/safety barriers, men who use public and private transport were more likely to agree with the barrier 'there is too much traffic along the route' ($P = 0.009$ and $P = 0.001$, respectively) compared to those who use active commuting. In addition, women who use private transport were more likely to agree with the barriers 'there are no bike lanes along the way' ($P = 0.005$) and 'it is unsafe because of crime to walk or bike' ($P = 0.003$) than those who use active commuting. Nevertheless, there were no significant associations between the average of the seven environmental/safety barriers and public and private transport.

In terms of the planning/psychosocial barriers, when considering the average of the seven planning/psychosocial barriers, both

Table 1
Sociodemographic characteristics of participants by sex and country.

Characteristic	Chile (n = 1257)		Spain (n = 1012)	
	Men (n = 598)	Women (n = 659)	Men (n = 469)	Women (n = 543)
	[n (%)]	[n (%)]	[n (%)]	[n (%)]
Locality area				
Rural	15 (2.5)	25 (3.8)	18 (3.8)	25 (4.6)
Urban	583 (97.5)	634 (96.2)	451 (96.2)	518 (95.4)
Type of residence				
Family residence	367 (61.4)	527 (20.0)	325 (69.3)	362 (66.7)
University residence	231 (38.6)	132 (80.0)	144 (30.7)	181 (33.3)
Distance to university				
>5 km	320 (53.5)	429 (65.1)	313 (66.7)	362 (66.7)
2–5 km	84 (14.0)	95 (14.4)	75 (16.0)	91 (16.8)
<2 km	194 (32.5)	135 (20.5)	81 (17.3)	90 (16.7)

Table 2
Mode of commuting to and from university by sex and country.

Mode of commuting	Chile (n = 1257)			Spain (n = 1012)		
	Men (n = 598)	Women (n = 659)	*P*-value	Men (n = 469)	Women (n = 543)	*P*-value
	[n (%)]	[n (%)]		[n (%)]	[n (%)]	
Active	207 (34.6)[a]	124 (18.8)	**<0.001**	113 (24.1)[a]	127 (23.4)	1.000
Public	330 (55.2)[b]	461 (70.0)[d]	**<0.001**	96 (20.5)[b]	149 (27.4)[d]	0.092
Private	61 (10.2)[c]	74 (11.2)[e]	1.000	260 (55.4)[c]	267 (49.2)[e]	0.086

Notes: common superscripts in the same row indicate significant differences ($P < 0.05$) between the groups with the same letter after Bonferroni's correction.
P-values trends were <0.001 in Chile and 0.030 in Spain.
Bold *P*-values indicate statistical significance.

men and women in Chile who use private transport agreed with these barriers ($P = 0.001$ and $P < 0.001$, respectively) compared to those who use active commuting. More significant differences in individual barriers can be seen in Table 4.

The mode of commuting associated with the perceived barriers to active commuting for students in Spain by sex is shown in Table 5. Regarding the environment/safety barriers, female students in Spain who use public transport were more likely to agree with the barrier 'streets are dangerous from cars' ($P = 0.002$), and in public and private transport 'there is too much traffic along the route' ($P = 0.002$ and $P = 0.016$, respectively) compared to those who use active commuting. In addition, for male students, the barriers 'usually bike lanes are occupied by pedestrians' ($P = 0.042$ and $P = 0.024$ for public and private transport, respectively), 'there is one or more dangerous crossings along the way' ($P = 0.044$ for private transport) and 'streets are dangerous from cars' ($P = 0.008$ and $P = 0.020$ for public and private transport, respectively) were significantly more selected compared to those using active commuting. Like the situation in Chile, for students in Spain, there were no significant associations between the average of the seven environmental/safety barriers and public and private transport.

In terms of the average of the seven planning/psychosocial barriers, both men and women who use private transport ($P < 0.001$ and $P = 0.036$, respectively) and women who use public transport ($P = 0.001$) were more likely to agree with these barriers compared to those who use active commuting. More significant differences in individual barriers can be seen in Table 5.

Discussion

The main findings of the present study were that, for both sexes, public and private transport were the main modes of transport to university used in Chile and Spain, respectively, followed by active commuting in the overall participants, except for women from Spain. In terms of barriers to active commuting, female students reported higher agreement with the perceived barriers than male students; students in Chile reported higher environmental/safety barriers and students from Spain reported higher planning/psychosocial barriers. Moreover, the planning/psychosocial barriers were most frequently associated with private transport in all university students (men and women, in both countries). These findings suggest that the barriers to active commuting to university are influenced by sex and the country context of the students.

