

Parental barriers to active commuting to school in children: does parental gender matter?

Abstract: *Background:* Children's active commuting to school (ACS) is directly influenced by parental attitudes, values and beliefs. Mothers and fathers may have different roles in family. This study compared mothers' and fathers' barriers to ACS in a sample of Spanish children. *Methods:* Data from 463 families (child (age: 9 to 12 years, 50.5% boys), mother and father) were analyzed. Children completed a questionnaire about socio-demographic characteristics and the mode of commuting to school. Parents completed a questionnaire about their perceived barriers to ACS. Distance from home to school was calculated using Google Maps. Data were analysed using multivariate binary logistic regression models with separate models for mothers and fathers. *Results:* Overall, 71.7% of children used ACS. Distance, parental mode of commuting to work and perceived convenience of driving children to school emerged as significant barriers to ACS for both mothers and fathers. In addition, perception of extra-curricular activities organization, and perception of child's interest in walking to school exclusively emerged as significant barriers to ACS in mothers. Both mothers and fathers perceived greater acceptable distances for their children to commute to school by bicycle than on foot. *Conclusions:* Although some barriers to ACS were similar for both parents (distance, convenience of driving and parental mode of commuting to work), other barriers were specific to mothers (children's extra-curricular activities organization and lack of children's interest in walking to school). Interventions strategies for promoting ACS in children focusing on parents should be gender-specific.

Keywords: Physical activity, Parents, Barriers, Children, Active transport, School.

1. Introduction

Active commuting has potential to increase physical activity (PA) and improve public health by preventing common non-communicable diseases in adults (Andersen, 2017) and should be politically promoted. The likely effects of policies supporting active commuting include important environmental and economical implications such as significant reductions in traffic-related air pollution, level of noise or even climate change mitigation (Nieuwenhuijsen & Khreis, 2016). Nevertheless, the main benefits of shifting from passive to active modes of transport are related to the health benefits associated with an increased PA (Rabl & de Nazelle, 2012).

Engaging children in PA during childhood is important as physical inactivity has been associated with cardiovascular risk factors including obesity in this age group (Ekelund et al., 2012). Childhood is considered a period of life when establishment of habits and positive attitudes towards PA plays an essential role for maintaining those habits throughout life. In terms of active commuting, childhood deserves special attention as high rates of active commuting might persist into adulthood and consequently provide long-term health benefits (Beige & Axhausen, 2012).

Promoting active commuting is one of the solutions for integrating PA into children's daily life (Faulkner et al., 2009). Children who walk or cycle to school have higher daily levels of PA (Davison et al., 2008; Pabayo et al., 2012) and better cardiovascular fitness than do children who use passive (i.e., motorized) modes of transport (Cooper et al., 2006). However, rates of active commuting to school (ACS) in children have declined over the last decades in the most developed countries (Buliung et al., 2009; Chillon et al., 2013; Grize et al., 2010; Pavelka et al., 2017).

The environments we live in have an important impact on our behaviour, including our preference to engage in PA (Lake & Townshend, 2013). To reverse the declining trend of ACS in children, barriers that may prevent children from walking or cycling to school should be further examined in diverse environmental, cultural and political environments such as those that characterize European cities (Lu et al., 2014).

Given the strong influence of family factors on children's behaviours, ACS in children may be directly influenced by parental attitudes, values and beliefs (Pont et al., 2009). For instance, parental concerns for safety (Carver et al., 2010) or parental

perceived convenience of driving (Trapp et al., 2011) are significant predictors of ACS in children. Furthermore, other factors related to households, such as distance from home to school (Merom et al., 2006), or parental mode of commuting to work (Henne et al., 2014) also significantly influence how children commute to school. Therefore, parental support could probably be considered as one of the most important social environmental factors for children's mode of transportation to school (Mah et al., 2017).

Most previous studies that examined parental barriers to ACS in children did not differentiate the findings based on whether the questionnaire was completed by a mother or a father (Lu et al., 2014; Pont et al., 2009). However, empirical findings show that mothers and fathers play different roles in family life. For instance, compared to fathers, mothers are more engaged in child care (Chesley & Flood, 2017). With respect to PA, previous findings have shown that father and mother may influence their child's PA by different processes (Bois et al., 2005; Edwarson & Gorely, 2010). Mothers seem to offer more logistic support to their children whereas fathers are more prone to provide higher levels of explicit modelling, intentionally using their behaviour to encourage their child to be active (Davison et al., 2003). Hence, it could be hypothesized that mothers' and fathers' perceptions of barriers to ACS may have different influence on the actual commuting to school behaviours in children.

The main objective of this study was to compare mothers' and fathers' barriers to ACS in a sample of Spanish children. To the best of our knowledge, this is the first study in which attention has turned to study mothers' and fathers' perspective on ACS in children. Understanding potential differences in mothers' and fathers' barriers to ACS in children will provide valuable knowledge for designing future ACS interventions which could successfully address gender-specific parental barriers.

2. Methods

2.1. Study design

Data were collected as part of the CAPAS-City project (Centre for the Promotion of PA and Health) in Huesca (Spain) in 2017. One of the main aims of this cross-cultural project between Spain and France deals with the analysis of children's ACS patterns and the implementation of context-based strategies to promote ACS. Huesca is a mid-sized Spanish city placed in the north-east of Spain with a population of

52,399 inhabitants who live in an urban area of 6.75 km² (4.21 km² when excluding an industrial area) with 7762.8 inhabitants/ km². The research project was approved by the Ethics Committee on Clinical Research of Aragon.

2.2. Participants

All 12 primary schools in Huesca were invited to participate in this study through a personal meeting with the headmaster of each school. Participating schools were asked to allow researchers to invite children from grades 4 to 6 (age: 9 to 12 years) and their parents to participate in this study. One school declined to participate. Thus, the final sample included 11 schools (92% school participation rate; 7 state and 4 state-integrated schools), with a total population of 1,560 potential children participants.

