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# Implications of school type for active commuting to school in primary education students

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ABSTRACT

School choice has implications for school travel as it allows students to attend schools that are further away from their residence than their neighborhood schools. The aim was to study the implications of school choice (i.e., private or public) for active commuting to school (ACS). Differences on ACS, parental attitudes, socio-economic status (SES) and CO2 emissions with respect to the type of school and the threshold distance to ACS were analyzed. The influence of distance, parents' attitudes, and family socioeconomic status, in the frequency of ACS by type of school were also analyzed. All students aged 9 to 11 years old, from eleven public or private primary education schools in Huesca (Spain), and their parents (i.e., mother and father, separately), participated in this study. The results show differences among students, who live above the threshold distance and attend public and private schools, in terms of frequency of ACS, mothers' attitudes, and SES. CO2 emissions were higher in the area around private schools than public schools, regardless of the threshold distance. Effects of school choice on weekly frequency of ACS behavior appear to be mostly explained by its connection with travel distance, SES and by mothers' attitudes, in students attending public schools. While, for private schools, the final model showed an influence of distance, mother's attitudes, and gender, on weekly frequency of ACS. This paper highlights how school choice can influence the mode of commuting to school, and some other related variables such as distance, mothers' attitudes, and CO2 emissions.

## 1. Introduction

More than 80% of the European population are expected to live in urban areas by 2030 (European Union, 2016). The growth model of European cities has been characterized by an expansion into peripheral areas (Jaraiz-Cabanillas et al., 2018), creating a decentralization of services (e.g., schools), changing mobility patterns (Dombriz, 2009; Pozueta and Gurovich, 2007), increasing the use of private vehicles for school travel (Ortúzar and Willumsen, 2008) and, consequently, reducing active transportation, such as walking or cycling (European Union, 2019; Gálvez-Fernández et al., 2020). This car reliance has led to negative impacts on the environment in several ways. For example, cars emit greenhouse gasses, such as carbon dioxide, which contribute to global warming (Van Ristell et al., 2013). A reduction in active commuting to school (ACS) patterns, has led to concerns over such environmental consequences as greenhouse gas emission, air and water pollution, and traffic congestion (Ewing, 2003; Ewing et al, 2004). Moreover, car reliance causes traffic congestion around schools and adverse health impacts related to less physical activity (PA) levels (Faulkner et al., 2009). The World Health Organization (WHO, 2016), recommends urban planners to encourage PA through the design of urban spaces, and to promote active transportation as a serious alternative to motorized options.

Several factors have been described as determinants of the decision to carry out ACS (Souza, et al., 2019). For instance, intra-individual factors including demographic and psycho-social factors (e.g., income, age, perception of competence, etc.), built and social/cultural environment (e.g., distance, neighborhood walkability, perceived safety, parents' attitudes, etc.), and the policy/regulatory environment (e.g., school planning or location, and zoning policies), are variables related to ACS. Some of these relevant variables (e.g., distance, traffic volume) should be considered in ACS promotion interventions (Chillón, et al., 2011). The probability of using motorized transport increases when travelling distance increases (Beck and Nguyen, 2017). However, an

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ecological perspective would suggest this relationship to be moderated by intra-individual, interpersonal or environmental factors (Garnham-Lee, et al., 2017), because several other factors, besides distance, have also been described as influential determinants regarding the decision to actively commute (Villa-Gonzalez et al., 2012). Further, some of these factors could be the result of decisions, such as, for instance, school location and school choice.

Habitually, children used to attend the school nearest to their homes (i.e., "neighborhood school"), but in different countries across the world, parents are allowed to choose any school for their children. (O"Shaughnessy, 2007). In Spain, the Ministry of Education and Vocational Training (*Ministerio de Educación y Formación Profesional* or MEFP) has overall responsibility for the country's education. However, seventeen autonomous regions have control over some decisions of their own education systems. National educational authorities have modified school choice policies over the last three decades, implementing two forms of school choice: a) an inter-district school choice or a unique educational zone (i.e., inter-district choice allows families to send their children to any public school in the district where they reside); and b) intra-district school or a zoning model (i.e., in intra-district open enrollment, families may choose to send their children to any type of school located within their resident school district). The Government of the region where this study was conducted (i.e., Community of Aragon) introduced the intra-district school choice policy (i.e., zoning model), where two models of school management (public and private) coexist. One of the defining characteristics of the schooling system in the Community of Aragon is its dual nature, consisting of a predominantly public sector provision, but with a substantial private sector. Public schools in Spain are open and lay centers, directly funded and managed by the central government and local administrations. However, private schools, within the limits established by law, have complete freedom of management. Enrollment limits and access are established by the private company that manages the center. Their funds depend exclusively on the contributions of the students' families.

The zoning model establishes a zonal structure in each municipality, and consequently, each of these zones or districts is assigned one public school and a private school if it exists in that area. Public schools are almost always within that zone, but it doesn't have to be that way for private schools (Decree-Law, 2016). This model allows families to freely choose a school (i.e., private or public). But, these school policies could influence children's transportation. School choice should be considered as a possible cause of longer journeys, and greater variation in transportation modes to and from school (Wilson et al., 2010; Yang et al., 2012).

