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Review Article

ACTIVE COMMUTING TO SCHOOL AND ASSOCIATED FACTORS AMONG ADOLESCENTS: A SYSTEMATIC REVIEW

DESLOCAMENTO ATIVO PARA A ESCOLA E FATORES ASSOCIADOS EM ADOLESCENTES: UMA REVISÃO SISTEMÁTICA

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RESUMO

A inatividade física, considerada um problema de saúde pública mundial, tem sido um comportamento típico na adolescência. Esta revisão sistemática objetivou examinar os estudos que analisaram o deslocamento para a escola em adolescentes e sua associação com fatores sociodemográficos, composição coporal, atividade física e aptidão cardiorrespiratória. A busca foi realizada nas bases de dados eletrônicas Medline, Cinahl e Web of Sceince. Foram incluídos vinte e três estudos observacionais com amostras de adolescentes (10-19 anos), todos publicados em inglês, de 2003 a 2014. A maioria das investigações teve como foco principal o deslocamento ativo, sendo que as maiores prevalências foram observadas entre os rapazes, os adolescentes mais jovens, de famílias de baixa renda e cujas mães tinham menor nível educacional. Os adolescentes com composição corporal mais saudável e com maiores níveis de atividade física e aptidão cardiorrespiratória foram os mais ativos no deslocamento de casa até escola. Apesar do deslocamento ativo para a escola estar associado com melhores condições de saúde, é necessário encorajá-lo nos adolescentes de famílias com melhores condições econômicas, moças, e entre os mais velhos.

Palavras-chave: Adolescente. Composição corporal. Atividade motora. Aptidão física.

ABSTRACT

Physical inactivity, considered a worldwide public health problem, has become a common behavior among adolescents. This systematic review aimed to examine the scientific evidence analyzing commuting to school in adolescents and its association with sociodemographic factors, body composition, physical activity and cardiorespiratory fitness. Articles were selected through the literature available in electronic databases (Medline, Cinahl and Web of Science). Twenty three observational studies, with samples composed of adolescents (10-19 years), all published in english language, from 2003 to 2014, were included. The majority of investigations had as main focus the active commuting and the highest prevalence of this outcome were found among boys, younger adolescents, those from lower income families and whose mothers had lower educational level. Adolescents with a healthier body composition and those with higher levels of physical activity and cardiorespiratory fitness were the most active in commuting from home to school. Despite the association between active commuting to school and better health conditions, it is necessary to encourage it among adolescents of better economic conditions, females and the older ones.

Keywords: Adolescent. Body composition. Motor activity. Physical fitness.

Introduction

The detrimental effects of physical inactivity on the health of the population are increasingly in evidence[1]. In 2009, a worldwide survey, made by self-report, estimated that 17.0% of the world population (both sexes) does not practice physical activity (PA) regularly[2]. Similarly, in 2012, a report with data from 122 countries, estimated that approximately 31.0% of the population did not reach the minimum PA recommendations[3].

In adolescence (13-15 years), the data of PA are further alarming, because it is estimated that 80.3% of them do not reach 60 minutes of PA per day of moderate/vigorous intensity[3,4] causing concern in public health agencies worldwide[5]. Towards that scenario,

researchers have recommended active commuting to school (ACS) as an interesting strategy which can of contributing part of the PA recommended for adolescents[6-7]. In addition, many studies have found evidences that ACS is associated with higher cardiorespiratory fitness (CRF) levels and with measures healthier of body weight and/or body mass index (BMI), however this information are still incoclusive[8-10].

In this context, evidences has showed that some sociodemographic factors may be associated to types of commuting from home to school, especially sex[11-13], age[13-15], economic level[16,17] and maternal educational level[14,15]. However, these factors were not previously compiled in systematic reviews, intending to identify adolescent groups more favorable to ACS, it still could help in identification of the adolescents more exposed to passive commuting. It is believed that this compilation of studies, showing the importance of PA for health living, can be an excellent justification to attract the attention of major governmental authorities towards the effectiveness of strategies that promote the ACS in adolescence, mainly considering that some behaviors at this stage of life may vary according to age, since is a period that comprises a very wide age range (10-19 years)[18].

