Association between the built environment characteristics and the parental perceived barriers towards active commuting to school

Asociación entre las características del entorno construido y las barreras percibidas por los padres para el desplazamiento activo al colegio

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Abstract

Introduction: The aim of this study was to analyze the associations between parental barriers and family built environment characteristics, differentiating by parents and adolescent's gender.
Methods: A total of 94 Spanish parents of adolescents belonging to 13 different schools (Granada, Jaén, and Valencia) answered a questionnaire about the mode of commuting to and from school of their children, and the barriers they perceived towards active commuting of their offspring. The analysis of the built environment was carried out with the "Microscale Audit Pedestrian Streetscapes" tool.
Results: Fathers perceived increased barriers for walking when pedestrian design were worse (β = -0.14; CI = -0.26, -0.01). The barriers perceived by mothers were higher when the aesthetics characteristic was worse (β = -0.22; CI = -0.40, 0.00). For boys, the parental general (β= -0.05; CI= -0.39, -0.00), cycling (β= -0.14; CI= -0.26, -0.01) and total barriers (β= -0.19; CI= -0.19, -0.02) were higher when pedestrian design was worse. However, no significant results were observed for girls.
Conclusion: Fathers perceived more barriers when pedestrian design features worsened, and mothers when street aesthetics worsened. Also, parents of boys presented more barriers when the pedestrian design characteristic was worse. Therefore, the development and improvement of pedestrian and street infrastructure could reduce parents' perception of barriers that influence the active commuting to school of their offspring.

Keywords

Active travel; environment design; household; neighbourhood.

Resumen

Introducción: El objetivo de este estudio fue analizar las asociaciones entre las barreras parentales y las características del entorno construido familiar, diferenciando por padres y género del adolescente.
Metodología: Un total de 94 padres españoles de hijos que pertenecen a 13 colegios diferentes (Granada, Jaén y Valencia) respondieron a un cuestionario sobre el modo de desplazamiento de ida y vuelta al colegio de sus hijos, y las barreras que percibían hacia el desplazamiento activo de sus hijos. El análisis del entorno construido se llevó a cabo con la herramienta "Microscale Audit PedestrianStreetscapes".
Resultados: Los padres percibían mayores barreras para caminar cuando el diseño peatonal (β = -0,14; IC = -0,26, -0,01) era peor. Las barreras percibidas por las madres eran mayores cuando la característica estética era peor (β = -0,22; IC = -0,40, 0,00). Para los niños, las barreras generales (β= -0,05; IC= -0,39, -0,00), las barreras en bicicleta (β= -0,14; IC= -0,26, -0,01) y totales (β= -0,19; IC= -0,19, -0,02) percibidas por los padres eran mayores cuando el diseño peatonal era peor. Sin embargo, no se observaron resultados significativos en el caso de las niñas.
Conclusiones: Los padres percibieron más barreras cuando empeoraron las características del diseño peatonal, y las madres cuando empeoró la estética de la calle. Asimismo, los padres de niños varones presentaban más barreras cuando la característica del diseño peatonal era peor. Por lo tanto, el desarrollo y la mejora de las infraestructuras peatonales y de las calles podrían reducir la percepción por parte de los padres de las barreras que influyen en el desplazamiento activo al colegio de sus hijos.

Palabras clave

Viajes activos; diseño ambiental; hogar; vecindario.

Introduction

The increasing prevalence of sedentary lifestyles and declining physical activity (PA) among young people (Schwarzfischer et al., 2019) is one of the main problems that can lead to various diseases, such as an increase in obesity (Hills et al., 2011) or worse cardiovascular health (Márquez Rosa et al., 2006). The World Health Organization recommends that young people perform at least 60 minutes of moderate-to-vigorous PA every day to contribute to physical, social, cognitive, and psychological well-being improvements (Bull et al., 2020). Despite this, approximately 80% of adolescents, most of them girls, around the world do not meet the recommended PA levels (Guthold et al., 2020).