Even so, within the Spanish state education system, children usually attend the school nearest to home (i.e., usually a public school) at both primary and secondary level. At primary level, the school is often within walking distance of home, while at secondary level, the nearest school may be some distance away, so pupils often travel to school on the school bus (Mayor, 2017).

Taken together, school choice has two different implications: a) education, and b) public health, transport and sustainability. Education is a key factor in enhancing equal opportunities, social mobility, and social cohesion. School choice will reduce the opportunities for students from different racial and socioeconomic backgrounds to interact and learn from each other. School choice is associated with higher levels of segregation of pupils from different socioeconomic and ethnic backgrounds between schools (Dronkers et al., 2010). From a public health, transport and sustainability perspective, can contribute to meeting physical activity guidelines, less congestion, and lower greenhouse gas emissions (Barnett, et al., 2019; Ewing, et al., 2004; McDonald, 2007; OECD, 2012).

The influence of school choice (public vs, private school) on ACS behavior occurs through two paths. First, it affects ACS via its connection with environmental factors, such as home-school distance (i.e., free school choice normally implies longer school commute distances because children attend schools anywhere in the district rather than in their neighborhood). Distance plays an important role in mode and frequency of ACS (i.e., long distances to school imply a low likelihood of adopting active transport practices) (Lee et al., 2008). Further, identifying the threshold distance below which young people are more likely to walk to school seems to be an important issue, because the walkable distance from home to school could be a context-specific variable to be considered (Chillón, et al., 2015). In other Spain context, the threshold distance to walk to school was 0.88 km for elementary school children (7–12 years old) (Rodríguez-Rodríguez et al., 2019). However, it is important identify the walkable distance from home to school in our specific context (e.g., our city, our neighborhood…) due to it could be also influenced by the urban planning and the cultural perception (Larouche et al., 2015). Second, school choice could affect parents' school travel decision-making process and may even influence their attitudes towards ACS (Yang et al., 2012). There is a growing body of evidence that parental attitudes are also critical determinants of children's school travel mode (Seraj, et al., 2012). Parents' negative perceptions of active travel, and neighborhood safety, strongly reduce the likelihood of their children participating in ACS (Mitra & Buliung, 2014). Specifically, when parents have more positive attitudes toward ACS, and negative attitudes toward car-use, they should be more likely to allow their children to walk or bike to school.

The available and limited empirical research suggests that school choice allows students to attend schools that are further away from their residences, resulting in longer travel distances, and a greater demand for motorized travel. (Yang, et al., 2012). But, this relationship between school choice and school travel cannot be completely explained only by the long travel distance, usually associated with free school choice (Wilson et al, 2010). Therefore, school choice policy is a possible cause of longer journeys and greater variation in transportation modes for journeys to school (Yang et al., 2012). Thus, there is a need to study how school choice could be affecting children's ACS in different contexts, as well as how it could be influenced by other closely-related variables. To our knowledge, this is the first study conducted in Spain on ACS in the light of school choice. This research adds a different perspective to current literature in terms of understanding the decline of active commuting, the increase in length of journeys, and some consequences (i.e., CO2 emissions) by linking travel distance and other related variables to school choice in Spanish primary education.

The aim was to study the implications of school choice (i.e., private or public) for ACS. More specifically, we examined if there were differences in ACS, parental attitudes towards ACS, family socioeconomic status (SES) and CO2 emissions by school type (i.e., public or private primary education schools) and threshold distance to school. Furthermore, we analyzed if the threshold distance, parental attitudes and family SES were associated with the frequency of ACS by the type of school.

## 2. Material and methods

### 2.1. Setting, participants and procedures

This study was conducted in the city of Huesca, a mid-sized city located in the north-east of Spain. It has 53,132 inhabitants and an urban area of 6.75 km2 (4.21 km2 without the industrial area), with a population density of 7,762.8 inhabitants/km2.

Prior to the start of the study, a meeting was held with all the principals of each of the city's schools, to explain and officially invite their schools to participate and collaborate in the study. From the twelve public and private primary schools in the city of Huesca (8 public and 4 private), eleven primary schools accepted to participate in this study (7 public and 4 private). After obtaining consent from the schools, all students aged 9 to 11 years old from all primary education schools and their parents (i.e., mother and father, separately), were invited to participate in this study. All parents (mothers and fathers) and children

were informed about the aims of the study, and about the anonymity conditions of the data compilation process, by invitational letter and initial meeting, respectively. Invitational letters, including an in-depth explanation of the study, were sent to parents, who gave their informed consent following opt-out or opt-in procedures based on the school's preference.

Data were collected from students and parents through self-reporting questionnaires. Students completed a questionnaire during class-time under the supervision of the research staff. It took 15–30 min to complete the questionnaire, depending on the children's age, and their reading and comprehension skills. Parents (i.e., mother and father, separately) completed the questionnaire at home, and then their children returned it to the respective schools. The study was approved by the Ethics Committee for Clinical Research of Aragon (CEICA) (Ethic code: C1P117/0018).