In the current study, the chosen mode of commuting to university was influenced by sex and country. Male and female students in Chile indicated that public transport was the main mode of commuting to the university. This result is in line with previous evidence reporting that the expansion and extension of public transport services will increase their use.[19] In fact, a study of university students from the USA showed that in both sexes, the choice

Table 3
Perceived barriers to active commuting to university by sex and country.

Perceived barriers	Chile (n = 1257)			Spain (n = 1012)		
	Men (n = 598)	Women (n = 659)	*P*-value	Men (n = 598)	Women (n = 659)	*P*-value
	Agree [n (%)]	Agree [n (%)]		Agree [n (%)]	Agree [n (%)]	
Environment/safety						
There are no bike lanes along the way	434 (72.6)[a]	474 (71.9)[b]	0.798	255 (48.0)[a]	276 (50.8)[b]	0.365
Usually, bike lanes are occupied by pedestrians	259 (43.3)	324 (49.2)[b]	**0.038**	206 (43.9)	303 (55.8)[b]	**<0.001**
There is too much traffic along the route	399 (66.7)[a]	467 (70.9)[b]	0.113	224 (47.8)[a]	290 (53.4)[b]	0.073
There is one or more dangerous crossings along the way	434 (72.6)[a]	540 (81.9)[b]	**<0.001**	290 (61.8)[a]	359 (66.1)[b]	0.157
It is unsafe because of crime to walk or bike	342 (57.2)[a]	450 (68.3)[b]	**<0.001**	82 (17.5)[a]	107 (19.7)[b]	0.366
There is nowhere to leave a bike safely	249 (41.6)	338 (51.3)	**0.001**	196 (41.8)	254 (46.8)	0.111
Streets are dangerous from cars	450 (75.3)[a]	543 (82.4)[b]	**0.002**	270 (57.6)[a]	335 (61.7)[b]	0.182
Average (out of 7 environment/safety barriers)	424 (70.9)[a]	533 (80.9)[b]	**<0.001**	207 (44.1)[a]	286 (52.7)[b]	**0.007**
Planning/psychosocial						
I get too hot and sweaty to walk or bike	263 (44.0)[a]	339 (51.4)[b]	**0.008**	276 (58.8)[a]	345 (63.5)[b]	0.127
I have too much stuff to carry to walk or bike	343 (57.4)	455 (69.0)	**<0.001**	293 (62.5)	383 (70.5)	**0.007**
It is easier for me to travel by my car or motorbike	325 (54.3)[a]	388 (58.9)[b]	0.106	350 (74.6)[a]	415 (76.4)[b]	0.506
It involves too much planning ahead to walk or bike	188 (31.4)	285 (43.2)	**<0.001**	145 (30.9)	205 (37.8)	**0.023**
Too much time is needed	339 (56.7)	408 (61.9)	0.060	259 (55.2)	341 (62.8)	**0.014**
Too much physical effort is needed	229 (38.3)	308 (46.7)	**0.003**	153 (32.6)	238 (43.8)	**<0.001**
I need a car or motorbike for work purposes	199 (33.3)	220 (33.4)	0.968	191 (40.7)	250 (46.0)	0.089
Average (out of 7 planning/psychosocial barriers)	250 (41.8)[a]	345 (52.4)[b]	**<0.001**	250 (53.5)[a]	330 (60.8)[b]	**0.020**
Total average (out of 14 barriers)	380 (63.5)[a]	495 (75.1)[b]	**<0.001**	251 (53.5)[a]	337 (62.1)[b]	**0.006**

Notes: *P*-value indicate differences between men and women within the same country; and common superscripts in the same row indicate significant differences ($P < 0.05$) between men and women from different countries (differences using Bonferroni's correction).
Bold *P*-values indicate statistical significance.

Table 4
Associations between mode of commuting with perceived barriers to active commuting to university for students in Chile by sex.