In order to develop an active lifestyle associated with these benefits, it is essential to consider four domains of PA: occupational (work/school), transport, household, and leisure activities (Sallis et al., 2012). One type of transportation is active commuting to and/or from school (ACS), defined as walking or cycling to/from school (Ruiz-Ariza et al., 2017) and it is associated with increased PA (Campos-Garzón et al., 2024). Furthermore, it is also related to different health, social, and environmental benefits, such as a lower body mass index (Davison et al., 2008), improved cardiorespiratory fitness (Bagatini et al. 2023), improved quality of life/well-being (Poitras et al., 2016), and reduced pollution (Zhang & Qian, 2024). Commuting is recognized as one of the top ten socioeconomic determinants of health by the World Health Organization (Patil & Sharma, 2021). Walking or cycling increases routine and daily physical activity, becoming a vital tool for population health intervention (Sallis et al., 2004). In Spain, Gálvez-Fernández et al. (2021) reported that 40% of Spanish children and adolescents commuted passively between 2010 and 2017. This percentage is still significantly high, so further work is needed to improve it.

Several factors influence the adolescent's ACS, which can be categorized into three main groups: personal factors, which are all those characteristics that influence the individual (e.g. motivation; Burgueño et al., 2022); social factors, which involve external influences (e.g. parental barriers; Aranda-Balboa et al., 2020); and environmental factors, which are those elements that can influence the individual's decisions (e.g. street conditions; Jiménez Boraita et al., 2022). Above all, one of the factors that most influence adolescents in their ACS is the opinion and concerns of their parents (Hagel et al., 2019). In this sense, Huertas-Delgado et al. (2017) indicated that age of the adolescent is a fundamental element that modulates these influences. For example, parents who have children under 9 years old perceived greater insecurities in relation to the built environment (e.g., amount of traffic), with delinquency being one of the main obstacles. According to this, Aranda-Balboa et al. (2020) explained that the main parental barriers associated with a higher frequency to ACS, from school or neighborhood, were built environment. Also, Rodríguez-López et al. (2017) considered distance between school and family home the most relevant factor inside built environment barrier for ACS. Furthermore, other factors also contribute to reduce ACS, such as the lack of safe street connectivity, the volume of traffic along the route to and/or from school (Wilson et al., 2022), as well as mixed land use and residential density also play a role (Molina-García et al., 2017). In this sense, depending on the parents' and, consequently, their offspring's perception of the neighborhood, they are reluctant to commute around the area (Lee et al., 2006).

There are previous studies such as Molina-García et al. (2019) that associated the built environment with ACS. However, under our knowledge, how the built environment may affect the barriers of parents and their offspring has not yet been studied. Considering that parents are the main decision maker of their children's mode of commuting, it is crucial to understand how the environment could be related to the perception of barriers. Therefore, the purpose of this study was to analyze the associations between parental barriers and family built environment characteristics, differentiating by parents and adolescent's gender.

Method

This cross-sectional study was conducted between January 2019 and April 2021. A total of 94 parents of children (from 6 to 18 years old) from 13 schools. This manuscript is part of the PACO Project (Pedalea y anda al cole) (https://profith.ugr.es/paco) whose main aim is to promote ACS among adolescents. The study was approved by the Research Ethics Committee of the University of Granada (162/CEIH/2016).

Participants

Participants included in this study were required to have responded to the following questions: 1) gender of the student; 2) age of the offspring; 3) the family address zip code; 4) ≤1350m between school and family home; 5) the age of the family member who completed the questionnaire; 6) the gender of the family member; 7) the family's socioeconomic level; and 8) all questions related to barriers. Participants who did not complete these questions and who lived within a distance ≤1350m from their home to the school were excluded from this study. From the total of 213 parents who agreed to participate in the study, one hundred nineteen participants were excluded when the above inclusion criteria were applied (Figure 1).

Figure 1. Flow chart of the participants included in the study.

Procedure

The schools were randomly selected as was done in the PACO project protocol (Chillón et al., 2021). A meeting was arranged with the management team and the Physical Education teacher, who facilitated the organization of the areas where the study would be carried out in the school. The objectives, benefits and requirements of the project were explained, as well as the request for the collaboration of teachers, students, and their families. For data collection, students were given an informed consent form and a paper questionnaire for families to complete at home. The questionnaires were subsequently read using *DataScan* to ensure an objective process.

With the assistance of Google Maps™, the distance between the school and the family home was calculated. For this purpose, the family's self-reported mailing address and the mailing address of the school were used as reference points. About the evaluation of the built environment, multiple raters were instructed to use the Microscale Audit of Pedestrian Streetscapes (MAPS-Global) tool (Cain et al., 2018) through an on-site seminar by an expert, and were provided training materials including a manual with item definitions and photos, also following the certification process indicated by Millstein et al. (2013). After the training, each evaluator practiced several streets online rating using *Google Maps™* and *GoogleStreet View* softwares and communicated with the expert to clarify specific issues. To be certified to rate independently, raters were required to complete observations of at least five routes with inter-rater reliability at 95% agreement or higher. Then, all family and school built environments were randomly assigned to the evaluators group.