Researchers sent a letter to all potential children participants and their fathers and mothers to inform them about the project and to invite them to participate in this study. Parents were given 3 to 4 days to consider the invitation and sign parental consent. Overall, 1,263 parents signed consent (80.96% participation rate). Children also signed their own consent before completing the questionnaire at school (100% participation rate). A total of 978 questionnaires from mothers and 833 questionnaires from fathers were received (77.43% and 65.95% completion rates, respectively). After excluding incomplete or invalid children's and parental questionnaires, and selecting only families in which all participants (i.e., child, father and mother) completed the study questionnaire, a sample of 649 families remained. In the next step, we excluded 59 families with divorced/separated parents who lived in different households and 127 households located >3.5 km from child's school (i.e. households located outside the urban area). Therefore, data from 463 families with complete and valid child's, mother's and father's questionnaires were included in the analysis.

2.3. Procedure

Data were collected from February to May 2017. The questionnaires for children were distributed by the research team and filled out at school during one class supervised by the class' mentor teacher. Parental questionnaires for mothers and fathers who had signed consent were given to children at school to take home along with an explanatory

letter. Fathers and mothers were asked to return completed questionnaires through standardized school lines of communication (e.g., direct return to mentor teacher, attached to homework, etc.) within ten days.

2.4. Outcome measures

Sociodemographic characteristics. Children self-reported their age and gender. Fathers and mothers self-reported their own age, education level (none, primary school, secondary school, professional training or university) and employment status (employed or unemployed). Socioeconomic status (SES) was calculated using the Family Affluence Scale II (FAS II, Currie et al., 2008) from the completed parental questionnaires. FAS II is a four-item scale which allows to calculate a composite score ranging from 0 to 9 which was used in analyses.

Commuting to and from school. Children self-reported their mode of commuting to and from school for every weekday using the Mode and Frequency of Commuting To and From School Questionnaire (Chillón et al., 2017). Mode of commuting to school was assessed using questions "How do you travel to/from school on... (day of the week)?" with the response categories "car", "public bus", "motorbike", "school bus", "bicycle", "on foot" and "other". Each journey to school (i.e., to and from school) for every day was categorized into (1) active (on foot or by bicycle), or (0) passive (by car, public bus, school bus, motorcycle). After that, all weekly active trips were summed into a single variable ranging from 0 to 10. Finally, a dichotomous variable 'active commuters' (≥ 6 active trips per week) versus 'passive commuters' to school (< 6 active trips per week) was calculated.

Parents self-reported their own modes of commuting to work by responding to a question "How do you usually travel to work?" with response categories being "car", "public bus", "motorbike", "bicycle", "on foot" and "other". Parents who walked or cycled to work were categorized as 'active commuters' whereas those using a car, public bus or motorbike were categorized as 'passive commuters'.

Distance from home to school. Household address was independently provided by children, father and mother to avoid any spelling mistakes occasionally found in younger children. In case of spelling differences, the researchers group checked the home address in all three surveys and the street map of the city to confirm the correct address.

Google Maps software was used to calculate distance from home to school for every participant, selecting the shortest route on foot via the street network between each household and the mainschool entrance.

Parental perceived barriers to ACS. Parental perceived barriers to ACS were assessed using a 23-item questionnaire (Chaufan et al., 2012) adapted to the Spanish cultural context (Huertas-Delgado et al., 2017). Assessed barriers included perceived distance to school, traffic, pedestrian and cycling infraestructure, personal and traffic safety, convenience, companionship, logistic requirements, child's interest in walking/cycling and the weather. All items were assessed using a 4-point Likert scale ranging from (1) strongly disagree to (4) strongly agree. To calculate the proportion of parents agreeing with each statement, 4-point Likert scale items were also recoded into 'disagree' (1 and 2) and 'agree' (3 and 4).

2.5. Statistical Analysis

Sociodemographic characteristics of children and parents were analyzed using descriptive statistics. Differences between mothers' and fathers' sociodemographic characteristics and perceived barriers to ACS were tested using independent samples t-test for continuous variables and chi-square tests for categorical variables. The threshold distance for active commuting was calculated using the receiver operating characteristic (ROC) curve analysis based on the mode of commuting to school ('active' versus 'passive') and the distance from home to school. Considering sensitivity and specificity data of the test, the Youden Index was calculated (Schisterman, Perkins, Liu, & Bondell, 2005) to obtain the threshold distance that best discriminates 'active commuters' from 'passive commuters'. The larger the area under the ROC curve (ranking from 0 to 1), the more discriminatory is the test. The area under the curve values of .90 are considered excellent, .80-.89 good, .70-.79 fair, and less than .70 poor (Metz, 1978).

Binary logistic regression analysis was used to determine multivariate correlates of children's ACS from mother's and father's perspective separately. First, bivariate associations were examined between the mode of children's commuting to school (as a dependant variable) and each of the independent variables (children's age and gender, distance from home to school, type of school, SES, mother's/father's mode of

commuting to work, mother's/father's level of education, mother's/father's age, number of working parents in a family and mother's/father's perceived barriers to ACS). All significant univariate correlates ($p < .05$) were included into a multivariate binary logistic regression model. Separate models were created for mothers and fathers including the total sample as well as parents living in households within the threshold ACS distance to school determined using the ROC analysis. All statistical analyses were conducted using the SPSS Software Version 21.0 for Windows. The level of significance was set at $p < .05$.

3. Results

Sociodemographic characteristics are presented in Table 1. Overall, 71.7% of children actively commuted to school including 46.6% boys and 65.7% of children enrolled in state schools. In the total sample, 375 (81.3%) households had two employed parents. Compared to fathers, mothers were on average 2 years younger, had higher education and higher rates of active commuting to work (Table 1). Families with both parents employed also showed higher rates of active commuting in mothers (50.6%) in comparison to fathers (40.9%).

Table 1. Socio-demographic characteristics of children and parents.

