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REVIEW

Parental barriers to active transport to school: a systematic review

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Abstract

Objectives We aimed to systematically review parental barriers towards children and adolescents' active transport to school (ATS) in the scientific literature and to provide a categorization of the barriers identified in the studies.

Methods A search was conducted through seven online databases, from the beginning of the database to March 2018.

Results A total of 27 of the identified studies met the inclusion criteria. The main parental barriers reported by parents of children (21 studies) were built environment, traffic safety, distance, crime-related safety and social support. The main parental barriers reported by parents of adolescents (6 studies) were built environment (street connectivity), distance, traffic safety and physical and motivation barriers. The parental barriers associated with ATS were mainly related to the built environment and traffic safety.

Conclusions It is crucial to involve parents through interventions to reduce the perception of safety and to increase awareness of the importance of ATS. In addition, these strategies should be complemented by environmental changes performed by local governments.

Keywords Perceived barrier · Family · Active commuting · Schoolchildren · Adolescents

Introduction

The lack of physical activity and the high obesity levels in children and adolescents are important problems in the developed countries (WHO 2015). The hours of physical activities have been reduced, the motorized transportation has increased, as well as the degree of urbanization of towns and cities, and industrialization within society (MSSSI 2015).

Recommendations from the World Health Organization (WHO) suggest that children and adolescents should participate in at least 60 min of moderate-to-vigorous daily physical activity (WHO 2010). One way to achieve these recommendations is the use of active modes of transport such as walking or cycling from home to school and vice versa (Chillón et al. 2010) that can easily be integrated in the daily routine. Active living is a concept that includes exercise, recreational activities, household and occupational activities and active transportation (Sallis et al. 2006). In addition, active transport to school (ATS) has different and important benefits, such as the improvement of cardiovascular health (with greater impact of cycling compared to walking), the development of social skills and the improvement of the environment through the reduction of exhaust gases (Chillón et al. 2010; Panter et al. 2013; Wilson et al. 2007). However, ATS in children has decreased from 2001 to 2013 in countries such as Australia (from 44 to 21%) (Van der Ploeg et al. 2008), USA (from 41 to 13%) (McDonald 2007), Canada (from 39 to 31%) (Buliung et al. 2009), England (from 71 to 62%) (Black et al. 2001) or Spain (from 61 to 46%) (Chillón et al. 2013).

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Active transport to school is influenced by many factors (Rodriguez-Lopez et al. 2013). According to the ecological framework developed by Mandic et al., there are three groups of factors (personal, social and environmental) influencing ATS. The model includes the perception of parents as a potential influencing factor (Mandic et al. 2015). The role of the parents is of high relevance to determine their sons and daughters' (i.e. hereinafter referred to as children, including both children and adolescents) mode of transport (Kerr et al. 2006), since parents are the main decision makers in relation to the mode of transport of children (Giles-Corti et al. 2009). Several studies have focused on studying the parental barriers to active transport to school of their children (Kerr et al. 2006; Salmon et al. 2007). Parental concerns, such as traffic safety and social support, play an important role in the encouragement and permission of active transport to school (Black et al. 2001; Dellinger 2002; Timperio et al. 2004). However, parental barriers seem to be highly context related (Heelan et al. 2008; Yeung et al. 2008). For example, depending on the environment and the family education, some parents felt more danger in the amount of traffic than in other barriers such as maintenance of sidewalks (Oluyomi et al. 2014). Therefore, the main aim of this study was to examine the parental barriers to active transport to school in the scientific literature. Since it is important to conceptualize and categorize the different barriers in order to design effective interventions that increase active transport to school in youth, the secondary aim was to provide a categorization of these identified barriers based on the current literature.

Methods

Search strategy

A search was conducted using seven electronic databases: Pubmed, Web of Science, SportDiscus, Cinahl, Cochrane Library, PsicoINFO and National Transportation Library, in March 2018. The search included studies up to this date. Five categories of search terms were identified: parents, barriers, school, active commuting/transport and children. Specific terms used in the search were obtained from previous reviews and experts' opinion; then, they were adapted to each database (see Online Resource 1 for more detail). The PRISMA guide was used to perform the review, and it was registered on PROSPERO (CRD42017064040).

Selection and review process

The search was conducted by two members of the research team independently. Once the search was finalized, the studies collected from each database were compared. Potentially relevant studies were identified based on their titles and abstracts by two researchers to determine whether they met the following inclusion criteria: (a) studies published until March of 2018; (b) original research; (c) published in English or Spanish; (d) participants: parents or relatives of schoolchildren; (e) assessment of barriers and perceptions; (f) school context; (g) transport to school. Then, a second selection was conducted reading the full texts regarding the previous inclusion criteria. Any disagreements in the inclusion process were solved by a third and independent researcher. Data were extracted from the articles, including descriptive information (i.e. sample and age; study date; design; measures), barriers of active transport and results, and the prevalence of active transport to school. The data extraction was performed by two researchers, and disagreements were solved by a third and independent researcher.

Quality assessment

The quality assessment was conducted using a standardized evaluation framework, the Evaluation of Public Health Practice Projects (EPHPP 1998). This tool assesses six methodological dimensions: selection bias, study design, confounders, blinding, data collection methods and withdrawals and dropouts. For the global rating, a final score was computed by summing the six dimension scores. Each dimension was rated on a three-point scale: weak, moderate or strong. Two additional methodological dimensions provided by the tool, but not involved in the global rating, are intervention integrity and analyses. The EPHPP tool was created primarily for individual-level observational and clinical studies based on populations; consequently, rating criteria for some items were modified by the authors to improve the suitability of the tool for the interventions included in this review. These criteria are attached in Online Resource 2.