Measures

Sociodemographic information

Regarding sociodemographic characteristics, parents reported their age, gender, highest educational level, socioeconomic level, and the age of their offspring. In the case of the parents' educational level, the response options were "no studies", "Primary", "Secondary", "Bachelor's degree", "Professional Training", or "University". It was categorized as "university" if one of the parents had a university degree, or "non university" if they had other types of studies (Huertas-Delgado et al., 2019). The socioeconomic status was computed by the average of the answers to four questions related to the Family Affluence

Scale (FAS; Boyce et al., 2006), which were summarized as a continuous variable from 0, as the minimum, to 8, like the maximum according to the following questions: 1) Does your child have their own room? Which answer could be "yes" or "no", 2) Do you have internet access? Which answer could be "yes" or "no", 3) How many computers does your family own? Which answer options could be "none", "one", "two", or "two or more", and 4) Do you have a four-wheel motorized vehicle at home? Which answer options could be "no", "yes, one", "yes two" or "yes, more than two". For most analysis, we use a three points ordinal scale, where FAS low (score=0,1,2) indicates low affluence, FAS medium (score=3,4,5) indicates middle affluence, and FAS high (score=6,7,8,9) indicates high affluence.

Mode of commuting

The students' mode of commuting to/from school was assessed through the question "How does your child usually go to/from school? (Check only one option. If you use several modes of commuting, please indicate the one you spend the most time on)". The possible answers were walking, cycling, car, motorbike, scholar bus, public scholar, subway/train/tram, other. The adolescents were categorized as "active" if they usually walked or cycled to or/and from school, and "passive" if they usually commuted to and from school using a passive mode of commuting (e.g., car, motorbike, train) or another means of transportation (Chillón et al., 2017).

The postal addresses of the family members were also declared by the participants in the questionnaire. They were collected and exported to Excel in CSV format. With the postal addresses and the help of the Google Maps web service, the geolocation process and the examination of the home-school family routes could be performed. Participants living more than 1350 m from home to school were excluded, as the threshold distance to walk to school in urban participants is ≤1350m (Rodríguez-López et al., 2017).

Parents' perceived barriers

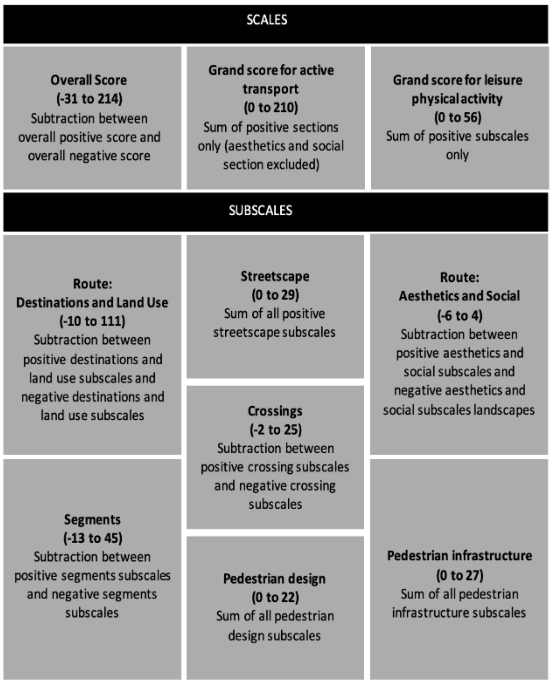
To assess parental perception of barriers towards ACS to and/or from school, the validated questionnaire "Parental Perception of Barriers Towards Active Commuting to School" (PABACS) was used (Huertas-Delgado et al., 2019). Ten items of the questionnaire assessed the general perceived parental barriers towards ACS, six items focused specifically on walking, and seven items focused on cycling. Therefore, the final questionnaire included 23 items about general, walking, and cycling barriers that assess parents' perceived barriers to ACS.