Perceived barriers[b]	Mode of commuting in Chile[a]			
	Men		Women	
	Public	Private	Public	Private
	[OR (95% CI)]	[OR (95% CI)]	[OR (95% CI)]	[OR (95% CI)]
Environment/safety				
There are no bike lanes along the way	1.28 (0.67, 2.43)	0.84 (0.38, 1.85)	1.76 (0.97, 3.20)	**3.12 (1.40, 6.94)**
Usually, bike lanes are occupied by pedestrians	0.82 (0.46, 1.48)	1.30 (0.62, 2.73)	1.34 (0.78, 2.30)	1.72 (0.88, 3.34)
There is too much traffic along the route	**3.06 (1.62, 5.78)**	**2.99 (1.32, 6.76)**	1.29 (0.73, 2.28)	2.03 (0.96, 4.32)
There is one or more dangerous crossings along the way	1.63 (0.86, 3.08)	1.49 (0.66, 3.40)	1.15 (0.60, 2.22)	1.54 (0.64, 3.65)
It is unsafe because of crime to walk or bike	0.64 (0.36, 1.15)	1.44 (0.67, 3.12)	1.75 (0.98, 3.10)	**3.17 (1.48, 6.80)**
There is nowhere to leave a bike safely	1.01 (0.56, 1.81)	1.14 (0.54, 2.40)	0.98 (0.57, 1.67)	0.76 (0.39, 1.47)
Streets are dangerous from cars	1.66 (0.87, 3.17)	1.21 (0.53, 2.76)	1.62 (0.84, 3.14)	1.57 (0.68, 3.63)
Average (out of 7 environment/safety barriers)	1.37 (0.72, 2.58)	1.34 (0.60, 3.02)	1.38 (0.72, 2.64)	1.97 (0.82, 4.71)
Planning/psychosocial				
I get too hot and sweaty to walk or bike	1.30 (0.73, 2.33)	1.54 (0.73, 3.23)	1.39 (0.81, 2.36)	0.99 (0.51, 1.91)
I have too much stuff to carry to walk or bike	0.81 (0.45, 1.44)	0.78 (0.37, 1.65)	1.66 (0.95, 2.89)	1.32 (0.66, 2.61)
It is easier for me to travel by my car or motorbike	1.20 (0.67, 2.14)	**3.61 (1.60, 8.14)**	1.26 (0.72, 2.19)	**17.83 (5.78, 54.97)**
It involves too much planning ahead to walk or bike	1.30 (0.68, 2.47)	**2.87 (1.31, 6.28)**	**3.61 (1.94, 6.72)**	**4.37 (2.11, 9.03)**
Too much time is needed	**2.72 (1.52, 4.86)**	2.04 (0.96, 4.34)	**3.01 (1.73, 5.23)**	**3.74 (1.86, 7.53)**
Too much physical effort is needed	1.51 (0.83, 2.76)	1.61 (0.75, 3.43)	**2.01 (1.15, 3.35)**	1.88 (0.95, 3.70)
I need a car or motorbike for work purposes	**0.39 (0.20, 0.75)**	**3.61 (1.58, 8.25)**	0.68 (0.38, 1.22)	**3.52 (1.76, 7.05)**
Average (out of 7 planning/psychosocial barriers)	1.30 (0.72, 2.37)	**3.54 (1.63, 7.69)**	1.58 (0.92, 2.74)	**3.57 (1.78, 7.16)**
Total average (out of 14 barriers)	1.63 (0.90, 2.94)	**4.58 (1.87, 11.18)**	**2.30 (1.28, 4.14)**	**4.20 (1.82, 9.67)**

OR, odds ratio; 95% CI, 95% confidence interval.
Bold = Significant association with $P < 0.05$.
[a] Active commuting was established as reference.
[b] Disagree was established as reference; and the analysis was adjusted for distance to university.

of the mode of commuting tends to be affected by their perceptions in terms of the viability of commuting modes.[20] It can therefore be inferred that the cities evaluated in Chile have good public transport connectivity with university campuses, thus promoting its use.

In Spain, male and female students use private transport as the main mode of commuting to university. However, another study in Spain (Valencia) evidenced that active commuting and public transport were the main modes of commuting to and from university.[9] These differences may, in part, be due to differences in the environment, characteristics or culture of the studied cities. In addition, for the city of Spain, included in the current study, Cádiz the university campuses are located a long distance from the city centre, and it has been stated that this type of suburban university campus is a large generator of motorised commuters.[21] Therefore, this topic may be an important issue for the future planning of new university campuses.

Table 5
Associations between mode of commuting with perceived barriers to active commuting to university for students in Spain by sex.