Results

Study selection

The electronic search produced 977 studies among the seven databases: 17 from Pubmed, 194 from Web of Science, 44 from SportDiscus, 7 from Cochrane Library, 376 from National Transportation Library, 66 from Cinahl and 273 from Psycinfo. After discarding 143 duplicates, 834 papers remained. From those, 797 studies were excluded because they failed to meet the inclusion criteria. From the remaining 37 studies, the full texts were read and 12 papers were still removed according to the inclusion criteria.

Based on forward and backward screening of the included primary studies, two additional studies that met the inclusion criteria were added. Thus, 27 studies were included in this review.

Study population and measurement

The 27 studies took place in four continents (America, Oceania, Asia and Europe). Twenty-one studies were conducted in the USA (see Online Resource 3), four studies in Australia (Hume et al. 2009; Salmon et al. 2007; Timperio et al. 2006; Yeung et al. 2008), two studies in Iran (Shokoohi et al. 2012a, b) and one study in Canada (Guliani et al. 2015), in Netherlands (Van Kann et al. 2016) and in Belgium (De Meester et al. 2014). All studies aimed to analyse the parental barriers related to active transport to school of children and adolescents (from 5 to 18 years old). Specifically, twenty-one studies focused on children (see Online Resource 3), five on children and adolescents (Deweese et al. 2013; Forman et al. 2008; Kerr et al. 2006; Yeung et al. 2008; Zhu and Lee 2009) and one on adolescents (Carlson et al. 2014). Five studies focused on both adolescents and children (Deweese et al. 2013; Forman et al. 2008; Hume et al. 2009; Kerr et al. 2006; Rosenberg et al. 2009).

Fifteen studies had additional criteria to include the participants in the sample of the study. Five studies included the distance between home and school as participants' requirement (Carlson et al. 2014; Heelan et al. 2008; Lu et al. 2014; Napier et al. 2011; Oluyomi et al. 2014), where students had to live within 2 miles (3.22 km) from school. Four studies included just schools or families that were involved in a programme which promotes active transport to school (Eyler et al. 2008; Gustat et al. 2015; Hume et al. 2009; Yeung et al. 2008). One study involved parents of children who had no access to bus services (Ahlport et al. 2008), and one study only included parents of students who lived more than 2 miles from school and had access to bus service (Zhu and Lee 2009). Finally, two studies analysed children from low-income families (Greves et al. 2007; Zhu et al. 2008) and one of them added as inclusion criteria to be Hispanic (Zhu et al. 2008).

The analysed studies used different tools to measure the parental barriers, using in some studies more than one tool. The main tool to collect data was the self-report survey, used in sixteen studies (see Online Resource 3), followed by the use of a questionnaire in seven studies (see Online Resource 3), a focus group in two studies (Ahlport et al. 2008; Greves et al. 2007), a telephone interview in two studies (Deweese et al. 2013; Eyler et al. 2008), an in-person interview in one study (Eyler et al. 2008) and a telephone survey in one study (Salmon et al. 2007).

Categorization of barriers

We found a wide variety of barriers reported by parents (Online Resource 4) in the studies identified in this review. These barriers have been classified regarding common concepts through consensus among experts, and 14 categories of barriers were developed. These categories have been structured keeping in mind the ecological framework developed by Mandic et al. (2015). Thus, the parental barriers have been classified in three categories of factors: personal, social and environmental. These categories are defined in Table 1, including literally the barrier name, its definition, and several examples of parental barriers shown in the studies included in this review.

Parental barriers to active transport to school

The reported parental barriers and the association of these barriers with active transport to school of children are shown in Table 2, using the barrier names presented in the previous Table 1. Table 2 provides information about: author and place of the studies and the main barriers associated with active transport to school. In addition, the Online Resource 3 displays the full information extracted in this review including: author and place of the studies, sample and age of the participants, date and measures of the study, the parental barriers associated and not associated with active transport to school and the prevalence of active transport to school. The identified studies are organized in Table 2 and Online Resource 3 according to the children's age: children, adolescents and all (i.e. children and adolescents).

The main parental barriers reported by the parents of children (21 studies) were built environment (18 studies), traffic safety (16 studies), distance (13 studies), crime-related safety (12 studies) and social support (11 studies). The main parental barriers reported by the parents of adolescents (1 study) were built environment (street connectivity), distance, traffic safety and physical and motivation barriers. The main parental barriers reported by the parents of children and adolescents (5 studies) were built environment (5 studies), traffic safety (3 studies), crime-related safety (3 studies) and social support (1 studies).

The main parental barriers associated with active transport to school with a higher frequency were built environment in 24 studies (see Table 2). Particularly, the subcategory walkability was the most reported built environment barrier in 22 studies (see Table 2). Additionally, traffic safety was associated with active transport to school in 20 studies (see Table 2), where the subcategory high amount of traffic was the most reported (14 times) by parents, while crime-related safety was associated with

Table 1 Categorization of parental barriers to active transport to school and their definitions