Variables	Children (n=463)			
Age (years) (mean \pm SD)	10.6 \pm .9			
Distance to school (meters) (mean \pm SD)	750.4 \pm 529.3			
Gender[n(%)]				
Male	234 (50.5%)			
Female	229 (49.5%)			
Type of school [n(%)]				
State school	256 (55.3%)			
State-integrated school	207 (44.7%)			
Mode of commuting [n(%)]				
Active	332 (71.7%)			
Passive	131 (28.3%)			
	Mother (n=463)	Father (n=463)		p-value
Age (years) (mean \pm SD)	43.16 \pm 4.69	45.59 \pm 5.23		.044
Education[n(%)]				
None	5 (1.1%)	10 (2.2%)		
Primary school	56 (12.1%)	91 (19.7%)		
Secondary school	63 (13.6%)	78 (16.8%)		
Professional training	59 (12.7%)	100 (21.6%)		
University	280 (60.5%)	184 (39.7%)		<.001
Employed [n(%)]	388 (83.8%)	444 (95.9%)		.121
Mode of commuting to work [n(%)]				
Active	235(50.8)	187(40.4)		
Passive	228(49.2)	276(59.6)		<.001

Table 2. Parental perceived barriers to active commuting to school.

Barriers	Mothers		Fathers		p-value
	Average (mean ± SD)	Agree [n(%)]	Average (mean ± SD)	Agree [n(%)]	
Perceived distance					
There is a long distance from home to school	1.9±1.2	137 (29.6)	1.9 ±1.2	132(28.7)	.384
It takes a long time to go from home to school	1.7 ±1.1	112 (24.2)	1.7±1.1	110 (23.8)	.539
Traffic					
There is heavy traffic in the route to school	2.6 ±1.1	150 (54)	2.5 ±1.1	233(50.3)	.645
Car's speed is too high in the route to school	2.5 ±1.1	232 (50.1)	2.4 ±1.1	134 (48.2)	.693
Pedestrian and cycling infrastructure					
There are no sidewalks or they are in poor conditions	1.6 ±1.0	80 (17.3)	1.7 ±1.0	97 (21)	.079
There are no bicycle lanes or they are in poor conditions	2.8 ±1.3	287 (62)	2.8 ±1.3	283 (41.1)	.701
There is no place to leave the bicycle	2.3±1.2	205 (44.3)	2.4 ±1.3	212 (45.8)	.753
Safety					
Lack of safety in intersections and crossings	2.8 ±1.1	188 (62.2)	2.6±1.1	260 (56.2)	.749
There are no policemen at the road crossings	2.8 ±1.1	204(65.7)	2.6 ±1.2	259(55.9)	.009
There is violence or crime in the area	1.4 ±0.8	48 (10.4)	1.4 ±0.9	52 (11.2)	.341
Convenience					
My child has activities before and/or after school which difficulty ACS.	2.1±1.1	179 (38.7)	2.2 ±1.1	183 (39.5)	.949
It is more convenient to drive than to accompany him/her on foot	1.6 ±1.0	88 (19)	1.6 ±1.0	95 (18.4)	.944
It is more convenient to drive than to accompany him/her by bicycle	1.9±1.2	149 (32.2)	1.9 ±1.2	140 (30.2)	.304
Companionship					
There are no adults who can walk my child to school on foot	1.7±1.1	109 (23.5)	1.8 ±1.1	119 (25.7)	.672
There are no other kids with whom my child can go on foot.	2.1 ±1.2	161 (34.8)	2.1 ±1.2	156 (33.7)	.990
There are no other parents who bring their children on foot.	1.7 ±1.1	105 (22.7)	1.7 ±1.0	104 (22.5)	.437
There are no adults who can walk my child to school by bicycle	2.5 ±1.3	229 (49.5)	2.4 ±1.3	224 (48.4)	.088
There are no other kids with whom my child can go by bicycle.	2.7 ±1.2	269 (58.1)	2.7 ±1.2	269 (58.1)	.761
There are no other parents who bring their children by bicycle	2.5 ±1.2	246 (53.1)	2.5±1.2	246 (53.1)	.268
Logistic requirements					
My child carry a lot of weight into his/her school bag.	3.00 ±1.1	225 (70.2)	2.9 ±1.1	318 (68.7)	.780
Child's interest in walking/cycling					
It is boring for my child to go on foot.	1.3±0.7	32 (6.9)	1.3 ±0.7	38 (8.2)	.102
It is boring for my child to go by bicycle.	1.5±0.9	55 (11.9)	1.4±0.8	55 (11.9)	.199
Weather					
Bad weather (cold, rain, heat...)	1.8±1.0	123 (26.6)	1.9±0.9	123(26.6)	.367

Perceived barriers for fathers and mothers are displayed in Table 2. The most common barrier to ACS reported by over two thirds mothers and fathers was concern about the weight of the school bag. Over half of parents reported the lack of sidewalks or their poor conditions, the lack of policemen at the road crossings, traffic volume, traffic speed and the lack of other children or adults cycling to school as a barrier to ACS for their child. Compared to fathers, mothers reported statistically significant higher rate of concern regarding the lack of a policeman at the road crossings as a barrier to ACS in children. No other statistically significant differences between fathers' and mothers' perceived barriers to ACS were observed.

The results of the binary logistic regression analysis conducted for mothers and fathers separately showed that for both parents a positive correlate of child's ACS was active commuting of parents to their work whereas negative correlates were distance from home to school and parental perception of convenience of driving rather than walking their child to school (Table 3). In addition, for mothers only, mothers' perceptions of child's extra-curricular activities organization before or after school were positively related to child's ACS whereas mothers' perception that it is boring for their child to walk to school was a negative correlate of ACS in children. Mothers' and fathers' models explained approximately half of the variance in children's ACS ($R^2 = .52$ and $R^2 = .49$, respectively).