In this way, the aim of this systematic review was to examine scientific evidence on commuting to school in adolescents and its association with sociodemographic factors, body composition, PA and CRF.

Methods

Search Strategy

This systematic review followed the recommendations of PRISMA - Preferred Reporting Items for Systematic Reviews and Meta-analyses[19,20]. The search was performed in electronic databases (MEDLINE, CINAHL and WEB OF SCIENCE), without a pre-established date, including all studies published until March 24, 2015. The study protocol was published on PROSPERO registry (CRD42012002541).

The search for the articles was conducted using the MeSH terms: Block 1: adolescence, adolescent, teenagers, teens, youth, students; Block 2: motor activity, physical activity, life style, sedentary, transportation, motor vehicles, physical fitness, exercise, locomotion, walking, physical performance, active school transport, active commut; Block 3: socioeconomic factors, standard of living, social class, socioeconomic status, body composition, anthropometry, body measures, body mass index, body fat, maternal educational status. Searches were conducted with terms in English language by combining Boolean operators “OR” and “AND”.

Selected articles had their report quality evaluated by STROBE - Strengthening the Reporting of Observational Studies in Epidemiology, used in previous international systematic reviews[22-27]. STROBE has a checklist consisting of 22 criteria and was used concurrently by two researchers in each study, it has received a score from zero to one and has been classified into three categories: A (≥ 80.0% of the criteria), B (50.0% to 79.0% the criteria) and C (< 50.0% the criteria).

Study selection

ACS was considered only when the distance from home to school was traveled by bicycle or walking. We included articles that investigated commuting to school with at least one of the items: sociodemographic factors (sex, age, economic level/family income, maternal educational level), body composition, PA and CRF (VO2max).

The methodological criteria used for the inclusion were: a) observational studies; b) sample of adolescents, from both sexes, aged 10-19 years[18]; and c) studies involving children and adolescents that performed analyzes stratified by age group. The exclusion criteria were

theses and dissertations, pilots, intervention and reviews studies, and articles that did not make clear the age of participants.

All stages of this review process (reading of titles, abstracts and full articles) were conducted by two researchers (Figure 1). When a study received divergent opinion among researchers, it was selected for the subsequent step to be then discussed until a final opinion. In addition, reference lists of selected articles were examined, which went through the same evaluation process. The data extraction was performed by means of electronic worksheet containing the main information of the articles (demographic and methodological).