The question about the parents' perceived barriers was formulated: "The following are situations that may be encountered on a day-to-day basis. Please indicate to what extent these situations may affect your decision not to allow your child to walk or cycle to and from school. Please "check only one option for each question". The response options related to general commuting situations, ACS walking and by bike, separately. The scale asked the participants to rate how strongly they agreed with each statement through a Likert scale of 4 points (from "Nothing" to "Substantially"). The barriers were grouped into 4 categories: general, walking, cycling, and total barriers. The average score of the questions generated each of the categories showed a good internal consistency. The Cronbach's alpha for the overall questionnaire was α =0.86. When divided by scales, the Cronbach's alpha values were α =0.83 for the general items, α =0.66 for the walking items, and α =0.73 for the cycling items. The overall dimension and the general and walking barrier dimensions showed a moderate to high validity to predict active modes of commuting.

Built environment

To assess the characteristics of school and family built environments, the MAPS-Global tool was used, which is highly reliable for the analysis of microscale urban areas and pedestrian built environments (Cain et al., 2018). This tool allows the assessment of elements of the physical environment, and therefore includes several properties on routes (e.g. speed bumps), segments (e.g. number of trees) and crossings (e.g. number of pedestrian crossings). Data for the blocks where the school and the family home were located were obtained from *Google Earth* and *Google Street View* images, as web platforms that allow assessing the characteristics of streets globally. After conducting the assessments, the results were categorized according to the environmental characteristics scores, divided into scales and subscales (Figure 2). In total, 78 family built environments were assessed (the remaining 16 could not be assessed due to incorrect location), whose locations corresponded to the geo-located postal addresses of the students. Thirteen school built environments were also assessed. It took an average of 75 minutes to analyse each built environment. In total, approximately 315 routes and segments, and 378 crossings were evaluated.

Figure 2. Environmental variables scales and subscales.



Data analysis

In the case of categorical variables, descriptive data on the participants were calculated by frequencies and percentages. Means and standard deviations were used for continuous variables. To analyze the differences of these descriptive data by adolescent gender, the "Chi-square test" was performed for categorical variables and "Student's t-test" for continuous variables.

Multiple linear regression models were created to study the association between parental perceived barriers and the family built environment. For parental perceived barriers, each category was included as a dependent variable with each of the family built environment scales as independent variables in separate models for each environmental variable. Adolescent's age, gender, and mode of commuting, distance to school, and parent's socioeconomic and educational level were included as adjustment variables. Analyses were performed according to the gender of both parents and adolescents and the mode of commuting to the school of the students. All analyses were performed using IBM SPSS® 23.0 statistical software, and the level of significance was set at $p<.05$.

Results

The description of the characteristics of the participants in this study by adolescent gender are shown in Table 1. Although the percentage in terms of gender of the participants is similar, the majority were girls (55.2%) and mothers (77.1%). Considering the distance capped at ≤1350m between the postal address reported by the families and the school, the sample shows an average of 811m in the ACS, with girls being the most active (54.7%). Also, it can be observed that the majority of the sample of parents do not have a university education (58.6%), but 81.5% of the families have a high SES.

Table 1. Description of the characteristics of the total participants and according to the gender of the adolescents.

	All (n = 94) Mean ± SD	Boys (n = 42) Mean ± SD	Girls (n = 52) Mean ± SD	P
STUDENT				
Age	14.2 ± 0.48	14.2 ± 0.50	14.2 ± 0.46	0.42
Active mode of commuting, n (%)*	86 (89.6%)	39 (45.3%)	47 (54.7%)	0.85
Distance toschool	811 ± 277	806 ± 278	815 ± 278	0.80
FAMILIAR				
Age	45.7 ± 5.00	45.9 ± 3.93	45.6 ± 5.68	0.05
Mother, n (%)*	74 (77.1%)	33 (44.6%)	41 (55.4%)	0.97
Universityeducation, n (%)*	37 (39.8%)	18 (43.9%)	19 (36.5%)	0.47
Socioeconomiclevel	5.19 ± 1.35	5.56 ± 1.60	5.33 ± 1.67	0.87
General barriers	2.30 ± 0.63	2.35 ± 0.57	2.25 ± 0.67	0.13
Walkingbarriers	1.82 ± 0.57	1.78 ± 0.52	1.84 ± 0.60	0.58
Cyclingbarriers	1.95 ± 0.60	1.91 ± 0.56	1.99 ± 0.63	0.75
General and walkingbarriers	2.13 ± 0.52	2.15 ± 0.48	2.11 ± 0.55	0.66
General walking and cycling barriers	2.08 ± 0.46	2.08 ± 0.46	2.07 ± 0.47	0.22

(Student's t-test for continuous variables, *Chi-square test for categorical variables)
SD (Standard Deviation)

Table 2 attempts to describe and compare the ranges of the variables between both environments, based on the scales and subscales of the built environment (Figure 2). In general, the school built environment presents a more disadvantaged environment, assigning lower values in all variables except for segments (20.0 ± 3.94) and pedestrian design (9.71 ± 1.97).