Perceived barriers[b]	Mode of commuting in Spain[a]			
	Men		Women	
	Public	Private	Public	Private
	[OR (95% CI)]	[OR (95% CI)]	[OR (95% CI)]	[OR (95% CI)]
Environment/safety				
There are no bike lanes along the way	0.78 (0.39, 1.58)	0.98 (0.54, 1.79)	1.64 (0.88, 3.08)	1.31 (0.73, 2.33)
Usually, bike lanes are occupied by pedestrians	**0.47 (0.23, 0.97)**	**0.49 (0.27, 0.91)**	1.16 (0.62, 2.17)	1.37 (0.77, 2.43)
There is too much traffic along the route	0.89 (0.44, 1.79)	0.85 (0.46, 1.55)	**2.79 (1.43, 5.28)**	**2.04 (1.14, 3.67)**
There is one or more dangerous crossings along the way	0.48 (0.22, 1.01)	**0.51 (0.27, 0.98)**	1.46 (0.76, 2.78)	1.29 (0.72, 2.33)
It is unsafe because of crime to walk or bike	0.56 (0.22, 1.41)	0.67 (0.31, 1.42)	0.75 (0.33, 1.66)	0.83 (0.40, 1.74)
There is nowhere to leave a bike safely	1.02 (0.50, 2.06)	0.10 (0.55, 1.82)	1.11 (0.59, 2.06)	0.80 (0.45, 1.42)
Streets are dangerous from cars	**0.36 (0.17, 0.77)**	**0.46 (0.24, 0.89)**	**2.69 (1.41, 5.12)**	1.56 (0.88, 2.78)
Average (out of 7 environment/safety barriers)	0.57 (0.28, 1.16)	0.67 (0.36, 1.23)	1.69 (0.91, 3.17)	1.32 (0.74, 2.34)
Planning/psychosocial				
I get too hot and sweaty to walk or bike	0.93 (0.46, 1.89)	1.06 (0.58, 1.95)	1.87 (0.98, 3.57)	**1.87 (1.03, 3.41)**
I have too much stuff to carry to walk or bike	1.04 (0.51, 2.14)	1.25 (0.68, 2.30)	1.27 (0.65, 2.49)	1.31 (0.70, 2.42)
It is easier for me to travel by my car or motorbike	0.75 (0.35, 1.61)	**2.82 (1.42, 5.59)**	1.51 (0.77, 2.97)	**3.84 (2.01, 7.32)**
It involves too much planning ahead to walk or bike	0.66 (0.30, 1.45)	1.05 (0.54, 2.03)	**4.19 (1.96, 8.95)**	**6.43 (3.14, 13.16)**
Too much time is needed	1.30 (0.64, 2.64)	**2.65 (1.45, 4.86)**	**3.28 (1.71, 6.23)**	**4.40 (2.41, 8.04)**
Too much physical effort is needed	1.19 (0.56, 2.50)	1.12 (0.58, 2.13)	**2.90 (1.46, 5.73)**	**3.60 (1.90, 6.81)**
I need a car or motorbike for work purposes	0.69 (0.33, 1.45)	1.44 (0.78, 2.67)	1.47 (0.76, 2.83)	**2.55 (1.39, 4.65)**
Average (out of 7 planning/psychosocial barriers)	1.02 (0.50, 2.05)	**1.89 (1.04, 3.44)**	**2.85 (1.50, 5.42)**	**3.82 (2.11, 6.93)**
Total average (out of 14 barriers)	0.52 (0.275, 1.07)	0.84 (0.46, 1.55)	**2.83 (1.48, 5.38)**	**3.74 (2.06, 6.78)**

OR, odds ratio; 95% CI, 95% confidence interval.
Bold = Significant association with $P < 0.05$.
[a] Active commuting was established as reference.
[b] Disagree was established as reference; and the analysis was adjusted for distance to university.

Active commuting was the second most frequently used mode of commuting by all students (except women in Spain), where men in Chile showed the highest percentages, with significant differences with women in Chile and men in Spain. This result may be explained by the fact that in the current study, male students from Chile reported the shortest distance to university (<2 km) compared with female students in Chile and male students in Spain. In agreement with this, previous studies have shown that active commuting is associated with shorter distance,[5,9] which is an important factor for choosing this mode of commuting.