To account for the effect of distance on ACS behaviours, ROC curve analysis was conducted to determine the threshold distance for ACS in the study sample. The threshold distance was 775 meters (area under the curve: .855; $p < .001$). Overall, 293 children (63.3%) lived within this threshold ACS distance to school (51% boys, 89% active commuters, 72.4% students from state schools). When binary logistic regression analysis was repeated in this subsample, only distance from home to school and parental perceptions of convenience to drive their child to school remained statistically significant as negative correlates of ACS in children whereas parental active commuting to work remained as a statistically significant positive correlate in both mothers' (OR (odds ratio): 10.03) and fathers' (OR: 3.26) models (Table 4).

Table 3. Correlates of active commuting to school in children from mothers' and fathers' perspectives in the total sample (n=463).

Variable	Mother				Father			
	B	SE	p-value	Exp (B)	B	SE	p-value	Exp (B)
Child's age	.14	.26	.583	1.154	.229	.226	.310	1.258
Sex (Ref.: girls)	-.63	.44	.157	.534	-.588	.377	.119	.555
Distance from home to school	-.00	.00	.000	.996	-.003	.001	.000	.997
Type of school (Ref.: state school)	-.13	.54	.803	.874	-.062	.425	.884	.940
Mother's/Father's age	.01	.05	.789	1.014	.084	.041	.041	1.087
Mother's/Father's mode of commuting to work (Ref.: Passive commuter)	1.76	.48	.000	5.828	1.683	.439	.000	5.383
There is a long distance from home to school	.22	.33	.507	1.242	.193	.307	.529	1.213
There is heavy traffic in the route to school	.17	.30	.581	1.181	.107	.255	.675	1.113
My child has activities before and/or after school which makes ACS difficult.	.49	.23	.033	1.635	-.015	.180	.935	.985
Car's speed is too high in the route to school	-.27	.33	.421	.765	.028	.272	.919	1.028
It takes a long time to go from home to school	.32	.38	.401	1.379	.033	.321	.918	1.034
Lack of safety in intersections and crossings	-.17	.29	.559	.844	-.212	.221	.338	.809
There are no policemen at the road crossings	.01	.27	.960	1.014				
Bad weather (cold, rain, heat...)	-.49	.26	.053	.610	-.095	.227	.675	.909
My child carry a lot of weight into his/her school bag.	-.05	.22	.811	.949	-.268	.187	.152	.765
It is more convenient to drive than to accompany him/her on foot	-1.31	.27	.000	.271	-.859	.244	.000	.424
There are no adults who can walk my child to school on foot	.11	.22	.610	.895	-.099	.187	.598	.906
There are no other kids with whom my child can go on foot.	-.32	.23	.168	.727	.053	.208	.799	1.054
It is boring for my child to go on foot.	-.58	.34	.050	.560	-.195	.280	.486	.823
There are no other parents who bring their children on foot	.50	.26	.054	1.647	.141	.229	.539	1.152
It is more convenient to drive than to accompany him/her by bicycle	-.06	.23	.792	.940	-.078	.198	.693	.925
There are no adults who can walk my child to school by bicycle	-.29	.20	.148	.746	-.315	.181	.082	.729
There are no other kids with whom my child can go by bicycle.	.15	.22	.490	1.164	.090	.196	.647	1.094
There are no other parents who bring their children by bicycle	.11	.22	.621	1.113	.096	.191	.616	1.101

Note: Only significant bivariate correlates were included into the analysis. Although children's age and sex were not statistically significant, they were included in the multivariate models. Percentages of explained variance: $R^2 = .52$ in mother's model. $R^2 = .49$ in father's model.

Table 4. Correlates of active commuting to school in children based on mothers' and fathers' perspective in families living within the threshold active commuting distance to school (n=293).

Variable	Mother				Father			
	B	SE	p-value	Exp (B)	B	SE	p-value	Exp (B)
Child's age	.098	.319	.760	1.102	.41	.263	.119	1.506
Sex (Ref.: girls)	-.374	.583	.522	.688	-0.285	.464	.539	.752
Distance from home to school	-.005	.002	.009	.995	-.003	.001	.016	.997
Mother's/Father's mode of commuting to work (Ref.: Passive commuter)	2.306	.68	.001	10.03	1.182	.524	.024	3.262
Car's speed is too high in the route to school	-.396	.301	.189	.673				
Lack of safety in intersections and crossings	-.031	.317	.923	.97				
Bad weather (cold, rain, heat...)	-.044	.329	.894	.957				
His/her child carry a lot of weight into his/her school bag.	-.487	.353	.168	.614				
It is more convenient to drive than to accompany him/her on foot	-1.269	.362	.000	.281	-1.006	.343	.003	.366
There are no adults who can walk my child to school on foot	.057	.309	.854	1.059	-.038	.252	.88	.963
There are no other kids with whom my child can go on foot.	-.083	.257	.746	.92				
It is boring for my child to go on foot.	-.502	.462	.277	.605				
It is more convenient to drive than to accompany him/her by bicycle	.005	.286	.986	1.005	.214	.269	.426	1.239
There are no adults who can walk my child to school by bicycle	-.377	.268	.159	.686	-.33	.203	.104	.719
There is no place to leave the bicycle	-.222	.25	.375	.801				

Note: Only significant bivariate correlates were included into the analysis. Although children's age and sex were not statistically significant, they were included in the multivariate models. Percentages of explained variance: $R^2 = .29$ in mother's model. $R^2 = .14$ in father's model.

4. Discussion

This study compared mothers' and fathers' barriers to ACS in a sample of Spanish children. Main findings showed that: (a) although some barriers to children's ACS were similar for both parents (distance from home to school, perception of convenience of driving children to school and parental mode of commuting to work), other perceived barriers were specific for mothers (perceptions of child's extra-curricular activities organization and the children's lack of interest in walking to school) in the total study sample; (b) when the barriers to ACS were analysed in families living within the walking distance to school (775 meters in this sample), distance from home to school and perception of convenience of driving emerged as significant negative correlates whereas parental active mode of commuting to work positively correlated with children's ACS from both mothers' and fathers' perspective and gender differences in parental barriers to ACS were not present.