### 2.2. School zoning model

Educational authorities of Huesca have implemented an intra-district school zoning model comprising eight different zones (see Fig. 1). Every zone has been assigned to one public school (usually inside the geographical zone) and to one private school (sometimes outside the geographical zone), by default. Nevertheless, families who live in each zone do not have to compulsorily choose the assigned public or private school; they may freely choose any other school in the city. But, there are some priority criteria to allocate a school, including (from the highest to lowest score): a) attendance of siblings at the same school; b) proximity to family home (i.e., living within the school zone assigned); c) parents or guardians working in the school or proximity of the job place (i.e., within the school zone assigned); d) low socioeconomic status with special attention to large families; e) existence of students', parents' or siblings' disability. All public and private schools follow the same criteria. Each criterion has a score and each family should choose 4 schools in preference. Finally, a ranking is established where the total score obtained by each family is included. If the families' demand is greater than the supply of places, the families that are not allocated places are distributed among other schools in the order that they established in their application, also respecting the order provided by the assigned score (Decree-Law, 2016).

### 2.3. Variables

#### 2.3.1. Sociodemographic variables.

Sociodemographic variables (i.e., gender, age, school zip code, and home address), were self-reported. School type was used to classify students according to the type of school (i.e., public or private school).

The objective measure of the distance to school was estimated using Google Maps, selecting the shortest route on foot option and car option (i.e., only used for CO2 analysis) between the home address and the school's main entrance.

To calculate the specific coordinates of the family home and school addresses, the National Cartographic System webpage was used (see at http://www.cartociudad.es/portal/web/guest/calculos).

#### 2.3.2. Usual mode of commuting and ACS Frequency.

Similar to previous studies (Villa-González et al., 2016) the usual mode of commuting to/from school was assessed by asking the following questions: 'How do you usually commute from home to school?' and 'How do you usually commute from school to home?' The answer options were walking, cycling, by car, motorcycle, or bus. Walking and cycling were categorized as usual active transport modes whereas travelling by car, motorcycle or bus were categorized as usual passive transport modes. Accordingly, participants were categorized as: (1) usual active commuters (i.e., having usual active transport mode to and from school, or (2) usual passive commuters (i.e., less than two usual active transport modes).

Usual weekly frequency of ACS to and from school of the weekday period (Monday to Friday) was expressed as the number of active trips per week to and from school. Children self-reported all their weekly trips to and from school using a single item from a validated school travel questionnaire (Chillón, et al., 2017) for each travel day: "How do you commute to school on 'Mondays'?" and "How do you commute from school on 'Mondays'?", repeating this question for every weekday. The answer options were walking, cycling, by car, motorcycle, or bus. Walking and cycling were categorized as active trips. All weekly active trips were summed into a single variable ranging from 0 to 10.

#### 2.3.3. Socioeconomic status

Socioeconomic status (SES) was reported by parents using the Family Affluence Scale (FAS II) questionnaire for children (Currie, et al., 1997). FAS II included four items and they were answered by parents from their children's perspective: (1) Car: does your family own a car, van, or truck? (Codes: No = 0; One = 1; Two or more = 3); (2) Own bedroom: do you have your own bedroom for yourself? (Codes: No = 0; Yes = 1); (3) Vacation: during the past 12 months, how many times have you gone on vacation with your family? (Codes: Never = 0; Once = 1; Twice = 2; Three or more times = 3); and (4) Computers: how many computers does your family own? (Codes: None = 0; One = 1; Two = 2; Three or more = 3). Family affluence was calculated by the summation of answers into a scale from 0 to 9.

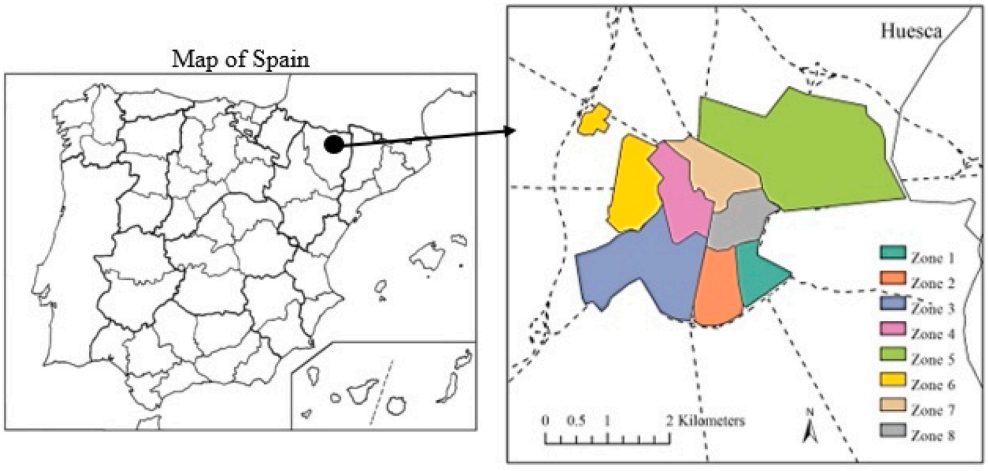


**Fig. 1.** Location of Huesca in Spain and distribution of school zones.

#### 2.3.4. Mother's and Father's attitudes

Based on previous studies investigating attitudinal factors in travel behavior (Mandic et al., 2016; Panter et al., 2010), we developed ten questions (see in Appendix 1) to assess parents' attitudes toward ACS (i.e., responsibility, convenience, and children skills). A five-point Likert-scale was used, ranking from 1 (strongly disagree) to 5 (strongly agree). There were 6 items that were reverse-coded (see in Appendix 1). The average score of the 10 items (ranging from 0 to 5) was calculated for mothers and fathers.