Barriers' name	Definitions
Environmental factors	
Distance	***Long distance from home to school***
	Examples: "My child's school is too far to walk to"; "Distance too far"
Traffic safety	***Circulation of motorized vehicles***
	High amount of traffic
	Examples: "Too much traffic at school"; "Heavy traffic"
	High speed of traffic
	Examples: "Lack of speed control for cars"; "Cars exceeding speed limits in nearby streets"
	Dangerous behaviours of vehicles
	Examples: "Drunk drivers and drivers not obeying traffic signals"; "Distracted motorists"
	Lack of Parking
	Example: "Car parking is difficult at my child's school"
Crime-related safety	***Presence of illegal actions that constitutes an offence that may be prosecuted on the way from home to school***
	Examples: "Bullying from teenage gangs, homeless people or drug dealers"; "I'm concerned my child might be assaulted or molested by an adult on the way to school"
Built environment	***Built configuration of the ground that hinders walking and/or cycling to school***
	Walkability (low): difficulties to be able to walk to school
	Examples: "There are many cul-de-sacs, courts or not-through roads near where I live"; "There are no footpaths in my neighbourhood"
	Bikeability (low): difficulties to use cycling as mode of commuting.
	Examples: "Nowhere to leave bike safely"; "Bike lanes/paths or trails well maintained"
	Land use mix: low variety of land uses
	Examples: "Presence of land uses en route to school: convenience store, bakery, restaurant and office building"; "Land use mix access"
	Residential density (low): low concentration of population
	Example: "Residential density"
	Street connectivity (low): Lack of connection between streets
	Example: "Street connectivity"
	Aesthetics: Low maintenance of the environment.
	Examples: "Attractive buildings and natural things to see"; "Neighbourhood aesthetics"
Natural environment	***Natural configuration of the ground that hinders walking and/or cycling to school***
	Examples: "The streets in my local neighbourhood are hilly"; "Terrain"
Weather	***Inappropriate climatic conditions***
	Examples: "Rain, darkness and cold, especially in winter months"; "Insufficient daylight in the morning"
Personal factors	
Time constraints	***Lack of time to walk or cycle to school.***
	Examples: "I have no time to walk with my child to/from school"; "Not enough time"
Schedules	***Parent's and children's schedules before or after school activities that hinder walk to school***
	Examples: "Inflexible work schedules"; "Child's before or after school activities"
Convenience	***Suitability of driving children to school because of work and/or familiar issues***
	Examples: "More convenient to drop children off on way to work". "Walking to school involves too much planning ahead"
Children's preferences	***Children's liking that hinders walking and/or cycling to school***
	Examples: "Child doesn't want to, or like to, walk or bicycle to school"; "My child prefers to be driven to school by car"
Children's competences	***Children's capability and skills that hinder walking and/or cycling to school safely***
	Examples: "Immature judgment on the part of the child"; "My child may get lost"
Physical and motivation barriers	***Corporeal and psychological reasons that hinder walking and cycling to school***
	Examples: "My child's school bag is too heavy to carry"; "Not having the energy, strength or motivation"

Table 1 (continued)

Barriers' name	Definitions
Social factors	
Social support	***Absence of children or adults in the way from home to school or neighbourhood***
	Absence of children
	Examples: "Other kids walk quite often in their daily routines"; "There are no other children for my child to walk to school with"
	Absence of adults
	Examples: "There are no adults for my child to walk to school with"; "I don't trust the people in our neighbourhood"
School policy	***School's norms and actions that hinder walking and cycling to school.***
	Examples: "My child's school does not encourage the children to walk to school"; "Lack of storage space at school for coats and bicycle helmets"

When appears "to school", it refers to "to and from school"

Social support: can be positive or negative

active transport to school 15 times, being the subcategories bullying and abductions the most commonly reported. Distance appeared in 15 studies, being the barrier with the strongest associations with active transport to school. Finally, social support was a barrier associated with active transport to school in 12 studies (see Table 2).

Concerning active transport to school prevalence, 20 studies reported rates of walking to school ranging from 18 to 88% and rates of cycling to school ranging from 0 to 50% (see Online Resource 3).

Regarding the association between objectively and subjectively measured parental barriers, only 1 study found a positive association (Zhu et al. 2008). In addition, parents of children presented more barriers, such as built environment (walkability), traffic safety or social support for active transport to school, than parents of adolescents (Forman et al. 2008; Kerr et al. 2006). Finally, parents provided several ways to promote active transport to school and improve this behaviour (i.e. someone accompanies my children to school).

Quality assessment

The quality of all included studies was evaluated as weak in the global rating. The analysis of the individual items was included in Online Resource 2. Regarding the selection bias, only one study included a representative sample, classified as strong (Shokoohi et al. 2012a). Three studies were classified as moderate (see Online Resource 5), whereas the rest of the studies were classified as weak. Taking into account the study designs, one study was rated as moderate because case–control designs were used (Eyler et al. 2008), and the other study designs were rated weak, based on using cross-sectional designs. Concerning the control of confounders, one study was rated as strong (Lee et al. 2013), one as moderate (Van Kann et al. 2016), two as not applicable (Ahlport et al. 2008; Greves et al. 2007) and twenty-three as weak. In most of the studies, blinding was assessed as moderate, and only one was assessed as weak (Yu and Zhu 2016). Regarding the assessment method for data collection, ten studies were rated as strong (see Online Resource 5), four as moderate (see Online Resource 5), and the rest of studies were rated as weak. The studies did not present information about dropout criteria and withdrawals as they only included a one-time assessment. The unit of intervention allocation in most of the studies was the organization/institution (i.e. school), except for four studies where it was the individual (Deweese et al. 2013; Greves et al. 2007) and the community (Carlson et al. 2014; Kerr et al. 2006). The unit of analysis was individual in all the studies. Finally, all the studies used appropriate statistical methods for the study design.

Discussion

A total number of 27 studies reporting the parental barriers to their children's active transport to school were identified in this study. The barriers reported in these studies were used to provide a categorization of parental barriers. The main barriers associated to active transport to school were distance, traffic safety, crime-related safety, social support and built environment.