Three main barriers to ACS identified by both mothers and fathers in this study included distance to school, mode of parental commute to work and parental perceptions of the convenience of driving their child to school. Distance from home to school is the strongest predictor of ACS in children and has been reported as one of the most frequent and influential environmental barriers to ACS in children in multiple countries (Lu et al., 2014; Rodriguez & Vogt, 2009; Timperio et al., 2006). The shorter the distance between home to school, the more likely a child is to use ACS (Galvez et al., 2010; Napier et al., 2011). Our findings are consistent with those studies and other recent studies conducted in other cities in Spain where greater distances were associated with lower rates of ACS (Huertas-Delgado et al., 2017; Villa-González et al., 2012). Hence, distance from home to school, and consequently school location, should be considered as a key point in terms of policy implications (Tester, 2009; Voorhees et al., 2010). It should be noted that Spanish local educative policy allows parents to choose any school in their city, with no obligation to be enrolled into the closest school. As reported in previous studies, the presence of school choice has significant implications not only for ACS (Mandic et al., 2017b), but also for education, health and sustainability (Mandic et al., 2017c). Feasibility of ACS should be considered as one of the main arguments for school location decisions (Tester, 2009). Education policies should also consider the wide range of both positive and negative implications of school choice that extend beyond education (Mandic et al., 2017c).

In the present study children's ACS was significantly associated with mothers' and fathers' mode of commuting to work, which seems to be consistent with previous studies (Henne et al., 2014). Although to our knowledge there are only a few studies which have analyzed associations between parental and children daily modes of commuting (Henne et al., 2014, Susilo& Liu, 2015), from an organizational familiar perspective the findings from the current study are not surprising. Parental modelling of active travel has been positively associated with ACS in adolescents of 12 to 15 years old (Carlson et al., 2014). In addition, parental active modes of commuting has been highly correlated with the children's active travel mode on a daily basis (Susilo& Liu, 2015). Active transport to school could be understood as a type of logistic support provided by parents, which, in turn, has been positively associated with higher levels of PA in children (Jago et al., 2011). This positive association between parental mode of commuting to work and children's ACS is also indirectly supported by other studies in which parental attitudes towards active transport and regular walking behaviour were positively associated with ACS in children (Lee et al., 2013; Zhu et al., 2009). In the present study children living within the walking distance to school and whose mothers used an active mode of commuting to work had 10 times higher odds to ACS. Other studies have shown that mothers usually offer high levels of logistic support, often higher than fathers(Davison et al., 2003). Therefore, it is possible that we found 10 times higher odds to ACS because in Spain it is mothers who in most cases accompany their children on the way to school. This explanation cannot be corroborated with our results, so further research is needed. However, these findings need to be interpreted with caution given the small city size.

Parental perception of driving being more convenient than walking their children to school emerged as a significant perceived barrier to ACS from both mothers' and fathers' perspective and was associated with a lower likelihood of children's ACS in this study. Previous studies have also reported convenience of driving children to school as a major parental barrier to children's ACS in general (Faulkner et al., 2010; MacDonald & Aalborg, 2009) as well as specifically for walking (Panter et al., 2010) and cycling to school (Trapp et al., 2011). A recent study also reported that more than half of adolescents reported convenience of being driven to school as a barrier to ACS (Mandic et al 2017a). Therefore, parental perceptions of convenience of driving their children to school may also influence children's preferences for different modes of

travel to school later in life. One review stated that convenience of car travel may be related to cultural influences as well as structural factors (Lorenc et al., 2008). For instance, the need of busy-time families to fulfil demanding scheduling commitments in children's afternoon may be one reason for the convenience of car use (Trapp et al., 2011). However, in our study, mothers' perception of extra-curricular activities organization showed an unexpected positive association with ACS in children. The small size of the city and the recent pedestrianisation process that occurred in the last few years in the city centre (0.32 km² pedestrianised; 7.6% of urbanised area) could explain this result (Mäki-Opas et al., 2016). Pedestrian areas may improve accessibility to facilities, making easier for mothers to fulfil children's commitments on foot rather than using a private car. Nevertheless, a multitude of factors related to family structure, decision-making and lifestyle choices could influence parental perception of convenience (Trapp et al., 2011). Therefore, parental perception of the convenience of driving children to school is a complex concept that should be further studied from a qualitative perspective to create better understanding of the underlying characteristics and to design future interventions to minimize the convenience of driving as one of the parental barriers to children's ACS.

In the present study, organization related to children's extra-curricular activities before and after school was a positive correlate of ACS from mothers' perspective. This finding needs to be further examined taking into consideration gender differences in child care responsibilities (Roeters & Gracia, 2016). Previous studies have shown that, compared to fathers, mothers were disproportionately more engaged in routine child care (Chesley & Flood, 2017, Offer, 2014), using the car to manage complex daily routines and to implement notions of what constitutes being a good mother (Dowling, 2000). Our findings seem to indicate that mothers also play a key role in children's commuting to school behaviours, which could contribute to further understanding of the subtle dimensions of the unequal division of childcare by gender (Offer, 2014). However, it is important to note that significant correlates of children's ACS from mothers' and fathers' were similar for both parents and did not include extra-curricular activities when analysed in the sample of families that lived within a walkable distance to school. Therefore, interventions programs to promote ACS should consider the key role of mothers and be based on family-friendly strategies that address promotion of ACS from a gender equality perspective, especially when designing interventions for children

living further away from school (Roeters&Gracia, 2016). For instance, following a participatory approach, parental child care workshops could be organised to discuss about how they could manage their child care time to ACS as much as possible.

The major strength of this study is the high school participation rate in one city (11 out of 12 schools; 92%) and the approach followed to analyze the influence of parental barriers on ACS in children considering mothers' and fathers' perspectives independently. Nevertheless, this study has several limitations including common limitations related to self-reported data and limited reliability of items used to assess mothers' and fathers' perceived barriers to ACS (MacDonald et al., 2011). In addition, our sample included only participants with both parents living in the same household. Therefore, our findings may not be generalizable to other family contexts (with divorced, separated, or single parents) that are more and more common nowadays. Moreover, we cannot exclude a possibility that mother and father completed the questionnaire together which could influence the reported results. Finally, these findings may not be generalizable to other urban or rural areas in Spain or internationally. Therefore, further research in other different urban and rural contexts is warranted.