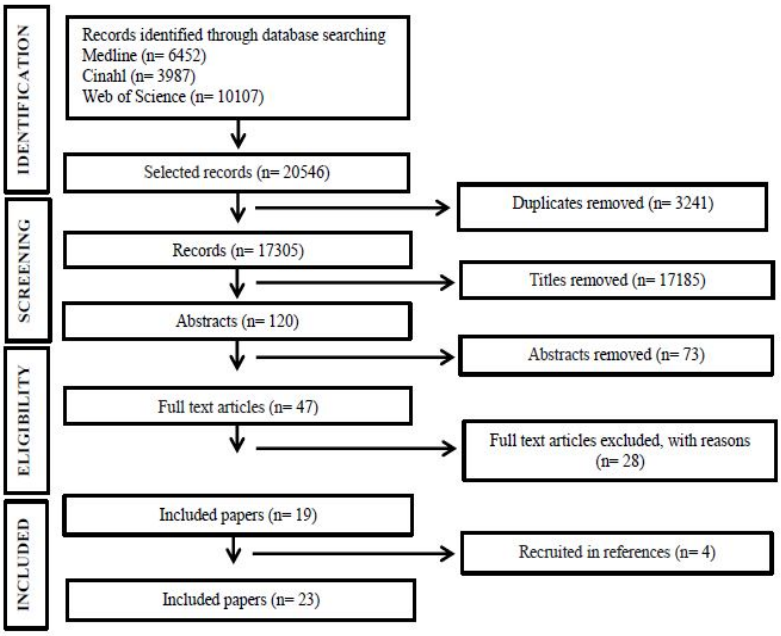

Figure 1 - Flow diagram of the included studies.
Source: The authors

Results

The search resulted in a total of 20,546 articles. It were excluded: duplicates (n=3,241), the ones which were not related with the theme and showed some exclusion criteria in the reading of title (n=17,185) and reading of abstract (n=73). In this way, 47 potential articles circumstantially presented criteria for inclusion and thus had their contents read in full. After careful reading and applying the inclusion and exclusion criteria, 28 articles were excluded. The scanning of references enabled the recruitment of four other investigations, which resulted in the inclusion of 23 articles, all cross-sectional design. No article had a quality report classified at C category, according to STROBE. This study gathered data from 57,607 adolescents and the samples size ranged from 92 to 10,380 individuals. Articles were published between 2003 to 2013, most of them were from European countries. Table 1 shows the characteristics of studies included in this review. The main results of these studies are described in Table 2.

Table 1. Sociodemographic and methodological characteristics of studies included in the systematic review.

First author (date)	Age (years)	Sample (country)	Main variables	Instruments	Statistical tests
Aires (2011)[28*]	11-19	1.708 (Portugal)	CS; BMI; PA; Body fat; Screen time; CRF.	Questionnaire; 20-m shuttle run test.	Linear Regression.
Alexander (2005)[29+]	13-14	92 (Scotland)	CS; PA.	Questionnaire; Accelerometer.	Uninformed.
Andersen (2009)[30*]	15-19	1.249 (Denmark)	CS; BMI; PA; Physical fitness.	Questionnaire; Field tests; Cycle-ergometer.	One-Way ANOVA.
Arango (2011)[31*]	11-18	546 (Colombia)	CS; BMI; PA; Screen time;	Questionnaire.	Logistic Regression.
Baig (2009)[32+]	11-14	673 (England)	CS; BMI; PA.	Questionnaire.	Logistic Regression.
Bere (2011)[11]*	12-15	2.558 (Netherlands/ Norway)	CS; BMI.	Questionnaire.	Logistic Regression.
Bungum (2009)[33]*	15	2.692 (United States)	CS; Barriers to practice PA. Psychosocial variables; Environmental conditions.	Questionnaire.	Logistic Regression.
Chillon (2009)[14+]	13-18	2.183 (Spain)	CS; Socioeconomic factors.	Questionnaire.	Logistic Regression.
Cooper (2006)[34+]	15	389 (Denmark)	CS; PA; Body fat; CRF.	Questionnaire; Accelerometer; Cycle-ergometer.	Linear Regression
Dyck (2010)[12]*	17-18	1.281 (Belgium)	CS; PA; Environmental conditions; Environment variables.	Questionnaire.	Logistic Regression.
Landsberg (2008)[35]*	14-15	626 (Germany)	CS; Life style. BMI; Body fat; PerC; .	Questionnaire.	
Ostergaard (2012)[36+]	12-16	3.847 (Denmark)	CS BMI, Body fat; Physical fitness.	Questionnaire.	Linear Regression.
Ostergaard (2013)[10]*	15	635 (Norway)	CS; BMI; Body fat;	Questionnaire; Cycle-ergometer.	Linear Regression.
Reimers (2013)[16]*	11-17	1.828 (Germany)	CS; Environmental conditions.	Questionnaire.	Logistic Regression.
Sandercock (2012)[9+]	10-16	6.819 (England)	CS; BMI; PA; Screen time.	Questionnaire; 20-m shuttle run test.	Logistic Regression.
Santos (2010)[15+]	14-19	4.207 (Brazil)	CS; BMI; PA; Life Style.	Questionnaire.	Logistic Regression.
Silva (2011)[13]*	11-17	1.622 (Brazil)	CS; PA; BMI; Sedentary behavior; Body fat; Waist circumference.	Questionnaire; Diary; 20-m shuttle run test.	Poisson Regression.
Silva (2011)[37]*	15-19	5.028 (Brazil)	CS; Commuting to work; Family income.	Questionnaire.	Logistic Regression.
Stock (2011)[17]*	13-15	10.380 (Denmark)	CS; Socioeconomic factors.	Questionnaire.	Logistic Regression.
Timperio (2006)[38+]	10-12	677 (Australia)	CS; BMI; Socioeconomic factors; Social perception and the environment.	Questionnaire.	Logistic Regression.
Tudor-Locke (2003)[39]*	14-16	1.518 (Filipinas)	CS; BMI; PA; Family income.	Questionnaire; Accelerometer.	One-Way ANOVA.
Voss (2010)[40+]	10-15	6.085 (England)	CS BMI; PA; CRF.	Questionnaire; 20-m shuttle run test.	Logistic Regression.
Wen (2010)[41]*	10-13	964 (Australia)	CS; BMI; PA; Screen time.	Questionnaire.	Logistic Regression.