Table 2. Description of the characteristics of the school and family environment.

	School builtenvironment (n = 13)	Familybuiltenvironment (n = 96)
	Mean ± SD	Mean ± SD
Destinations and land use subscale	8.31 ± 4.02	8.35 ± 4.36
Streetscapesubscale	2.75 ± 1.85	5.21 ± 2.48
Aesthetic and social subscale	-2.80 ± 0.68	-2.71 ± 0.76
Segmentssubscale	20.0 ± 3.94	16.4 ± 3.46
Crossingssubscale	8.49 ± 1.62	9.72 ± 0.54
Pedestrianinfrastructuresubscale	8.16 ± 1.63	8.98 ± 1.91
Pedestriandesignsubscale	9.71 ± 1.97	7.57 ± 1.11
Overall score	38.5 ± 7.86	39.7 ± 8.26
Grand score for active transport	41.6 ± 8.08	43.1 ± 8.95
Grand score for leisure physical activity	12.7 ± 3.17	14.3 ± 2.49

SD (Standard deviation)

The association of parental barriers with the family built environment, separately for adolescents' gender, are shown in Table 3. For boys, parental general (β= -0.05; CI= -0.39, -0.00), cycling (β= -0.14; CI= -0.26, -0.01) and total barriers (β= -0.19; CI= -0.19, -0.02) were higher when pedestrian design was worse. No association was found between parental perceived barriers of girls and family built environment.

The association of general, walking, cycling, and parental barriers with the family built environment, distinguishing between father and mother, are shown in Table 4. Fathers' perceived higher barriers towards walking increased when pedestrian design (β = -0.14; CI = -0.26, -0.01) were lower. Mothers perceived greater barriers to cycling when street aesthetics characteristics (β = -0.22; CI = -0.40, 0.00) were worse.

Table 3. Association between family built environment characteristics and adolescents gender.

	General barriers				Walking barriers				Cycling barriers				Total barriers			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI
Destinations and land use subscale	0.03	-0.03, 0.04	0.05	-0.04, 0.06	0.06	-0.03, 0.04	-0.08	-0.06, 0.03	-0.21	-0.06, 0.01	-0.06	-0.06, 0.04	-0.03	-0.03, 0.02	-0.01	-0.04, 0.03
Streetscapesubscale	0.16	-0.03, 0.12	-0.19	-0.20, 0.03	0.06	-0.06, 0.09	-0.05	-0.13, 0.09	-0.13	-0.12, 0.05	-0.14	-0.06, 0.18	0.06	-0.05, 0.08	-0.08	-0.11, 0.06
Aesthetic and social subscale	-0.13	-0.35, 0.13	-0.11	-0.40, 0.17	0.07	-0.19, 0.29	-0.09	-0.36, 0.18	0.02	-0.25, 0.28	-0.25	-0.54, 0.03	-0.05	-0.23, 0.17	-0.20	-0.35, 0.05
Segmentssubscale	-0.10	-0.06, 0.02	-0.14	-0.06, 0.02	-0.25	-0.08, 0.00	-0.09	-0.05, 0.02	-0.07	-0.06, 0.04	-0.19	-0.07, 0.01	-0.15	-0.06, 0.01	-0.19	-0.05, 0.00
Crossingssubscale	0.04	-0.15, 0.20	-0.21	-0.16, 0.02	0.09	-0.13, 0.23	-0.01	-0.09, 0.08	-0.02	-0.21, 0.18	0.01	-0.09, 0.10	0.03	-0.13, 0.17	-0.13	-0.10, 0.03
Pedestrian infrastructure subscale	0.09	-0.07, 0.13	-0.05	-0.14, 0.09	-0.07	-0.13, 0.08	0.00	-0.10, 0.11	0.21	-0.03, 0.18	-0.02	-0.13, 0.11	0.10	-0.05, 0.11	-0.04	-0.09, 0.07
Pedestriandesignsubscale	-0.05	-0.39, -0.00	-0.15	-0.12, 0.03	0.01	-0.09, 0.10	-0.15	-0.12, 0.03	-0.14	-0.26, -0.01	0.03	-0.07, 0.09	-0.19	-0.19, -0.02	-0.23	-0.11, 0.00