The categorization extracted 14 different barriers from the scientific literature. All these barriers referred to the parental perception of different factors that affect their children's active transport to school, and they can be classified as personal (e.g. children's preferences, convenience), social (e.g. social support, school policy) or environmental barriers (e.g. distance and built

Table 2 Author and place of the studies, and the main barriers associated with active transport to school

AuthorLocality, (country)	Associated barriers	Author locality (country)	Associated barriers
Timperio et al. (2006) Melbourne, (Australia)	Social support (absence of children) Built environment (walkability: no lights or crossings)	De Meester et al. (2014) Flanders (Belgium)	Built environment (land use mix diversity; land use mix access; residential density; walkability; bikeability) Distance
Greves et al. (2007) Seattle, Washington (USA)	Crime-related safety (violence from strangers; bullying; unsupervised children) Social support Distance Time constraints Schedule Physical and motivation barriers Traffic safety (high-speed traffic; danger behaviour) Built environment (walkability: crossings unsafe, lack of crossing guards, safe walking routes) Natural environment (hills) Weather	Lu et al. (2014) Texas (USA)	Children's preferences (cues to action) Built environment (walkability: sidewalks; footpaths; crossings); (bikeability: facilities) (aesthetics) Crime-related safety (bullying) Traffic safety (high amount of traffic; high speed of traffic) Distance Weather Social support (absence of children and adults) Convenience Time constraints Children's competences
Salmon et al. (2007) (Australia)	*Decreased likelihood of active commuting* Time constraints Children's preferences Social support (absence of children and adults) Traffic safety (danger behaviour) Built environment (walkability: no direct route, footpaths) Distance Physical and motivation barriers	Oluyomi et al. (2014) Texas (USA)	Built environment (walkability: sidewalks, crossings; safety intersections; crossing guards) Natural environments (trees) Traffic safety (high speed of traffic; high amount of traffic) Social support Crime-related safety (violence; attacked by animals)
Ahlport et al. (2008) North Carolina (USA)	Crime-related safety (abducted; bullying) Children's competences Convenience Schedule Physical and motivation barriers Built environment (walkability: sidewalks, crossing guards) Built environment (walkability: sidewalks, crossing guards) Natural environment Weather Distance Traffic safety (high amount of traffic; danger behaviour) School policy	Guliani et al. (2015) Toronto (Canada)	Distance Built environment (walkability: intersection density; crossings) (aesthetics) Traffic safety (high amount of traffic)

Table 2 (continued)

AuthorLocality, (country)	Associated barriers	Author locality (country)	Associated barriers
Eyler et al. (2008)	Crime-related safety (abductions)	Gustat et al. (2015)	Distance
Missouri, Massachusetts, South Carolina, North Carolina, Columbia (USA)	Traffic safety (high amount of traffic; danger behaviour)	Louisiana (USA)	Time
	Built environment (walkability: sidewalks, crosswalks and crossing guards)		Children's preferences (permission)
			School policy
			Social support (absence of adults and children)
			Traffic safety (high speed of traffic)
Heelan et al. (2008)	Traffic safety (high amount of traffic)	Van Kann et al. (2016)	Built environment (walkability: light)
Nebraska (USA)	Time constraints	Southern Limburg (Netherlands)	
	Built environment (walkability: crosswalks)		
Yeung et al. (2008)	Distance	Yu and Zhu (2016)	Social support (absence of children and adults)
Queensland (Australia)		Austin, Texas (USA)	Children's competences
			Children's preferences
			Crime-related safety (strangers; bullying; attacked by dogs)
			Distance
			Built environment (walkability: intersection; sidewalks; overall walkability)
			Traffic safety (high amount of traffic; danger behaviour)
Zhu et al. (2008)	Physical and motivation	Carlson et al. (2014)	Built environment (street connectivity)
Austin, Texas (USA)	Traffic safety (high amount of traffic; danger behaviour)	Baltimore, Maryland–Washington, DC and Seattle-King County, Washington metropolitan areas (USA)	Traffic safety (high amount of traffic)
	Social support (absence of adults and children)		Distance
	Distance		Physical and motivation barriers
	Built environment (walkability: highway/freeway); (land use mix: stores and office buildings)		
	Convenience		
	Time constraints		
	Crime-related safety		
	School policy		
Zhu and Lee (2009)	Distance	De Weese et al. (2013)	Built environment (walkability: sidewalk); (bikeability)
Austin, Texas (USA)	Built environment (walkability: highways/freeways); (land use mix: stores and office buildings)	New Jersey (USA)	
	Time constraints		
	Convenience		
	School policy (bus service)		
	Physical and motivation barriers		
	Social support		
	Traffic safety (danger behaviour)		
	Crime-related safety		
	Children's preferences		

Table 2 (continued)

AuthorLocality, (country)	Associated barriers	Author locality (country)	Associated barriers
Napier et al. (2011)	Crime-related safety	Kerr et al. (2006)	Crime-related safety (strangers; bullying)
(USA)	Distance	Seattle (USA)	Traffic safety (high amount of traffic; high speed of traffic)
	Built environment (walkability)		Built environment (walkability, bikeability, land use mix (stores) and aesthetics)
	Traffic safety		Schedule
			Convenience
Shokoohi et al. (2012a)	Crime-related safety	Forman et al. (2008)	Built environment (walkability: sidewalks, crossings); (bikeability: facilities)
Tehran (Iran)	Social support (absence of children and adults)	San Diego, Boston, Cincinnati (USA)	Natural environment (hills)
			Weather (bad lighting)
			Distance
			Physical and motivation barriers (boring)
			Traffic safety (high amount of traffic)
			Crime-related safety (bullying; attacked by dogs)
Shokoohi et al. (2012b)	Traffic safety (high speed of traffic; high amount of traffic)	Hume et al. (2009)	Social support (absence of children)
Tehran (Iran)	Built environment (walkability: cross road with more than four lanes; narrow streets; crosswalks; traffic signs)	Melbourne (Australia)	Traffic safety (danger behaviour)
			Crime-related safety (stranger danger)
			Built environment (walkability: lights or crossings and pedestrian crossings); (aesthetics)
Lee et al. (2013)	Traffic safety (high amount of traffic)	Rosenberg et al. (2009)	*Children:*
Austin, Texas (USA)	Crime-related safety (abduction)	Boston, Cincinnati and San Diego (USA)	Built environment (land use mix diversity); (residential density)
	Distance		*Adolescents:*
	Convenience		Built environment (walkability and overall environment); (Bikeability); (others: recreation facilities)
	Built environment (walkability: sidewalks; overall walking environments)		
Chillón et al. (2014)	Children's preferences		
Florida, North Carolina, Texas, Colorado, California, Alaska, Minnesota, Pennsylvania and New Jersey (USA)	Crime-related safety (attacked by dogs)		
	Weather		
	Traffic safety (high amount of traffic)		
	Built environment (walkability)		
	Social support		