#### 2.3.5. Estimated CO2 emissions

Similar to previous studies (Singleton, 2014), CO2 emissions (kg/km) were estimated by multiplying the distance (i.e., shortest distance driving a car –kilometers– between home address and the school's main entrance) and frequency of passive trips (i.e., number of car trips) between locations. These total kilometers traveled by car were multiplied by the average CO2 (Kg of CO2/Km) attributed to specific modes of transport (i.e., car) according to The Guide To Low Carbon Lifestyles (Mitchell, 2007).

### 2.4. Statistical analysis

Percentages of usual active commuters and differences by gender, type of school and age in the usual mode of commuting for the total sample were tested using Chi-square test (i.e., gender and type of school) and t-student analysis (i.e., age).

Threshold distance for active commuting was calculated using the Receiver Operating Characteristic (ROC) curve analysis, based on the mode of commuting to school (active vs. passive), and the distance from home to school, similar to a previous study (Zaragoza et al., 2019). The Younden Index (Schisterman, 2005) was calculated to identify the threshold distance that best distinguishes active from passive commuters. The area under the curve values of 0.90 is considered excellent, 0.80 to 0.89 good, 0.70 to 0.79 fair, and<0.70 poor (Metz, 1978).

Percentages of usual active commuters for each school were calculated. Every active (i.e., represented as a point in Fig. 2) and passive commuter (i.e., represented as a triangle in Fig. 2) child for each school were then represented on maps (see Fig. 2). Differences by schools in usual mode of commuting were tested using Chi-square test, and distance and socioeconomic status were examined with t-student analysis.

Differences in weekly frequency of ACS, mother's attitudes, father's attitudes, distance, socioeconomic status, and estimated CO2 emission by type of school were analyzed using one-way analysis of variance. All these differences were explored in the total sample and in three different subsamples (i.e., students living above the threshold distance, below the threshold distance, and for the total sample).

First of all, we initially considered the nested nature of data at the very beginning of the study. However, after conducting two initial null models (i.e., one for public schools and another for private schools), ICC values (0.079; p = .112 for public schools; 0.0004; p = .921 for private schools) showed that a two-level multilevel structure (i.e., student and school) was not required. Then, two different stepwise linear regression models (i.e., one for public schools and another for private schools) were used to test the influence of parent's attitudes to ACS (i.e., mothers and fathers), distance and socioeconomic status on weekly frequency of ACS. Moreover, age and gender were also included as control variables in both models. The Nagelkerke R Square values were provided as a goodness-of-fit measure.

A low percentage of missing values were found in fathers' and mothers' attitudes (i.e., 0.45% fathers and 12.45% mothers). Those individuals (fathers = 3; mothers = 139) with missing values in the other parent' attitude were omitted for the regression analysis. Finally, $n$ = 655 fathers and mothers had both attitude values and were included in the analysis.

All significant levels were established at p < .05. All analyses were conducted using SPSS V.26 and ArcGISpro v. 2.4.

## 3. Results

A total sample of 800 children (i.e., *Mean* age = 10.60 *Standard Deviation*=0.92; 52.0% girls), and the majority of their parents (i.e., n = 795 mothers, n = 658 fathers) were recruited. From the total sample of children (n = 800), the percentage of usual active commuters to school was 67.9% (i.e., n = 543). We found significant differences (p < .05) in the percentage of active commuters in public (i.e., 79.2%) versus private schools (i.e., 53.25%). No significant differences in usual active commuters were found in the total sample, according to age (p = .661) or gender (p = .393).

The ROC curve analysis showed a threshold distance of 725 m (area under the curve: 0.834; $p < .000$), below which 59.3% (i.e., n = 474) of the total sample lived. Of the children who lived above the threshold distance, 41.7% (i.e., n = 136) were classified as usual active commuters, whilst 85.9% (i.e., n = 407) of the children, who lived below the threshold distance, were classified as usual active commuters.

Fig. 2 shows the distribution of usual active commuters according to schools. In most cases, we found significant differences ($p < .05$) between all public and private schools, except in the percentage of usual active commuters between Public Schools F/D and all private schools ($p > .05$).

Mothers of Public School F significantly reported ($p < .05$) higher socioeconomic status (i.e., M = 10.80, DT = 1.29) than mothers of Public School C (i.e., $M = 9.39$, $SD = 1.56$). Children who belonged to Public School D showed a significantly ($p < .05$) higher distance (i.e., $M = 751$, $SD = 493$) from home to school than children who belonged to Public School G (i.e., $M = 384$, $SD = 344$).

As shown in Table 1 there were statistically significant differences between public and private school for students who lived above the threshold distance in frequency of ACS (p = .010), and mother's attitudes (p = .034). Furthermore, there are statistically significant differences in the CO2 emissions between public and private school students in total sample (p = .000).