Overall score	0.03	-0.02, 0.02	-0.15	-0.03, 0.01	-0.00	-0.02, 0.02	-0.09	-0.03, 0.01	-0.19	-0.04, 0.01	-0.07	-0.03, 0.01	-0.05	-0.02, 0.01	-0.16	-0.02, 0.00
Grand score for active transport	0.03	-0.02, 0.02	-0.14	-0.03, 0.01	-0.02	-0.02, 0.02	-0.08	-0.02, 0.01	-0.20	-0.04, 0.01	-0.03	-0.02, 0.02	-0.06	-0.02, 0.01	-0.13	-0.02, 0.00
Grand score for leisure physical activity	-0.01	-0.05, 0.05	-0.05	-0.07, 0.05	-0.16	-0.08, 0.02	-0.06	-0.07, 0.04	-0.05	-0.06, 0.04	-0.17	-0.09, 0.02	-0.07	-0.05, 0.03	-0.12	-0.06, 0.02

CI (Coefficient Interval)
Analyses adjusted by: Families' gender, walking distance home-school, and Family Affluence Scale (FAS).

Table 4. Association between family built environment characteristics and parents' gender.

	General barriers				Walking barriers				Cycling barriers				Total barriers			
	Fathers		Mothers		Fathers		Mothers		Fathers		Mothers		Fathers		Mothers	
	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI	Beta	CI
Destinations and land use subscale	0.13	-0.06, 0.09	0.02	-0.03, 0.04	-0.16	-0.11, 0.07	0.00	-0.03, 0.03	-0.36	-0.14, 0.03	-0.12	-0.05, 0.01	-0.11	-0.09, 0.06	-0.03	-0.02, 0.02
Streetscapesubscale	0.16	-0.10, 0.18	-0.10	-0.11, 0.04	0.07	-0.16, 0.20	-0.03	-0.08, 0.06	-0.18	-0.23, 0.12	0.01	-0.07, 0.08	0.03	-0.13, 0.15	-0.07	-0.07, 0.03
Aesthetic and social subscale	-0.02	-0.45, 0.41	-0.12	-0.31, 0.10	0.09	-0.43, 0.62	-0.09	-0.26, 0.12	0.09	-0.42, 0.62	-0.22	-0.06, -0.00	0.05	-0.38, 0.47	-0.20	-0.26, 0.01
Segmentssubscale	-0.27	-0.09, 0.02	-0.01	-0.04, 0.03	-0.22	-0.10, 0.11	0.07	-0.02, 0.04	-0.36	-0.13, 0.01	-0.02	-0.04, 0.03	-0.44	-0.10, 0.13	0.00	-0.02, 0.02
Crossingssubscale	0.20	-0.10, 0.22	-0.18	-0.16, 0.02	-0.07	-0.23, 0.18	0.04	-0.07, 0.10	0.06	-0.18, 0.22	-0.01	-0.10, 0.08	0.09	-0.13, 0.19	-0.11	-0.09, 0.03
Pedestrian infrastructure subscale	0.26	-0.10, 0.28	0.00	-0.09, 0.09	-0.22	-0.32, 0.15	0.07	-0.05, 0.10	-0.05	-0.26, 0.22	0.11	-0.04, 0.12	0.04	-0.18, 0.21	0.07	-0.04, 0.07
Pedestriandesignsubscale	-0.19	-0.16, 0.07	-0.19	-0.13, 0.01	-0.48	-0.29, -0.01	0.09	-0.04, 0.09	-0.25	-0.21, 0.06	0.07	-0.05, 0.09	-0.32	-0.19, 0.03	-0.07	-0.06, 0.03
Overall score	0.04	-0.03, 0.04	-0.07	-0.02, 0.01	-0.45	-0.08, 0.01	0.03	-0.01, 0.01	-0.46	-0.08, 0.01	-0.08	-0.02, 0.01	-0.27	-0.05, 0.02	-0.07	-0.01, 0.00
Grand score for active transport	0.03	-0.03, 0.04	-0.07	-0.02, 0.01	-0.45	-0.07, 0.01	0.03	-0.01, 0.01	-0.46	-0.08, 0.01	-0.05	-0.02, 0.01	-0.28	-0.05, 0.02	-0.05	-0.01, 0.00
Grand score for leisure physical activity	0.03	-0.08, 0.09	0.00	-0.04, 0.04	-0.32	-0.15, 0.05	-0.00	-0.04, 0.04	-0.26	-0.15, 0.05	-0.08	-0.06, 0.03	-0.17	-0.11, 0.06	-0.03	-0.03, 0.02

CI (Coefficient Interval)
Analyses adjusted by: Adolescent's gender, walking distance home-school, and Family Affluence Scale (FAS).