environment) (Mandic et al. 2015). This categorization provides researchers and practitioners with a useful tool in order to name each barrier using the same terminology and making the communication between experts easier and more direct.

The identified studies mainly focused on parents of children and focused less on parents of adolescents. A previous study suggested that the perception of barriers by parents decreases as children grow (Forman et al. 2008). Furthermore, parents of adolescents reported a less amount

barriers than parents of children (Yeung et al. 2008). When children grow up, their involvement in the decision making and their autonomy increase (Panter et al. 2008; Valentine 1997). Besides, in the studies identified in this review, both parents of children and parents of adolescents reported barriers to active transport to school, although parents of children had more concerns than parents of adolescents (Kerr et al. 2006). Moreover, the main reported barriers of the parents of children were built environment, traffic safety, distance, crime-related safety and social support. The parental barriers of the adolescents' parents were built environment, distance and traffic safety. Generalization is, however, not possible with only a single study focusing solely on adolescents (Carlson et al. 2014). In addition, parents of children who passively commute to school reported a high number of barriers or higher scores of barriers than parents of children who use active transport to school (Lee et al. 2013). When children grow, they get a greater degree of autonomy to perform better any type of task and the parental concerns are reduced to some extent (Forman et al. 2008). In terms of physical activity, when parents are physically active, they tend to encourage their children to set these behaviours and attitudes (Rodriguez-Lopez et al. 2013; Mitchell et al. 2012). Accordingly, parental barriers might be more important for parents of children than for parents of adolescents and for inactive parents than for active parents. It is necessary to continue examining both populations separately to know accurately what the barriers of parents of both children and adolescents are, in order to create and develop strategies to reduce them.

The barrier distance was highly reported in the 15 studies, and it was found to be associated with active transport to school in 14 studies, while only 1 study did not report association (Heelan et al. 2008). Therefore, this barrier is perceived by parents as the main predictor to active transport to school (Weigand and McDonald 2011). When the distance is shorter, the rates of active transport to school are higher (D'Haese et al. 2011; Mandic et al. 2015). The threshold distance that young Spanish people are willing to actively transport to school is 875 m in children, and 1350 m in adolescents (Rodríguez-López et al. 2017). Also, Timperio et al. (2006) found a negative association between the distance to school and the mode of transport in children from Australia. However, real distances from home to school may be higher because of different reasons such as parents preferring to enrol their children in a particular school rather than in the local school; or them wanting a specific type of school; or the lack of available place at the local school, among others (Carver et al. 2013). These findings are important for policy makers in order to build schools with available walking distance for the students (Mandic et al. 2015; Huertas-Delgado et al. 2017) or implement drop-off spots close to school (Vanwolleghem et al. 2014).

Regarding the traffic safety barrier, most of the studies that found an association with active transport to school referred to the high amount of traffic as the main reason (13 studies), and dangerous behaviour of drivers (9 studies); a lower number of studies mentioned high-speed traffic (5 studies) as a barrier. The traffic barriers referred to the areas around school, in the neighbourhood and on the route to and from school. Traffic may be caused by school and work schedules and is related to the increased traffic in peak times in urban areas. Furthermore, the parents' fear of traffic may reverse to paradoxically increase the traffic, since parents may think that the best way of avoiding traffic accidents is driving their children (Fyhri et al. 2011). For this reason, it is important to reduce traffic in school surroundings and promote active transport to school as a safe behaviour.

Regarding crime-related safety, parents reported that they are afraid of bullying by other children or strangers and the possibility of abduction of their children (Ahlport et al. 2008; Lee et al. 2013). These reasons may be emphasized by social media that may make parents wonder if it is safe to let their children go to school walking or cycling and taking these risks. These risks are not totally real, as sometimes parents are influenced by media, which focuses too much on the problem and causes (Lorenc et al. 2008), where the truth is that it is more probable that a child will be abducted by a relative or an acquaintance than by a stranger (Shutt et al. 2004).

According to the built environment category, the studies mentioned walkability as a barrier based mainly on two elements: sidewalks (i.e. lack of sidewalk and maintenance of this) and street crossings (i.e. lack of crossings). The built environment might improve through infrastructure modifications around the school and in the route from home to school, supported by governments and politicians. Examples of environmental policies to increase active transport to school are to increase the facilities for walking or cycling to the school, such as reducing the speed of traffic to 30 km/h or to build bicycle lines; or to decline the architectural barrier for people with specific needs (Kerr et al. 2006; Lee et al. 2013; Napier et al. 2011).