Table 2 shows the results of the two linear regression models (i.e., one for each type of school). For public schools, the final model showed statistically significant influence from distance and socioeconomic status (negative influence), and from mother's attitudes (positive influence) on weekly frequency of ACS. For private schools, the final model showed statistically significant influence from distance (negative influence), from mother's attitudes (positive influence) and gender (i.e., higher odds of ACS in girls) on weekly frequency of ACS.

The fathers' attitudes became statistically non-significant in both public and private school samples. For the public school model, the Nagelkerke $R^2$ increased from 0.37 in model 1, to 0.41 in model 2, and to 0.42 in model 3, including mother's attitudes and socioeconomic status, respectively. Meanwhile, for the private school model, the Nagelkerke $R^2$ increased from 0.49 in model 1 to 0.54 in model 2, and to 0.55 in model 3 after including the mothers' attitude variable and gender variable (i.e., girl).

## 4. Discussion

This study was designed to produce novel insights into the implication of school choice in primary education for ACS, CO2 emission as a consequence of car use, and some closely-related variables with ACS, in a small city in the north of Spain. Our objective was mainly to study the implications of school choice (i.e., private or public) for ACS. More specifically, we have analyzed, a) if there were differences on ACS, parental attitudes to actively commute, SES and CO2 emissions by type of school and the threshold distance to active commute and b) if distance, parents' attitudes, and family socioeconomic status, influence the frequency of ACS by type of school (i.e., public and private primary education schools). Overall, findings showed differences in frequency of ACS, mothers' attitudes, and SES, between students from public and private schools, who lived below the threshold distance of 725 m.

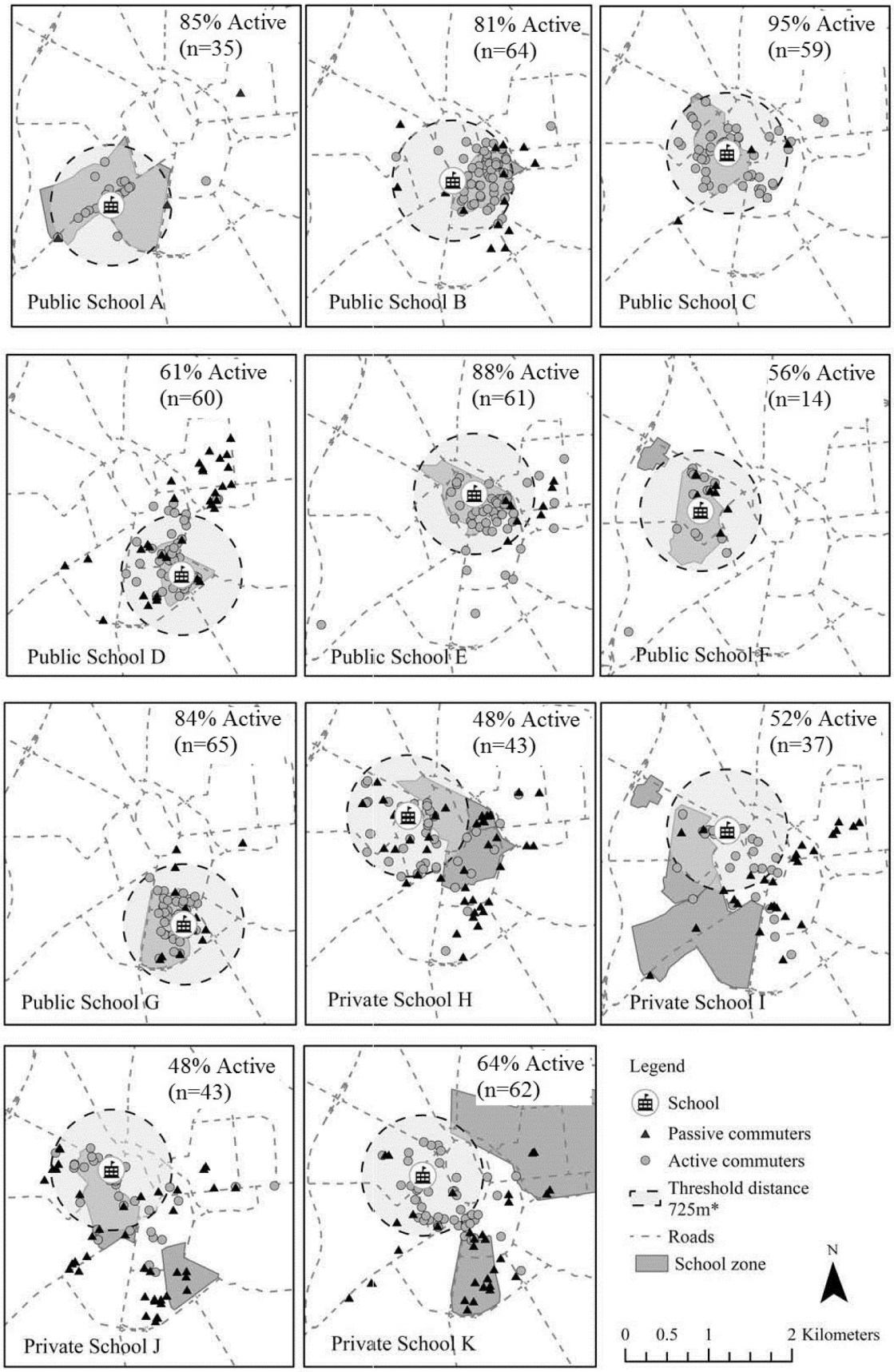


**Fig. 2.** Distribution and percentages of active and passive commuters for the eleven schools of the study.

**Table 1**
Differences in study variables for total sample, and students who lived above and below the threshold distance by type of school.