Abbreviations: ACS: active commuting to school; CS: commuting to school; BMI: body mass index; PA: physical activity; CRF: cardiorespiratory fitness; STROBE classification ([*]A, [+]B).
Source: The authors

Of the 23 included studies, eight found that boys were more active in commuting to school than girls[11-13,17,33,37,38,40], four pointed to an inverse direction[14,15,30,32]. In relation to age, five studies found that younger adolescents were more active than older ones[13-15,35,37,39], while two studies found an inverse situation[15,32]. Regarding economic level, seven studies had investigated the association with commuting to school[13,16,17,35-37,39], being that five found

association between ACS and lower economic conditions[13,16,17,37,39] and other two found a reverse direction[35,36]. Three studies investigated the association between commuting to school and maternal educational level[12,14,15], but only two studies found an association[14,15].

Among the studies included, 16 used body composition variables, but only six found association between commuting to school and body composition[10,11,31,35,37,41]. The most commonly used anthropometric indicators were BMI[11,31,37,41] and body fat measured by skinfolds[10,35]. In terms of PA, 16 studies of the 23 included in this review found association between ACS and PA, being that only in three, PA was assessed by accelerometer[29,34,39], while in the others[9,12,13,15,28,31-33,35,36,40,41] PA was estimated by self-report. Eight studies[12,13,29,34-36,39,40] found association between ACS and PA levels according to the recommendations for adolescents. A total of seven studies found association between ACS with CRF[9,10,28,30,34,37,40], three used the cycle ergometer protocol[10,30,34], and four used the 20m shuttle run test[9,28,37,40] to measure CRF.

Table 2. Main results of the studies included in the review.