The social support barrier is the presence or absence of other children. If children are accompanied by adults or other children, the rates of active transport to school increase (Greves et al. 2007; Gustat et al. 2015; Kerr et al. 2006). Moreover, parents' accompaniment of their children when walking or cycling to school can be an opportunity to teach them how to handle different situations, avoid road hazards and improve their skills (Ghekiere et al. 2016). This knowledge could increase the confidence of parents in their children and the child's autonomy and independence

for going with their friends or others acquaintance. Since this barrier has been improved in previous intervention programmes in the USA such as school walking (Mendoza et al. 2009), further intervention programmes should address it.

These findings suggest that future interventions should aim to improve the perceptions of parents and to improve some barriers in the built environment (Greves et al. 2007), such as providing adequate crosswalks, sidewalks and crossing guards (Ahlport et al. 2008). In addition, the social support should be increased to get parents less worried about their children while they go to and from school (Hume et al. 2009).

The current review has some limitations that merit to be mentioned. On the one hand, the classification of the category of barriers has been prepared according to the ecological general framework for active transport to school but there is not a specific framework for parental barriers. In addition, there is only one study that solely reports barriers of parents of adolescents. Therefore, conducting more studies in this population is necessary. Besides, the vast majority of the studies included in this review are from the USA (18) and only 9 of the studies included are from Europe (2), Asia (2) and Oceania (4). Studying parental barriers in other regions should be encouraged, as they are very context related. Moreover, due to the different tools used in the studies (self-report survey, questionnaire, focus group, telephone and in-person interview), and the different terms used to specify the barriers, it is difficult to compare the different studies. Also, EPHPP identify that the quality of primary research is weak overall. Therefore, more high-quality research is needed. On the other hand, some strengths must be highlighted. To our knowledge, this review might be the first systematic review about parental barriers to active transport to school of their children and adolescents. Moreover, we provide a categorization that includes all parental barriers in the literature according to a theoretical framework. Furthermore, every process in the selection and extracting data were conducted by two researchers to assure the quality of the results. Another strength is the inclusion of a quality assessment.

Conclusions

Parental barriers of active transport to school in children and adolescents are reported. To conclude, the main barriers were distance, traffic safety, crime-related safety, built environment and social support. Additionally, a solid classification of the barriers was provided to all the identified barriers from all the studies included in this review, according to the ecological framework. This classification could be useful for administration and researchers. Due to weak quality identified by EPHPP, more high-quality research is needed. Consequently, future interventions might aim to reduce these parental barriers to active transport to school through programmes focused on increasing the safety and improving the social support. These programmes should be based on two strategies: a) develop public health policies to improve the built environment and the traffic problems in the route to school and b) develop educational interventions to improve the negative parent's perceptions of their children's active transport to school.

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Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

References

Ahlport KN, Linnan L, Vaughn A, Evenson KR, Ward DS (2008) Barriers to and facilitators of walking and bicycling to school: formative results from the non-motorized travel study. Health Educ Behav 35:221–244

Black C, Collins A, Snell M (2001) Encouraging walking: the case of journey-to-school trips in compact urban areas. Urban Stud 38:1121–1141

Buliung RN, 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. https://doi.org/10.1016/j.ypmed.2009.03.001

Carlson JA, Sallis JF, Kerr J, Conway TL, Cain K, Frank LD, Saelens BE (2014) Built environment characteristics and parent active transportation are associated with active travel to school in youth age 12–15. Br J Sports Med 48:1634–1639. https://doi.org/10.1136/bjsports-2013-093101

Carver A, Timperio A, Crawford D (2013) Parental chauffeurs: what drives their transport choice? J Transp Geogr 26:72–77

Chillón P, Ortega FB, Ruiz JR, Veidebaum T, Oja L, Mäestu J, Sjöström M (2010) Active commuting to school in children and adolescents: an opportunity to increase physical activity and fitness. Scand J Public Health 38:873–879. https://doi.org/10.1177/1403494810384427

Chillón P, Martínez-Gómez D, Ortega FB, Pérez-López IJ, Díaz LE, Veses AM, Veiga OL, Marcos A, Delgado-Fernández M (2013) Six-year trend in active commuting to school in Spanish adolescents. Int J Behav Med 20:529–537. https://doi.org/10.1007/s12529-012-9267-9

Chillón P, Hales D, Vaughn A, Gizlice Z, Ni A, Ward DS (2014) A cross-sectional study of demographic, environmental and parental barriers to active school travel among children in the United States. Int J Behav Nutr Phys Activity 1:61. https://doi.org/10.1186/1479-5868-11-61

De Meester F, Van Dyck D, De Bourdeaudhuij I, Cardon G (2014) Parental perceived neighborhood attributes: associations with active transport and physical activity among 10–12 year old children and the mediating role of independent mobility. BMC Public Health 14:631. https://doi.org/10.1186/1471-2458-14-631

Dellinger AM, Centers for Disease Control and Prevention (2002) Barriers to children walking and biking to school–United States, 1999. MMWR: Morbidity and mortality weekly report, vol 51, pp 701–704

DeWeese RS, Yedidia MJ, Tulloch DL, Ohri-Vachaspati P (2013) Neighborhood perceptions and active school commuting in low-income cities. Am J Prev Med 45:393–400. https://doi.org/10.1016/j.amepre.2013.04.023

D'Haese S, De Meester F, De Bourdeaudhuij I, Deforche B, Cardon G (2011) Criterion distances and environmental correlates of active commuting to school in children. Int J Behav Nutr Phys Activity 8:88. https://doi.org/10.1186/1479-5868-8-88

Effective Public Health Practice Project: Quality assessment Tool for Quantitative Studies (EPHPP) (1998). http://www.ephpp.ca/tools.html. Accesed March 2018