| Variables | Type of school | N | Mean | SD | F | p |
|---|---|---|---|---|---|---|
| Weekly frequency of active trips | Total | 800 | 7.57 | 3.57 | | |
| Below the threshold | Public | 344 | 9.24 | 1.86 | 1.68 | 0.094 |
| | Private | 130 | 8.84 | 2.44 | | |
| Above the threshold | Public | 108 | 6.14 | 4.32 | 6.67 | **0.010** |
| | Private | 218 | 4.90 | 3.91 | | |
| Total sample | Public | 452 | 8.50 | 2.97 | 75.68 | **0.000** |
| | Private | 348 | 6.38 | 3.92 | | |
| Distance from school (m) | Total | 800 | 752 | 534 | | |
| Below the threshold | Public | 344 | 387 | 167 | 3.82 | 0.051 |
| | Private | 130 | 422 | 184 | | |
| Above the threshold | Public | 108 | 1183 | 489 | 5.91 | **0.016** |
| | Private | 218 | 1312 | 430 | | |
| Total sample | Public | 452 | 577 | 439 | 129.21 | **0.000** |
| | Private | 348 | 979 | 560 | | |
| Socioeconomic status | Total | 800 | 10.19 | 1.62 | | |
| Below the threshold | Public | 344 | 10.08 | 1.54 | 2.68 | 0.102 |
| | Private | 130 | 10.35 | 1.58 | | |
| Above the threshold | Public | 108 | 9.58 | 1.60 | 24.63 | **0.000** |
| | Private | 218 | 10.55 | 1.67 | | |
| Total sample | Public | 452 | 9.96 | 452 | 19.72 | **0.000** |
| | Private | 348 | 10.47 | 348 | | |
| Mothers' attitudes | Total | 795 | 4.04 | 0.67 | | |
| Below the threshold | Public | 341 | 4.17 | 0.58 | 0.893 | 0.345 |
| | Private | 129 | 4.23 | 0.58 | | |
| Above the threshold | Public | 107 | 3.94 | 0.75 | 4.526 | **0.034** |
| | Private | 218 | 3.76 | 0.69 | | |
| Total sample | Public | 448 | 4.12 | 0.64 | 14.81 | **0.000** |
| | Private | 347 | 3.93 | 0.69 | | |
| Fathers' attitudes | Total | 658 | 3.97 | 0.73 | | |
| Below the threshold | Public | 284 | 4.14 | 0.64 | 0.348 | 0.556 |
| | Private | 106 | 4.19 | 0.63 | | |
| Above the threshold | Public | 83 | 3.70 | 0.88 | 0.020 | 0.887 |
| | Private | 185 | 3.69 | 0.72 | | |
| Total sample | Public | 367 | 4.04 | 0.72 | 9.241 | **0.002** |
| | Private | 291 | 3.87 | 0.73 | | |
| CO2 emission (kg/km) | Total | 800 | 0.872 | 2.27 | | |
| Below the threshold | Public | 344 | 0.119 | 0.359 | 3.62 | 0.058 |
| | Private | 130 | 0.275 | 1.40 | | |
| Above the threshold | Public | 108 | 1.97 | 4.78 | 0.08 | 0.778 |
| | Private | 218 | 1.87 | 1.91 | | |
| Total sample | Public | 452 | 0.562 | 2.48 | 19.71 | **0.000** |
| | Private | 348 | 1.27 | 1.90 | | |

Note. SES range 0 (low)-13 (high) score. Mothers' and fathers' attitude range 1 (bad attitudes towards ACS of their children) −5 (great attitudes towards ACS of their children) score.

Among students living below the threshold distance, those from public schools, had higher rates of frequency of ACS, and higher values of mothers' attitudes towards ACS, than those from private schools. In contrast, students who lived below the threshold distance and attended private schools, were associated with having higher family SES than students attending public schools. Further, effects of school choice on weekly frequency of ACS behavior appear to be mostly explained by their connection with travel distance, SES and mothers' attitudes towards ACS, in the case of students attending public schools. Meanwhile, for students attending private schools, the final model only showed a significant influence of distance, mothers' attitudes, and gender (i.e., be a girl) on weekly frequency of ACS.