First author (date)	Prevalence (%) ACS	Results found
Aires (2011)[28]	21,4	ASC was positively associated to CRF.
Alexander (2005)[29]	48,9	ACS was positively associated to higher levels of PA.
Andersen (2009)[30]	76,1	Girls commuted to school more actively than boys. Adolescents who pedaled to school had better CRF than those who walked or commuted passively.
Arango (2011)[31]	66,3	ACS was negatively associated to overweight.
Baig (2009)[32]	50,0	Girls and older adolescents (13-14 years) commuted to school more actively.
Bere (2011)[11]	65,8/69,6	Boys commuted to school more actively than girls. ACS was negatively associated do overweight.
Bungum (2009)[33]	4,6	Boys commuted to school more actively than girls.
Chillon (2009)[14]	64,8	Girls and younger adolescents (13-14 years) commuted to school more actively. ASC to school was positively associated to lower maternal educational level in male and, negatively associated to this factor in female.
Cooper (2006)[34]	86,4	Adolescents that walked to school had higher PA level than those who pedaled ans those who commuted passively. Adolescents who pedaled to school had better CRF than those who walked and those who commuted passively.
Dyck (2010)[12]	58,4	Boys commuted to school more actively than girls. ACS was positively associated to higher PA levels.
Landsberg (2008)[35]	62,6	Younger adolescents (14 years) and those with higher economic level commuted to school more actively. Adolescents that commuted actively had lower body adiposity. ACS was positively associated to higher PA levels.
Ostergaard (2012)[36]	83,6	Adolescents with higher economic level commuted to school more actively. ACS was negatively associated to overweight and positively associated to higher PA levels.
Ostergaard (2013)[10]	65,2	Adolescents that commuted actively had lower body adiposity. ACS was positively associated to CRF.
Reimers (2013)[16]	41,6	Adolescents with lower economic level commuted to school more actively.
Sandercock (2012)[9]	55,1	ASC was positively associated to CRF.
Santos (2010)[15]	57,0	Girls and older boys (17-19 years) commuted to school more actively. ACS was positively associated to lower maternal educational level.
Silva (2011)[13]	62,5	Boys and younger adolescents (11-14 years) commuted to school more actively.
Silva (2011)[37]	56,7	Boys, younger adolescents (15-16 years) and those with lower economic level commuted to school more actively. ACS was positively associated to higher PA levels. ACS was positively associated to CRF.
Stock (2011)[17]	64,7	Boys and adolescents with lower economic level commuted to school more actively.
Timperio (2006)[38]	66,5	Boys commuted to school more actively than girls.
Tudor-Locke (2003)[39]	41,2	Younger adolescents (mean aged 15,5 years for boys and 14,5 for girls) and those with lower economic level commuted to school more actively. ACS was positively associated to higher PA levels.
Voss (2010)[40]	57,9	Boys commuted to school more actively than girls. Adolescents who pedaled to school had higher PA levels than those who used any other type of transport. ACS was positively associated to CRF.
Wen (2010)[41]	66,5	ACS was negatively associated to obesity.

Source: The authors

Discussion

The main findings of this systematic review were: a) male and younger adolescents from families with lower economic status were more active in commuting to school than female, older adolescents from families of better economic level; b) ACS was associated with healthy body composition; c) ACS was associated with higher PA and CRF levels.

Male gender was associated with ACS in eight studies[11-13,17,33,37,38,40], while girls were more active only in four[14,15,30,32]. A study in Scotland that sought to explore the views of adolescents on ACS found that some factors may be decisive in choosing a type of commuting to school[42]. According to the authors, factors such as time/distance and personal safety were reported by adolescents as barriers to ACS. Considering the lack of personal safety observed by adolescents in the study by Kirby and Inchley[42], it is possible that social tendency of parents to protect more daughters than sons may restrict this behavior in girls[43]. Furthermore, girls seem more concerned about some situations than boys, such as perspiration, weather conditions and physical appearance regarding the use of the safety helmet for use of a bicycle[33], which could result in their resistance to ACS.

Among studies, it was observed a higher trend of ACS among younger adolescents[13,14,35,37,39]. Despite this trend, it is necessary to consider the age-group utilized in the studies, because it can be complex to compare pre-adolescents (10-14 years) and adolescents (15-19 years), since behavior between these ages-groups can differ. In this way, the result must be interpreted with caution because this comparison per phases was not the focus of this review. However, it is possible that the positive relationship between ACS and younger adolescents is valid up to the moment they obtain their driver's license and thus begin to drive to school because in some countries of America and Europe, driver's license can be acquired at younger age (14-16 years)[43].

Still considering the age, another possible explanation may be related to extracurricular activities, which are common among high school students. This was the result of research with American students found, a higher prevalence of ACS among high school students who were not engaged in activities out of school[44]. Thus, to optimize the time spent between school activities and work, older adolescents can opt for passive travel.

Adolescents of families with lower income were more likely to ACS than their peers from wealthier families. It is important to note that despite this observation have indicated an association between ACS with a lower family income, short number of found evidences do not allow to establish a cause and effect between these factors, specially by the cross-sectional design studies. Possibly, the absence of motorized transport in the family as an alternative to go to school, as well as the impossibility of hiring services for the driving school could explain this situation because both conditions may reflect the low economic condition of the family[45].