Eyler A, Baldwin J, Carnoske C, Nickelson J, Troped P, Steinman L, Pluto D, Litt J, Evenson K, Terpstra J, Brownson R, Schmid T (2008) Parental involvement in active transport to school initiatives: a multi-site case study. Am J Health Educ 39:138–147. https://doi.org/10.1080/19325037.2008.10599029

Forman H, Kerr J, Norman GJ, Saelens BE, Durant NH, Harris SK, Sallis JF (2008) Reliability and validity of destination-specific barriers to walking and cycling for youth. Prev Med 46:311–316. https://doi.org/10.1016/j.ypmed.2007.12.006

Fyhri A, Hjorthol R, Mackett RL, Fotel TN, Kyttä M (2011) Children's active travel and independent mobility in four countries: development, social contributing trends and measures. Transp Policy 18:703–710. https://doi.org/10.1016/j.tranpol.2011.01.005

Ghekiere A, Carver A, Veitch J, Salmon J, Deforche B, Timperio A (2016) Does parental accompaniment when walking or cycling moderate the association between physical neighbourhood environment and active transport among 10–12 year olds? J Sci Med Sport 19:149–153. https://doi.org/10.1016/j.jsams.2015.01.003

Giles-Corti B, Kelty SF, Zubrick SR, Villanueva KP (2009) Encouraging walking for transport and physical activity in children and adolescents. Sports Med 39:995–1009. https://doi.org/10.2165/11319620-000000000-00000

Greves HM, Lozano P, Liu L, Busby K, Cole J, Johnston B (2007) Immigrant families' perceptions on walking to school and school breakfast: a focus group study. Int J Behav Nutr Phys Activity 4:64

Guliani A, Mitra R, Buliung RN, Larsen K, Faulkner GE (2015) Gender-based differences in school travel mode choice behaviour: examining the relationship between the neighbourhood environment and perceived traffic safety. J Transp Health 2:502–511. https://doi.org/10.1016/j.jth.2015.08.008

Gustat J, Richards K, Rice J, Andersen L, Parker-Karst K, Cole S (2015) Youth walking and biking rates vary by environments around 5 Louisiana schools. J School Health 85:36–42. https://doi.org/10.1111/josh.12220

Heelan KA, Unruh SA, Combs JH, Abbey BM, Sutton S, Donnelly JA (2008) Walking to school: taking research to practice. J Phys Educ Recreat Danc 79:36–41. https://doi.org/10.1080/07303084.2008.10598197

Huertas-Delgado FJ, Herrador-Colmenero M, Villa-González E, Aranda-Balboa MJ, Cáceres MV, Mandic S, Chillón P (2017) Parental perceptions of barriers to active commuting to school in Spanish children and adolescents. Eur J Public Health 27:416–421. https://doi.org/10.1093/eurpub/ckw249

Hume C, Timperio A, Salmon J, Carver A, Giles-Corti B, Crawford D (2009) Walking and cycling to school: predictors of increases among children and adolescents. Am J Prev Med 36:195–200. https://doi.org/10.1016/j.amepre.2008.10.011

Kerr J, Rosenberg D, Sallis JF, Saelens BE, Frank LD, Conway TL (2006) Active commuting to school: associations with environment and parental concerns. Med Sci Sports Exerc 38:787–793

Lee C, Zhu X, Yoon J, Varni JW (2013) Beyond distance: children's school travel mode choice. Ann Behav Med 45:S55–S67. https://doi.org/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 Commun Health 62:852–857. https://doi.org/10.1136/jech.2007.070250

Lu W, McKyer ELJ, Lee C, Wang S, Goodson P, Ory MG (2014) Active commuting to school: a test of a modified integrative model. Am J Health Behav 38:900–913. https://doi.org/10.5993/AJHB.38.6.12

Mandic S, De la Barra SL, Bengoechea EG, Stevens E, Flaherty C, Moore A, Middlemiss M, Williams J, Skidmore P (2015) Personal, social and environmental correlates of active transport to school among adolescents in Otago, New Zealand. J Sci Med Sport 18:432–437. https://doi.org/10.1016/j.jsams.2014.06.012

McDonald NC (2007) Active transportation to school: trends among US schoolchildren, 1969–2001. Am J Prev Med 32:509–516. https://doi.org/10.1016/j.amepre.2007.02.022

Mendoza JA, Levinger DD, Johnston BD (2009) Pilot evaluation of a walking school bus program in a low-income, urban community. BMC Public Health 9:122. https://doi.org/10.1186/1471-2458-9-122

Ministry of Health Social Services and Equality. Spanish Government. (2015) Actividad Física para la Salud y Reducción del Sedentarismo. Recomendaciones para la población. Estrategia de Promoción de la Salud y Prevención en el SNS. Madrid, 2015. https://www.msssi.gob.es/profesionales/saludPublica/prevPromocion/Estrategia/docs/Recomendaciones_ActivFisica_para_la_Salud.pdf. Accessed March 2018

Mitchell J, Skouteris H, McCabe M, Ricciardelli LA, Milgrom J, Baur LA, Fuller-Tyszkiwicz M, Dwyer G (2012) Physical activity in young children: a systematic review of parental influences. Early Child Dev Care 182:1411–1437. https://doi.org/10.1080/03004430.2011.619658

Napier MA, Brown BB, Werner CM, Gallimore J (2011) Walking to school: community design and child and parent barriers. J Environ Psychol 31:45–51. https://doi.org/10.1016/j.jenvp.2010.04.005

Oluyomi AO, Lee C, Nehme E, Dowdy D, Ory MG, Hoelscher DM (2014) Parental safety concerns and active school commute:

correlates across multiple domains in the home-to-school journey. Int J Behav Nutr Phys Activity 11:32. https://doi.org/10.1186/1479-5868-11-32