Similarly to previous studies (Merom, et al., 2006), our results suggest that students who attend public schools, are more likely to actively commute to school than those who attend private schools. Investigation of the relationship between school type and ACS has focused on the analysis that school choice (private vs. public) allows parents and students to attend schools farther from their home than neighborhood schools, resulting in longer travel distances and greater demand for car travel (Yang, et al., 2012; Steiner et al, 2006). Specifically, the differences are more evident in the case of private schools in some countries, with almost four times the average home-school distance in comparison to public schools (Torres, et al., 2010). In the city of Huesca, private schools are not distributed around the city in a homogenous way, in fact, they are placed together in the same peripheric area. The distance that children are currently willing to walk to school (i.e., threshold distance) differs between contexts (D'Haese et al., 2011; Merom, et al., 2006; Rodríguez-López, et al., 2017). For example, 875 m has been evidenced as a walkable distance to commute to school in Spanish children (Rodríguez-López, et al., 2017) and specifically, 725 m in our city research context. According to Rodríguez-Rodríguez, et al. (2019), the use of private transportation (i.e., own car) to and from school, seems to be higher in big urban areas than in small cities like Huesca, because the conditions for ACS in small cities are more favorable (e.g., shorter distance from home to school), increasing the possibilities of using active transport modes (Ikeda et al., 2019; Mota et al., 2007). This may suggest that effects of school choice on ACS, could be not completely explained by travel distance, typically associated with private school (Wilson et al, 2010). In this sense, private schools could solve distance problem, implementing promotion ACS programs that incorporate strategies oriented towards different variables (i.e., personal and environmental). Promoting cycling use through these programs could help dismissing distance problem, due to cycling' threshold distance could be higher than walk threshold distance, as it happens with Spanish university students (Chillón et al., 2016). In this sense, Yang et al. (2012), indicated that school type affects ACS via environmental factors as home-school distance, but also, could affect parents' attitudes to use ACS. The transport mode adopted by students for their daily commuting to school, has implications for CO2 emissions (Singleton, 2014). Therefore, rates of ACS and as a consequence, traffic volumes during school commuting times, could be influenced by school choice (Keall et al., 2020). Our study shows that pupils attending private schools travel, on average, further to school, with lower rates of active transport and, consequently, higher average CO2 in kg/km travelled. As Bearman and Singleton (2014) proposed, our results showed that CO2 emissions seem to be higher in the area around private schools than public schools, regardless of the threshold distance. These data support some previous studies in

**Table 2**
Regression models on weekly frequency of ACS for each type of school.

| | | MODEL 1 | | | MODEL 2 | | | MODEL 3 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B | $\beta$ | p | B | $\beta$ | p | B | $\beta$ | p |
| Public | Constant | 10.76 | | <0.001 | 6.71 | | <0.001 | 8.53 | | <0.001 |
| | Distance | -0.004 | -0.607 | <0.001 | -0.004 | -0.565 | <0.001 | -0.004 | -0.566 | <0.001 |
| | Mothers' attitudes | | | | 0.941 | 0.197 | <0.001 | 0.993 | 0.208 | <0.001 |
| | SES | | | | | | | -0.203 | -0.105 | 0.010 |
| Private | Constant | 11.20 | | <0.001 | 4.69 | | <0.001 | 4.49 | | <0.001 |
| | Distance | -0.005 | -0.701 | <0.001 | -0.004 | -0.586 | <0.001 | -0.004 | -0.583 | <0.001 |
| | Mothers' attitudes | | | | 1.45 | -0.254 | <0.001 | 1.41 | 0.246 | <0.001 |
| | Gender | | | | | | | 0.635 | 0.081 | 0.04 |

Note. Males are the reference group. B: non-standardized coefficient. $\beta$: standardized coefficient.

this field (Van Ristell et al. 2013), that defend more sustainable 'neighborhood schools', where pupils are assigned to the nearest school, thus minimizing travel distance and increasing the prevalence for active transport.

The predictors of ACS are complex and conditioned not only by environmental factors, but also by school-level factors, as well as individual or household characteristics (Easton and Ferrari, 2015). Our findings support the hypothesis that the effects of school choice on ACS are further explained by family factors like SES (i.e., in this study, only in the case of public schools), demographical factors like gender (i.e., in this study, only in the case of private school), attitudinal variables (i.e., mothers' attitudes), and not only by environmental variables, such as distance (Mah et al., 2017).

The type of school could reflect specific characteristics of the families (e.g., parents' professional or educational level). Our data showed that attending private schools was associated with having higher family SES. However, our study also showed that higher SES predicted lower frequency of ACS in public school students. This variable seems to be inversely related to ACS in Spanish youth (Chillon et al., 2009). Similar findings have also been reported in European children (Cooper et al., 2005, 2003). For example, Mehdizadeh et al. (2018) reported that children from households with a higher income, are more likely to travel to school by car. It seems that the influence mechanisms of SES on ACS need to be further investigated, considering the potential mediator effects of inter- and intra-personal factors (e.g., socio-demographic characteristics, social support), and environmental factors (e.g., distance, traffic safety, etc.) (Cerin et al., 2009).

Gender plays a role in commuting behavior and varies across geographic contexts. Studies carried out in Spain have shown inconclusive results. While some studies reported that gender is not associated with the frequency of active trips to school (Villa-Gonzalez et al., 2012; Zaragoza et al., 2020), others (Chillón et al., 2009), showed that ACS levels were higher among the Spanish females compared with their male peers. Similar to previous studies, our results suggest that girls are more active commuters than boys but only, in the case of private schools. Similar findings have also been reported in European (Cooper et al., 2003, 2005) and in American children (Sirard et al., 2005). However, the opposite pattern has been shown in Australian children (Timperio et al., 2006) where a greater proportion of boys commuted actively to school compared with girls. Commuting to/from school is a daily activity highly influenced by environmental and cultural factors, that are specific for each country and geographical area (Faulkner et al., 2009). Some study has proposed security as a possible cause of gender differences in ACS (Chillón et al., 2013). Further research should be conducted to explore in depth this issue.