Discussion

This cross-sectional study analyzed the associations between the characteristics of the built environment and parental barriers to their children's ACS, differentiating by the sex of the relative and their offspring. Our results showed that the parents of boys perceived more barriers when the pedestrian design was worse. In particular, fathers' barriers were higher for walking when pedestrian design were worse. For mothers, perceived barriers to cycling were higher when the aesthetic characteristics of the built environment were worse.

Secondly, the results showed that parents of boys presented more barriers when the pedestrian design (as well as the amount of traffic, lack of signage, and poor visibility at crossings or obstacles when walking on the sidewalk) was worse. Authors such as Carver et al. (2008) or McCormack (2017), showed that some characteristics such as tree density, sidewalk length, number of traffic lights, or else pedestrians walking, are positively associated with active commuting. In these walking commuting, boys are more aware of pedestrian design (e.g., number of stores or storefronts, increased walkability or street connectivity). This awareness could help them choose roads with these favorable characteristics that make them perceive less personal danger and insecurity (Nelson & Woods, 2010). Despite this, parents ultimately decide how their adolescent commuted. In the study by Huertas-Delgado et al. (2017), the authors explained that parents tend to perceive greater insecurity when their sons walk to school in an uncared-for built environment, which is related to some of the dangers perceived by parents such as delinquency. In addition, Foster et al. (2014) showed that parents are afraid of strangers when their sons walk in the street, leading to a reduction in their active commuting. In our study, parents of girls did not show significant differences. This result could be due to the fact that their sons, by showing a greater tendency towards independent and risky behaviours in public space, generate in parents a greater perception of vulnerability to environmental dangers, such as traffic or accidents (Florenzano et al. 2009).

The influence of the built environment is different for fathers and mothers. Worse pedestrian design (e.g., lack of signals or benches to sit on, poor condition of crosswalks or lack of curb ramps) were associated with the perception of father's barriers. Indeed, poor road safety makes parents feel insecure about their offspring's ACS, especially because of the dangers of motor vehicle traffic as well as hit-andruns or accidents (Oluyomi et al., 2014). Despite this, they feel more comfortable if their offspring use the same route but accompanied by other adolescents (Timperio et al., 2006). Therefore, it is important to further study accompaniment, in other words, whether fathers' barriers are affected when their offspring are actively with other friends on the way to school. Also, the creation or improvement of neighborhood routes (e.g., paths, shortcuts, walkways) that avoid traveling to and crossing busy intersections could also serve to facilitate increased ACS (Clark et al., 2016).

Finally, mothers perceive a greater number of barriers in their offspring's bike ACS when street aesthetics are worse (e.g., poor landscaping, visible dirt and dog excrement, or graffiti in urban areas). First, it is known from research that fathers manifest less overprotective behaviors than mothers (O'Hara & Holmbeck, 2013). In addition, Emond and Handy (2012) mentioned that parental support for cycling is the main promoter of cycling among adolescents. This becomes difficult for mothers when they perceive a poor physical and social built environment, as active commuting is influenced by mothers' perception of safety (Cleland et al., 2008). Considering parents' perspective towards their children's ACS, it is important to modify the built environment to prevent perceived threats (Evers et al., 2014), and thus also promote strategies that improve their children's ACS, from the personal to the political level (Sallis, 2018).