It is important to note that among the studies that found association, the one of Santos et al.[13] was conducted in student adolescents from Brazilian public schools, where the students are generally from middle/low income families and, maybe because their financial conditions that hamper the access to a motorized transport, so they are more likely to practice ACS.

Only two studies found association between commuting to school and maternal educational level, which suggests the need of further researches. In Brazil, a study found that the likelihood of adolescents to passively commute to school increased considerably as the maternal educational level increased[15]. In Spain, another study found that low maternal educational level increased the chances of adolescents to actively commute to school, while the likelihood of girls to actively commute to school reduced[14]. Based on this, it can be assumed that adolescents whose mothers have a lower educational level, are more

independent in their choices about how to commute, compared with those whose mothers have a higher educational level. Furthermore, it is possible to suppose that mothers with a higher educational level contribute more effectively for financial conditions of the family, increasing the chances of passive commuting to school. This hypothesis was suggested in previous studies, where adolescents of low financial income are more active in the commuting to school[13,16,17,37,39]. In relation to Spanish girls it is possible that they are, culturally, more protected by parents[15] and that excessive cares of daughters by mothers, is a more important factor in the choice of how to commute than the maternal educational level, although among Brazilian girls, a lower maternal educational level was associated to ACS.

The studies included showed no consensus about the association between ACS with a healthier body composition. Among the 16 studies that used anthropometric measures, only six[10-11,31,35-36,41] found associations with ACS, and of these, two used self-reported measures of body weight and height, that may have decreased the reliability of the BMI results. Probably, the absence of a greater number of evidence about this association is related to the possibility of compensation of energy expenditure from ACS in another daily behavior, such as the long time involved in sedentary activities, consumption of high-calorie food and low practice of PA[8].

Furthermore, it is not possible to assume that ACS gives, exclusively, sufficient amount of PA that impacts on body composition of adolescents, without considering the distance traveled to school[35], because in previous study, it was observed a decreased on body adiposity of adolescents that actively commuted in a larger distance from home to school[35]. In addition, considering that bicycle is a typical means of transport to go to school in Norway and the Netherlands, Bere et al.[11] found that adolescents who used this means of transport were less likely to be overweight than their peers (those who walked or commuted passively), and suggest that the use of bicycles can have an effect on weight status. Therefore, it is important to pay attention to the fact that the transversal design adopted in Bere et al. [11] does not allow to assume causality among the ways of commuting to school with weight status. Despite this, it is not rejected the hypothesis that cycling to school, requiring higher physical effort than walking, results in a higher spent of calories and contribute for a body weight maintenance[10].

We still supposed that the low number of adolescents in the studies that cycled to school may have reduced the number of evidences that reinforce the hypothesis of a possible impact on ACS focused in a healthier body composition. This precedent still suggests that cycling and walking groups, in a single category, may not be appropriate when the objective is to investigate a possible associations with body composition. Still, in relation to the use of bicycles, it can be emphasized that countries in which evidence recommends ACS to maintain body weight, except for the United States, the use of bicycles is a typical means of transport, and for this reason, it is acceptable that studies carried out in other nations have not found such associations[11,14,36].

In summary, some care should be taken when considering that ACS in this manner can, exclusively, reduce the likelihood of overweight/obesity in adolescence, because other factors such as cultural, social and environmental differences among populations that directly influence in the adhesion of commuting modes also can influence body composition[31]. However, when accepting the hypothesis that with the advancing of age, the risk of having overweight increases[11,] and considering the current patterns of PA in adolescence[3], as well as the increase of obesity in this stage of life, any opportunity that contribute to reverse these problems should be supported[35]. Future investigations on the use of bicycles by older adolescents, and specially case-control and prospective studies, can contribute to a better understanding of the relationship between cycling and body mass.