5. Conclusions

This study contributes to a deeper understanding of the specific correlates of mothers' and fathers' perspectives on ACS in children. The present study reveals that from both mothers' and fathers' perspective the negative correlates of children's ACS were distance from home to school and parental perception of the convenience of driving their child to school whereas a positive correlate was parental active commuting to work behaviours. In addition, mothers-specific correlates of ACS included a positive association with children's extra-curricular activities organization and a negative association with the lack of child's interest in walking to school. However, gender differences in parental perceptions were not present among families living within a walking distance to school.

These findings reinforce the idea that the design of future interventions for promoting ACS in children should consider the specific influence of fathers and mothers and be based on family-friendly strategies which respect a gender equality perspective. Addressing built and social environmental factors that affects mothers' and fathers'

perspective might directly contribute to increase rates of ACT in children. Finally, due to the fact that parents' cognitive, behavioural and affective responses to children's behaviour seem to be cross-culturally different (Bornstein et al., 2011), further research is warranted in order to investigate whether mothers' and fathers' perspective on barriers to ACS in children are different in different geographical and cultural contexts.

Highlights (85 characters)

- Distance and convenience of driving were negative barriers for both parents.
- Parental active commuting to work was a positive correlate for both parents.
- Extra-curricular activities and child's interest were mothers-specific correlates.
- No gender differences in correlates for families living within a walking distance.
- Promoting strategies should be respect a parental gender equality perspective.

Acknowledgements

We would like to thank the help of all children who took part in this study as well as their parents and teachers for their collaboration.

Funding sources

This study was financially co-funded up to 65% by the European Funding to regional development (FEDER) through Interreg V-A Spain, France, Andorra (POCTEFA 2014-2020). Funding was complemented by the University of Zaragoza (Spain).

Conflicts of interest

No conflicts of interest.

References

Andersen, L.B., 2017. Active commuting is beneficial for health. *BMJ*. 357, 1740-1742.doi: 10.1136/bmj.j1740

Beige, S., &Axhausen, K.W., 2012. Interdependencies between turning points in life and long-term mobility decisions. *Transportation*. 39, 857–872. DOI 10.1007/s11116-012-9404-y

Bois J.E., Sarrazin P.G., Brustad R.J., Trouilloud D.O., Cury F., 2005. Elementary schoolchildren's perceived competence and physical activity involvement: the influence of parents' role modelling behaviours and perceptions of their child's competence. *Psychol. Sport. Exerc.* 6, 381–397.<https://doi.org/10.1016/j.psychsport.2004.03.003>

Bornstein M.H., Putnick D.L., & Lansford J.E., 2011. Parenting Attributions and Attitudes in Cross-Cultural Perspective. *Parent. Sci. Pract.* 11(2-3), 214–237.[doi:10.1080/15295192.2011.585568](https://doi.org/10.1080/15295192.2011.585568)

Buliung, R.N., Mitra R., & Faulkner G., 2009. Active school transportation in the Greater Toronto Area, Canada: An exploration of trends in space and time (1986–2006). *Prev. Med.* 48, 507–512.[doi:10.1016/j.ypmed.2009.03.001](https://doi.org/10.1016/j.ypmed.2009.03.001)

Carlson, J.A., Sallis, J.F., Kerr, J., Conway, T.L., Cain, K., Frank, L.D., & Saelens, B.E., 2014. Built environment characteristics and parent active transportation are associated with active travel to school in youth age 12-15. *Br. J. Sports. Med.* 48(22), 1634-1639.[doi:10.1136/bjsports-2013-093101](https://doi.org/10.1136/bjsports-2013-093101)

Carver, A., Timperio, A., Hesketh, K., & Crawford, D., 2010. Are children and adolescents less active if parents restrict their physical activity and active transport due to perceived risk?. *Soc. Sci. Med.* 70, 1799-1805.[doi:10.1016/j.socscimed.2010.02.010](https://doi.org/10.1016/j.socscimed.2010.02.010)

Chaufan, C., Yeh, J., Fox, P., 2012. The Safe Routes to School Program in California: An Update. *Am. J. Public Health.* 102, 8–11.

Chillón, P., Martínez-Gómez, D., Ortega, F.B., Pérez-López, I.J., Díaz, L.E., Veses, A.M., Veiga, O.L., Marcos, A., & Delgado-Fernández, M., 2013. Six-year trend in active commuting to school in Spanish adolescents. The AVENA and AFINOS Studies. *Int. J. Behav. Med.* 20, 529–37.[doi: 10.1007/s12529-012-9267-9](https://doi.org/10.1007/s12529-012-9267-9).

Chillón, P., Herrador-Colmenero, M., Migueles, J. H., Cabanas-Sánchez, V., Fernández-Santos, J. R., Veiga, Ó. L., ... Group, O. behalf of the U. S., 2017. Convergent validation of a questionnaire to assess the mode and frequency of commuting to and from school. *Scand. J. Public Health.* 45, 612-620.[DOI: 10.1177/1403494817718905](https://doi.org/10.1177/1403494817718905)

Cooper, A.R., Wedderkopp, N., Wang, H., Andersen, L.B., Froberg, K., Page, A.S., 2006. Active travel to school and cardiovascular fitness in Danish children and adolescents. *Med. Sci. Sports. Exerc.* 38(10), 1724-31. DOI: 10.1249/01.mss.0000229570.02037.1d

Currie, C., Molcho, M., Boyce, W., Holstein, B., Torsheim, T., & Richter, M., 2008. Researching health inequalities in adolescents: The development of the Health Behaviour in School-Aged Children (HBSC) Family Affluence Scale. *Soc. Sci. Med.* 66, 1429-1436. doi: 10.1016/j.socscimed.2007.11.024.