In terms of the perceived barriers to active commuting, classified as environment/safety and planning/psychosocial barriers, these were also impacted by sex and country. Female students in Chile perceived more barriers to active commuting to university than men from Chile, while men and women in Spain perceived similar barriers. For women from Chile, the selection of the mode of commuting is frequently determined by the security it provides.[22] Indeed, a study conducted in Latin America indicated that the mode of commuting and female sex may impact each other, as well as gender diversity, because women are frequently exposed to harassment in commuting environments.[23]

In addition, students in Chile more frequently reported environmental/safety barriers, and students in Spain more frequently reported planning/psychosocial barriers. The infrastructure or road safety conditions for active commuting across Latin America are generally poor and/or non-existent and discourage potential users.[24] However, Chile is implementing new strategies on this topic and created the 'Road Coexistence Law' (aiming to put all modes of commuting on the roads on an equal footing), which came into effect at the end of 2018, and hopes to see the impact of this initiative towards 2030.[25] On the contrary, Spain has a better infrastructure for active commuting than developing countries such as Chile. However, the best examples of friendly environments for active commuting are seen in European countries such as the Netherlands, Denmark and Sweden, where there are dedicated cycle and pedestrian paths and a safer environment.[26] Spain has been included in an initiative of the European Union called the 'Handshake project' that helps cities of all types to become more liveable places by improving conditions for active commuting.

In the last few years, to contain the spread of COVID-19 and prevent overburdening of healthcare systems during the global pandemic, active commuting has been shown to be the most effective mode of transportation[27] because, by its nature, it is in isolation[28] and enables physical distancing.[29] In fact, the World Health Organisation (WHO) expressed that, whenever possible, individuals should consider walking or cycling, as this provides physical distancing and also helps meet the minimum requirements for daily physical activity.[30] In response to this, several countries, such as England, the US, Peru, Colombia, Chile and Spain, have improved the implementation of road extensions and provision of new temporary use bike lanes to promote a safer, healthier and more sustainable urban mobility.[31] Therefore, it is assumed that after the COVID-19 pandemic, there will be changes in attitudes to active commuting and its barriers.

Finally, this study analysed the association between modes of commuting and the perceived barriers in participants in Chile and Spain. Overall, the interesting result was that the use of private transport was associated with higher perceptions of planning/psychosocial barriers in both men and women in Chile and Spain, compared to those using active commuting. A study of university students in Sevilla (Spain) indicated that although there are more sustainable and less polluting ways of commuting (such as walking or cycling) and more economical ways of commuting (such as public bus or metro/train), students were reluctant to use them due to the optimisation of time or convenience.[32] In line with this finding, one study showed that if the use of motorised transport is the only option (for instance, due to distance) and without improvements to the quality of public transport (e.g. service reliability, speed and frequency), there is no customer satisfaction, and consequently, the use of private transport increases.[33] This may be an important call for planners and urban services, where if the use of private transport is to be reduced, the quality of public transport services must be optimal. It is already known that there is an urgent need to reduce the use of private transport[34] for more sustainable alternatives, such as active commuting together with public transport;[33] thus, mitigating existing psychosocial and planning barriers should be a key strategy. In addition, it is important to continue considering creating and improving infrastructures for active commuting and providing education programmes from an early age to a university or work level.

Limitations and strengths

There were some limitations in this study that should be mentioned. First, the use of a self-reported questionnaire restricts the potential accuracy of the observed relationships, especially the perceived environmental barriers, which can be cross-checked with objective assessments of the built environment. Second, due to the fact that Chile and Spain are geographically large countries, the data cannot be extrapolated to different regions or provinces, which limits generalisability of the findings to other parts of Chile and Spain. Nevertheless, there are some strengths to this study. First, to the best of the authors' knowledge, this is the first study to include such a large university population. Second, the novelty of studying the barriers responsible for not using active modes of commuting to university could lead to improvements in higher education infrastructures, and bring personal as well as environmental benefits through active commuting.

Conclusions

This study suggests that the mode of commuting and the barriers to active commuting were different and may be influenced by sex and country. However, further confirmation will be necessary by intervention studies. This study contributes new and important knowledge in terms of active commuting for university students in Chile and Spain. The results will be of interest to future studies and transport policy strategies aimed to promote active commuting in this population and to improve the active commuting environments to university campuses, as well as contributing to increased physical activity and better health of these young adults.

Author statements

Acknowledgements

The authors would like to thank all the students and the institutions who participated and collaborated in this study for making this research possible.

Ethical approval

All procedures followed the Helsinki protocols and were approved by the Ethics Committee of Pontificia Universidad Católica de Valparaíso (Code: CCF02052017), and by the Ethics Committee for Non-Biomedical Experimentation and evaluation of experimentation with Genetically Modified Organisms at the University of Cádiz (Ref. 004/2021).

Funding

This work was supported by National Agency for Research and Development (ANID)/Scholarship Program/DOCTORADO BECAS CHILE/2020 – [Grant N° 72210020] for X.P.-L, and the University of Cádiz, Plan Propio de Investigación 2017 (PR2017-087) for D.C.-M.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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