ACS was associated with higher levels of PA in eight studies. This relationship, however, cannot be explained only by the higher or lower PA levels between active or passive commuting[8]. Alexander et al.[29] analyzed PA in adolescents, using accelerometry, in different times of the day, and revealed that those who walked both ways (home-school-home), followed by those who walked at least one way, accumulated more time in minutes of moderate/vigorous PA than those who commuted passively, suggesting that ACS in school days contributes to higher levels of PA. Similarly, Van Dyck et al.[12] investigated the association of ACS, in leisure and in sports with PA and they found that only ACS was associated to overall PA level, supposing that this result is linked to the fact that classes occur in most days of the week.

Another study[46] found higher PA levels among those who commuted actively to school compared with their peers who commuted passively, but there was no difference in the PA levels of the children, during the class and in weekends, when stratified by the type of commuting. Other study[47] found that the students that commuted actively to school accumulated 3.0% more moderate/vigorous PA during the week in relation to those who commuted passively. Furthermore, an accumulation 8.5% higher of moderate/vigorous PA before and after school, among active students (comparing active and passive students) was verified, but at other moments times of the day (during classes and at night) the PA level did not differ between students who commuted actively and passively.

These results suggest that the ACS can be considered an excellent opportunity to increase overall and daily PA levels, but that the traveled distance should be considered, because of prominent oscillations in the PA levels were previously observed in studies that controlled the increase of the distance between home and school[8,46,48]. In relation to studies that not found associations between ACS and PA, it is possible to suppose that those who are active in commuting to school are less active at other moments of the day, and those who commuted passively do more PA at other times of the day.

Association between ACS and CRF was observed in the studies. However, stratifying ACS according to the type of transport (cycling or walking), results are inconsistent. Aires et al.[28] observed in 1,708 adolescents, by a run test, higher CRF among those who commuted actively than those who commuted passively to school. Interestingly, of the 355 adolescents who actively commuted to school, only 10 used a bicycle as mean of transport, and cycling to school was associated with better CRF, while walking was not. Other studies conducted with adolescents corroborate this findings[10,34]. This difference can be explained by the effort intensity provided by different types of ACS (walking and cycling), as evidence show that the beneficial use of bicycles in commuting seems to be more prominent on CRF than walking[49-50].

Other aspects should be considered for analysis of CRF in relation to commuting to school, such as PA level, familiarization with the collection instrument and effort intensity on the way to school[10,34]. Given the above, future studies should not group ACS because misinterpretation regarding CRF can be induced.

Among the limitations of this review, it is important to note that using only three databases and information from the titles and abstracts of studies, which may have resulted in reduced evidence and the cross-sectional design of the study, did not allow identifying causal inferences and specially for this, the results must be interpreted with prudence. Moreover, since all the included studies were of cross-sectional design, it was choosing not to use an assessment of risk bias, respecting the limitations of the present investigations.

However, this systematic review has strong aspects such as the use of a sensible strategy and no date or language restrictions, as well as good quality report of the included studies. Moreover, this appears to be the first systematic review using the context of

commuting to school that puts together, exclusively, adolescents (10-19 years) and also that included sociodemographic aspects, whom were not previously considered by others researchers.

Conclusions

Most studies showed that male and younger adolescents, from lower income families seem to be more likely to actively commute to school. In relation to maternal educational level, evidence about types of commuting associated to this factor are still limited, however, it was observed that ACS was most frequently among adolescents whose mothers had lower educational levels. Other findings suggested that ACS is associated to a healthier body composition, but further clarification is necessary. Regarding PA, a positive association between ACS and higher levels of PA was verified. Other evidence show to a positive association between ACS, particularly in relation to the use of bicycle and better CRF, also the need of studies that can explain properly how CRF behaves in different types of commuting.

Based on the results, we suggest that professionals who are directly involved with the adolescents at school, such as Physical Education teachers, should encourage active commuting from home to school, mainly girls, older adolescents, those from families with greater financial conditions and those whose mothers have a higher educational level. We also recommend that government agencies to develop strategies that encourages ACS, because it can be useful to reduce of development of health risk factors.

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