Davison, K.K., Cutting, T.M., & Birch L.L., 2003. Parents' Activity-Related Parenting Practices Predict Girls' Physical Activity. *Med. Sci. Sports Exerc.* 35(9), 1589-95. DOI:10.1249/01.MSS.0000084524.19408.0C

Davison, K.K., Werder, J.L., Lawson, C.T., 2008. Children's active commuting to school: current knowledge and future directions. *Prev. Chronic. Dis.* 5(3), 1-11.

Dowling, R., 2000. "Cultures of Mothering and Car Use in Suburban Sydney: A Preliminary Investigation." *Geoforum.* 31(3), 345-353.

Edwardson, C.L., & Gorely, T., 2010. Parental influences on different types and intensities of physical activity in youth: A systematic review. *Psychol. Sport Exerc.* 11, 522-535. <https://doi.org/10.1016/j.psychsport.2010.05.001>

Ekelund, U., Luan, J., Sherar, L.B., Eslinger, D.W., Griew, P., Cooper, A., & International Children's Accelerometry Database (ICAD) Collaborators, 2012. Moderate to vigorous physical activity and sedentary time and cardiometabolic risk factors in children and adolescents. *JAMA.* 307, 704-12. doi: 10.1001/jama.2012.156.

Faulkner, G.E.J., Buliung, R.N., Flora, P.K., Fusco, C., 2009. Active school transport, physical activity levels and body weight of children and youth: A systematic review. *Prev. Med.* 48, 3-8. doi:10.1016/j.ypmed.2008.10.017

Faulkner, G.E.J, Richichi, V., Buliung, R.N., Fusco, C., Moola, F., 2010. What's "quickest and easiest?": parental decision making about school trip mode. *Int. J. Behav. Nutr. Phys. Act.* 7, 62-73.

Galvez, M.P., Pearl, M., & Yen, I.H., 2010. Childhood obesity and the built environment: A review of the literature from 2008-2009. *Curr. Opin. Pediatr.* 22(2), 202-207. doi: 10.1097/MOP.0b013e328336eb6f

Grize, L., Bringolf-Isler, B., Martin, E., & Braun-Fahrländer, C., 2010. Trend in active transportation to school among Swiss school children and its associated factors: three cross-sectional surveys 1994, 2000 and 2005. *Int. J. Behav. Nutr. Phys. Act.* 7, 28-36.

Henne, H.M., Pooja, S., Tandon, M.D., Larry, D.F., & Saelens, B.E., 2014. Parental Factors in Children's Active Transport to School. *Public Health.* 128(7), 643–646. doi:10.1016/j.puhe.2014.05.004.

Huertas-Delgado, F.J., Herrador-Colmenero, M., Villa-González, E., Aranda-Balboa, M.J., Cáceres, M.V., Mandic, S., & Chillón, P., 2017. Parental perceptions of barriers to active commuting to school in Spanish children and adolescents. *Eur. J. Public Health.* 1–6. doi:10.1093/eurpub/ckw249

Jago, R., Davison, K.K., Brockman, R., Page, A.S., Thompson, J.L., & Fox, K.R., 2011. Parenting styles, parenting practices, and physical activity in 10- to 11-year olds. *Prev. Med.* 52, 44–47. doi:10.1016/j.ypmed.2010.11.001

Lake, A.A., & Townshend, T.G., 2013. Exploring the built environment, physical activity and related behaviours of young people attending school, college and those not in employment. *J. Public. Health.* 35, 57–66. doi: 10.1093/pubmed/fds059

Lee, C., Zhu, X., Yoon, Y., & Varni, J., 2013. Beyond distance: children's school travelmode choice. *Ann. Behav. Med.* 45(1), 55–67. DOI 10.1007/s12160-012-9432-z

Lorenc, T., Brunton, G., Oliver, S., Oliver, K., & Oakley, A., 2008. Attitudes to walking and cycling among children, young people and parents: a systematic review. *J. Epidemiol. Community Health.* 62, 852-7. doi:10.1136/jech.2007.070250

Lu W., McKyer, E.L.J., Lee, C., Goodson, P., Ory, M.G., & Wang, S., 2014. Perceived barriers to children's active commuting to school: a systematic review of empirical, methodological and theoretical evidence. *Int. J. Behav. Nutr. Phys. Act.* 11, 140-160. doi: 10.1186/s12966-014-0140-x.

Mäki-Opas, T.E., Borodulin, K., Valkeinen, H., Stenholm, S., Kunst, A.E., Abel, T., Härkänen, T., Kopperoinen, L., Ikonen, P., Prättälä, R., Karvonen, S., & Koskinen, S., 2016. The contribution of travel-related urban zones, cycling and pedestrian networks and green space to commuting physical activity among adults - a cross-sectional population-based study using geographical information systems. *BMC*. 16(1), 760-773. DOI 10.1186/s12889-016-3264-x

Mah, S.K., Nettlefold, L., Macdonald, H.M., Winters, M., Race, D., Voss, C., & McKay, H.A. 2017. Does parental support influence children's active school travel?. *Prev. Med. Rep.* 6, 346-351. <http://dx.doi.org/10.1016/j.pmedr.2017.04.008>

Mandic, S., Hopkins, D., García Bengoechea, E., Flaherty, C., Williams, J., Sloane, L., Moore, A., Spence, J.C., 2017a. Adolescents' perceptions of cycling versus walking to school: Understanding the New Zealand context. *Journal of Transport & Health*. 4, 294-304. DOI: <http://dx.doi.org/10.1016/j.jth.2016.10.007>

Mandic, S., Sandretto, S., García Bengoechea, E., Hopkins, D., Moore, A., Rodda, J., Wilson, G., 2017b. Enrolling in the closest school or not? Implications of school choice decisions for active transport to school. *J. Transp. Health*. 6, 347-357 DOI: <https://doi.org/10.1016/j.jth.2017.05.006>