According to McMillan (2007), attitudes influence the travel mode choice more than the attributes of the built environment. Parental attitudes have been identified as a key factor that influences active transport, especially in terms of travel to school (Kerr, et al., 2006; Pont et al., 2011). Further, school type appears to be related to parents' consideration about the choice of an active school travel mode. We found that, in contrast to parents who sent their children to public schools, parents of private school students tended to give less consideration (i.e., attitudes) towards ACS. According to literature, several factors can influence parental attitudes towards children's ACS (e.g., children's age and gender, school type, household attributes, built environment attributes) (Merom et al., 2006; Sirard and Slater, 2008). Our results suggest that school choice (i.e., public or private schools) could be related to parents' attitude toward ACS, specifically to mothers' attitude, but it is necessary further investigation to clarify it.

Moreover, the effects of school choice policy on weekly frequency of ACS behavior appear to be mostly explained by its connection with mothers' attitudes towards ACS, both in students who attend public and private schools. This could suggest that, in the context of school choice, the mothers' positive attitude toward ACS has a major impact on ACS behavior. Accordingly, there is growing evidence indicating that the mother's traits have a higher influence than father's on several behaviors (Schoeppe et al.,2017). One possible explanation is that mothers spend more time at home with their offspring (Aranceta, et al., 2003), and therefore, their role in the family structure is still as the primary caregiver (Schoeppe et al., 2017), which could have a greater influence on their children's attitudes and behaviors. Some studies reveal that escorting is shared unequally between mothers and fathers, even when both parents are earners, women do more of the chauffeuring, because they are considered to be the primary caregivers for the children (Schwanen, 2007). Also, in Spain and more specifically in the city of Huesca, women in dual-earner households tend to have jobs with shorter and more flexible working hours, jobs that are closer to home and that allow them to do most of the caregiving and escorting for the children (Schuh et al., 2019).

The findings of this study should be interpreted in light of the following limitations. Our study context may not fully represent other contexts, and the generalization of our research results may be limited. The unique setting of Huesca may limit generalizability of findings to other Spanish cities and other countries with different characteristics and school enrollment policies. Another limitation includes the use of self-reported measures of ACS, which are frequently under/over-estimated (McCormack et al., 2008). Despite this limitation, we have used the children's ACS questionnaire that has proven acceptable validity (Herrador-Colmenero et al., 2014). Despite these limitations, this study has an important strength, such as including a large representative sample of students aged 9 to 11 years old, and their parents (i.e., mother and father, separately) from almost all primary education schools from one city in Spain (91.6% participation rate between the schools).

## 5. Conclusions

The effects of school choice on weekly frequency of ACS behavior appear to be partially explained by environmental conditions (i.e., distance), mothers' attitudes and SES (only in public schools). In addition, school choice may have substantial implications for ACS (e.g., such as adverse health impacts on children due to a reduction in physical activities, increased reliance on motorized transport, and greenhouse gas emissions. Promoting ACS should require a coordination of efforts among institutions (e.g., schools, university, police, healthcare…) and extensive collaboration among educational policy-makers and urban designers, to increase rates of ACS.

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## CRediT authorship contribution statement

**Ana Corral-Abós:** Formal analysis, Resources, Writing - original draft, Writing - review & editing. **Alberto Aibar:** Methodology, Writing - review & editing. **Sergio Estrada-Tenorio:** Writing - review & editing. **Jose Antonio Julián:** Conceptualization, Investigation. **Eduardo Ibor:** Conceptualization, Investigation. **Javier Zaragoza:** Conceptualization, Methodology, Resources, Writing - review & editing, Supervision.

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## Appendix 1. . Questionnaire on parents' attitudes

1-Strongly disagree 2-Somewhat disagree 3-I am not clear 4-Somewhat agree 5-Strongly agree

| Indicate whether or not you agree with these phrases. | | | | | |
|---|---|---|---|---|---|
| - *It is very convenient to take my child to school by car. | 1 | 2 | 3 | 4 | 5 |
| - I am usually willing to walk with my child to school | 1 | 2 | 3 | 4 | 5 |
| - It is interesting for my child to walk to school alone or with friends | 1 | 2 | 3 | 4 | 5 |
| -*It is dangerous for my child to walk to school alone or with friends | 1 | 2 | 3 | 4 | 5 |
| -*I think it is useless (it is useless) for my child to walk to school alone or with friends | 1 | 2 | 3 | 4 | 5 |
| -*It is irresponsible for parents to allow their children to walk to school alone, without being accompanied by adults | 1 | 2 | 3 | 4 | 5 |
| -*I think the most responsible thing is for parents to take their children to school by car | 1 | 2 | 3 | 4 | 5 |
| -*I think that the most responsible thing is for parents or an adult to walk with their children to school | 1 | 2 | 3 | 4 | 5 |
| - I think it is important for my son to develop skills to walk to school alone | 1 | 2 | 3 | 4 | 5 |
| - I am sure that my son has the ability to walk to school alone, without an adult | 1 | 2 | 3 | 4 | 5 |

Note: * Items with reverse coded.

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