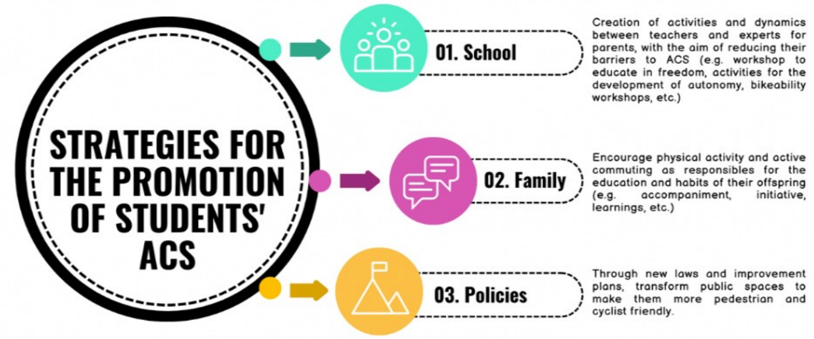
Implications

The role of families is crucial in promoting the ACS of their offspring (Panter et al., 2008). In addition, the LOMLOE (BOE, 2020), as the Spanish educational law, advocates maintaining healthy and autonomous built environments for school commuting, with safe and barrier-free road spaces. Therefore, it would be interesting to join efforts between teachers and experts in active commuting with families to increase active behaviors. Through different activities and/or dynamics they could work on all the barriers that families present and how to address them in order to reduce them. On the other hand, some authors such as De Aguiar Greca et al. (2023), showed that active accompaniment and the creation of bike lanes in the city center are essential to reduce parental barriers. Applied infrastructure strategies, as well as bicycle parking lots or increased school-related signage, reported a behavioral change in students' parents to reduce the use of the car in home-school commuting (Mammen et al., 2014). For the promotion of ACS, the school can also be key to help create dynamics such as a walking school bus (Timperio et al., 2006), or even bikeability workshops that promote cycling and complement learning about road safety (Chillón et al., 2014). In this way, cycling and the safety of the school and family built environment can be promoted.

Other strategies such as new laws and plans to make cities more walkable, or the contribution of citizens' own actions to make the city more pedestrian friendly, have already been implemented. As a qualitative research proposal, focus groups could be used to share options for improving the environmental situation, as well as raising awareness and proposing to the city council improvements in pedestrian design and neighborhood aesthetics to promote active commuting. A national example is Pontevedra, considered the healthiest and most sustainable Spanish city (Pazos-Otón et al., 2024). As international examples, Copenhagen, recognized as the European Green Capital in 2014 (Gudmundsson, 2015), and Amsterdam, considered the most sustainable city in the world (Baron et al., 2012). Another effective strategy was implemented in Bogotá by the local government, which closed more than 122 kilometers of streets to create a good net of bike lanes. Surveys have concluded that almost half of Bogotá residents actively use these streets for at least three hours (González Pérez et al., 2021). All of them have transformed their public spaces to make them more friendly for pedestrians and cyclists.

For the future, accompaniment should be further explored as a way to reduce parental barriers in the ACS of their offspring. To find out perceptions and attitudes about this, work can be done with parents and students through the focus group tool. Also, this research offers several improvement strategies to implement (Figure 3).

Figure 3. Improvement strategies to reduce the parent's barriers to ACS.



Limitations and strengths

Regarding the limitations of this study, due to the built environments studied are specific to the context analysed, the results obtained cannot be generalised to built environments with different characteristics. In addition, the evaluation of the built environments only studied a specific buffer range (the block surrounding the building). Therefore, other types of built environments and buffering can be taken into account in future research.

The main strength of the study is the use of the MAPS-Global tool, which analyzes the characteristics of the built environment at the microscale level. Both this tool and the ACS questionnaire for the Spanish adolescent population (Huertas-Delgado et al., 2019) have been previously validated in Spanish settings. Other strengths are the sample size and the novelty of the study, as there are no other investigations that analyze the influence of the built environment and parental barriers, using a tool of this type. In addition, the sample of this research has taken into account only those families living ≤ 1350 meters away from the school, so all the families are. This radius is evidenced as a walkable distance, within which considerable changes can occur in the families' mode of commuting.

Conclusions

Regarding the association between the characteristics of the built environment and parental barriers, the parents of the boys perceived more barriers when the pedestrian design was worse. Specifically, fathers perceived more barriers to walking ACS for their offspring when the pedestrian design were worse. In the case of mothers, they perceived more barriers to their offspring's cycling ACS when neighborhood aesthetics were worse. For all these reasons, it is vital to develop and improve infrastructure and pedestrian space policies, both in the school built environment and in the family neighborhood. In addition, it is essential to work on the perception that parents have of the built environment, thus reducing the barriers that affect their children's ACS.

Conflicts of interest

The authors declare no conflict of interest.

List of abbreviations

PA: Physical Activity.

ACS: Active Commuting to/from School

MAPS-Global: Microscale Audit of Pedestrian Streetscape.

FAS: Family Affluence Scale.

SES: Socioeconomic Status.

PABACS: Parental Perception of Barriers towards Active Commuting to/from School.

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