Mandic, S., Sandretto, S., Hopkins, D., Wilson, G., Moore, A., & García Bengoechea, E., 2017c. "I wanted to go here": Adolescents' perspectives on school choice. *J. Sch. Choice*. (in press; Epub: 17 Oct 2017) DOI 10.1080/15582159.2017.1381543

McDonald, N.C., Dwelley, A.E., Combs, T.S, Evenson, K.R., & Winters, R.H., 2011. Reliability and validity of the Safe Routes to school parent and student surveys. *Int. J. Behav. Nutr. Phys. Act.* 8, 56-64. <https://doi.org/10.1186/1479-5868-8-56>

Nieuwenhuijsen, M.J., & Khreis, H., 2016. Car free cities: Pathway to healthy urban living. *Environ. Int.* 94, 251–262. <http://dx.doi.org/10.1016/j.envint.2016.05.032>

McDonald, N.C., 2007. Active transportation to school. Trends among U.S. schoolchildren, 1969-2001. *Am. J. Prev. Med.* 32, 509–16. doi:10.1016/j.amepre.2007.02.022

McDonald, N.C., & Aalborg, A.E., 2009. Why parents drive children to school: Implications for safe routes to school programs. *J. Am. Plann. Assoc.* 75, 331-342. DOI: 10.1080/01944360902988794

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, 678–687. doi:10.1016/j.healthplace.2005.09.003

Metz, C.E., 1978. Basic principles of ROC analysis. *Semin. Nucl. Med.* 8, 283–298.

Napier, M.A., Werner, C., Brown, B., & Gallimore, J., 2011. Walking to school: Community design and child and parent barriers. *J. Environ. Psychol.* 31(1), 45-51. <https://doi.org/10.1016/j.jenvp.2010.04.005>

Offer S., 2014. Time with children and employed parents' emotional wellbeing. *Social Science Research*. 47, 192–203. <http://dx.doi.org/10.1016/j.ssresearch.2014.05.003>

Panter, J.R., Jones, A.P., van Sluijs, E.M., & Griffin, S.J., 2010. Attitudes, social support and environmental perceptions as predictors of active commuting behaviour in school children. *J. Epidemiol. Community Health*. 64, 8-9. doi:10.1136/jech.2009.086918.

Pont, K., Ziviani, J., Wadley, D., Bennett, S., & Abbott, R., 2009. Environmental correlates of children's active transportation: A systematic literature review. *Health Place*. 15, 849–862. doi:10.1016/j.healthplace.2009.02.002

Pavelka, J., Sigmundová, D., Hamřík, Z., Kalman, M., Sigmund, E., & Mathisen, F., 2017. Trends in active commuting to school among Czech school children from 2006 to 2014. *Cent. Eur. J. Public. Health*. 25, S21–S25. <https://doi.org/10.21101/cejph.a5095>

Pabayo, R., Maximova, K., Spence, J.C., Ploeg, K.V., Wu, B., & Veugelers, P., 2012. The importance of Active Transportation to and from school for daily physical activity 2 among children. *Prev. Med.* 55(3), 196-200. doi:10.1016/j.ypmed.2012.06.008

Rabl, A., & de Nazelle A., 2012. Benefits of shift from car to active transport. *Transport Policy*. 19, 121–31. doi:10.1016/j.tranpol.2011.09.008

Rodriguez, A., & Vogt, C.A., 2009. Demographic, environmental, access, and attitude factors that influence walking to school by elementary school-aged children. *J. Sch. Health.* 79(6), 255–261. doi: 10.1111/j.1746-1561.2009.00407.x.

Roeters, A., & Gracia, P., 2016. Child Care Time, Parents' Well-Being, and Gender: Evidence from the American Time Use Survey. *J. Child. Fam. Stud.* 25, 2469–2479. DOI 10.1007/s10826-016-0416-7.

Schisterman, E.F., Perkins, N.J., Liu, A., & Bondell, H., 2005. Optimal cut-point and its corresponding Youden Index to discriminate individuals using pooled blood samples. *Epidemiology.* 16, 73–81.

Susilo, Y.O., & Liu, C., 2015. The influence of parents' travel patterns, perceptions and residential self-selectivity to their children travel mode shares, *Transportation.* 43, 357-378. DOI 10.1007/s11116-015-9579-0

Tester, J.M., 2009. The built environment: designing communities to promote physical activity in children. *Pediatrics.* 123, 1591–1598. doi: 10.1542/peds.2009-0750.

Timperio, A., Ball, K., Salmon, J., Roberts, R., & Giles-Corti, B., Simmons, D., Baur, L.A., Crawford, D., 2006. Personal, Family, Social, and Environmental Correlates of Active Commuting to School. *Am. J. Prev. Med.* 30(1), 45-51. doi:10.1016/j.amepre.2005.08.047

Trapp, G.S.A., Giles-Corti, B., Christian, H.E., Bulsara, M., Timperio, A.F., McCormack, G.R., & Villaneuva, K.P., 2011. On your bike! a cross-sectional study of the individual, social and environmental correlates of cycling to school. *Int. J. Behav. Nutr. Phys. Act.* 8, 123-132. doi: 10.1186/1479-5868-8-123.

Villa-González, E., Rodríguez-López, C., Huertas Delgado, F.J., Tercedor, P., Ruiz, J.R., Chillón, P., 2012. Factores personales y ambientales asociados con el desplazamiento activo al colegio de los escolares españoles. *Rev. Psicol. del Deport.* 21, 343–9.

Voorhees, C.C, Ashwood, J.S., Evenson, K.R., Sirard, J.R., Rung, A.L., Dowda, M., & McKenzie, T.L., 2010. Neighborhood Design and Perceptions: Relationship with

Active Commuting. *Med. Sci. Sports. Exerc.* 42(7), 1253–1260.doi:
10.1249/MSS.0b013e3181cd5dfd

Zhu, X., & Lee, C., 2009. Correlates of walking to school and implications for public policies: survey results from parents of elementary school children in Austin, Texas. *J. Public Health Policy.* 30, S177–S202.doi: 10.1057/jphp.2008.51.