Panter JR, Jones AP, Van Sluijs EM (2008) Environmental determinants of active travel in youth: a review and framework for future research. Int J Behav Nutr Phys Activity 5:34. https://doi.org/10.1186/1479-5868-5-34

Panter J, Corder K, Griffin SJ, Jones AP, van Sluijs EM (2013) Individual, socio-cultural and environmental predictors of uptake and maintenance of active commuting in children: longitudinal results from the SPEEDY study. Int J Behav Nutr Phys Activity 10(1):83

Rodriguez-Lopez C, Villa-Gonzalez E, Perez-Lopez IJ, Delgado-Fernandez M, Ruiz JR, Chillon P (2013) Family factors influence active commuting to school in Spanish children. Nutr Hosp 28:756–763. https://doi.org/10.3305/nh.2013.28.3.6399

Rodríguez-López C, Salas-Fariña ZM, Villa-González E, Borges-Cosic M, Herrador-Colmenero M, Medina-Casaubón J, Ortega FB, Chillón P (2017) The threshold distance associated with walking from home to school. Health Educ Behav 44:857–866. https://doi.org/10.1177/1090198116688429

Rosenberg D, Ding D, Sallis JF, Kerr J, Norman GJ, Durant N, Harris SK, Saelens BE (2009) Neighborhood environment walkability scale for youth (NEWS-Y): reliability and relationship with physical activity. Prev Med 49:213–218. https://doi.org/10.1016/j.ypmed.2009.07.011

Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J (2006) An ecological approach to creating active living communities. Annu Rev Public Health 27:297–322. https://doi.org/10.1146/annurev.publhealth.27.021405.102100

Salmon J, Salmon L, Crawford DA, Hume C, Timperio A (2007) Associations among individual, social, and environmental barriers and children's walking or cycling to school. Am J Health Promot 22:107–113. https://doi.org/10.4278/0890-1171-22.2.107

Shokoohi R, Hanif NR, Dali MM (2012a) Influence of the socio-economic factors on children's school travel. Procedia Soc Behav Sci 50:135–147. https://doi.org/10.1016/j.sbspro.2012.08.022

Shokoohi R, Hanif NR, Dali MM (2012b) Children walking to and from school in Tehran: associations with neighbourhood safety, parental concerns and children's perceptions. Procedia Soc Behav Sci 38:315–323. https://doi.org/10.1016/j.sbspro.2012.03.353

Shutt JE, Miller JM, Schreck CJ, Brown NK (2004) Reconsidering the leading myths of stranger child abduction. Crim Justice Stud 17:127–134. https://doi.org/10.1080/0888431042000217688

Timperio A, Crawford D, Telford A, Salmon J (2004) Perceptions about the local neighborhood and walking and cycling among children. Prev Med 38:39–47. https://doi.org/10.1016/j.ypmed.2003.09.026

Timperio A, Ball K, Salmon J, Roberts R, Giles-Corti B, Simmons D, Baur LA, Crawford D (2006) Personal, family, social, and environmental correlates of active commuting to school. Am J Prev Med 30:45–51. https://doi.org/10.1016/j.amepre.2005.08.047

Valentine G (1997) 'My Son's a Bit Dizzy''.My Wife's a Bit Soft': gender, children and cultures of parenting. Gend Place Cult J Fem Geogr 4:37–62. https://doi.org/10.1080/09663699725495

Van der Ploeg HP, Merom D, Corpuz G, Bauman AE (2008) Trends in Australian children traveling to school 1971–2003: burning petrol or carbohydrates? Prev Med 46:60–62. https://doi.org/10.1016/j.ypmed.2007.06.002

Van Kann DHH, Kremers SPJ, De Vries SI, De Vries NK, Jansen MWJ (2016) Parental active transportation routines (PATRns) as a moderator of the association between neighborhood characteristics and parental influences and active school transportation. Environ Behav 48(7):946–965. https://doi.org/10.1177/0013916515574548

Vanwolleghem G, D'Haese S, Van Dyck D, De Bourdeaudhuij I, Cardon G (2014) Feasibility and effectiveness of drop-off spots to promote walking to school. Int J Behav Nutr Phys Activity 11:136. https://doi.org/10.1186/s12966-014-0136-6

Weigand L, McDonald N (2011) Evaluation of safe routes to school programs: qualitative and quantitative analysis of parental decision-making. https://doi.org/10.15760/trec.52

Wilson EJ, Wilson R, Krizek KJ (2007) The implications of school choice on travel behavior and environmental emissions. Transp Res Part D: Transp Environ 12:506–518

World Health Organization (WHO) (2010) World recommendations of physical activity. http://whqlibdoc.who.int/publications/2010/9789243599977_spa.pdf?ua=1. Accessed March 2018

World Health Organization (WHO) (2015) Global Strategy on Diet, Physical Activity and Health. http://www.who.int/dietphysicalactivity/childhood/en/. Accessed March 2018

Yeung J, Wearing S, Hills AP (2008) Child transport practices and perceived barriers in active commuting to school. Transp Res Part A Policy Pract 42:895–900. https://doi.org/10.1016/j.tra.2007.12.007

Yu CY, Zhu X (2016) From attitude to action: what shapes attitude toward walking to/from school and how does it influence actual behaviors? Prev Med 90:72–78. https://doi.org/10.1016/j.ypmed.2016.06.036

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. https://doi.org/10.1057/jphp.2008.51

Zhu X, Arch B, Lee C (2008) Personal, social, and environmental correlates of walking to school behaviors: case study in Austin, Texas. Sci World J 8:859–872. https://doi.org/10.1100/tsw.2008.63