Active commuting to school among 36,781 Spanish children and adolescents: A temporal trend study

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Abstract: This study examines trends in the rates of active commuting to school (ACS) in Spanish children (n = 18 343; 8.93 ± 1.68) and adolescents (n = 18 438; 14.11 ± 1.58) aged 6-18 years from 2010 to 2017. Given the study period included the economic crisis in Spain (2008-2013), the second aim of this study was to compare ACS rates during and after the economic crisis. Data were obtained from 28 studies conducted across Spain. The overall trends in ACS were evaluated using multilevel logistic regression analysis. Among Spanish children and adolescents, the rates of ACS to school ranged around 60% between 2010 and 2017. The rates of ACS in Spanish youth did not change significantly during the 2010-2017 period, except a sporadic increase in the rate of ACS in adolescents in 2012-2013. No significant association between the ACS and the economic crisis time period in youth was found. As conclu- sion, the ACS remains stable in Spain during the last decade, which is a promising re- sult regarding the evidenced decreasing trend in many countries. Further educational and policy strategies are important to continue promoting this behavior in children and adolescents in the long term.

Introduction

A growing body of evidence demonstrates that regular physical activity has multiple health benefits for children and adolescents (1). However, the majority of children and adolescents worldwide do not meet the current recommendations of engaging in at least 60 minutes of moderate-to-vigorous physical activity per day (2, 3). In Spain, around 80% of children and adolescents are not sufficiently physically active (2).

Active commuting to school (ACS), defined as the use of active means of transport, such as walking and/or cycling to and from school, represents an opportunity to integrate physical activity into everyday life of children and adolescents (4). Importantly, ACS is associated with numerous health benefits for individuals and the society including higher physical activity levels (5, 6), reduced risk of development of metabolic diseases (7), greater interpersonal relationships (8, 9) in children and adolescents, increased independent mobility in these age groups (10) as well as it provides environmental and economic benefits (11).

Despite numerous benefits, rates of ACS vary across countries (12, 13). A growing number of studies has also reported the decline in the prevalence of ACS among children and adolescents in the last decades in the United States (14, 15), the United Kingdom

(16), Spain (17), Switzerland (18), Czech Republic (19), Vietnam (20), Australia (21, 22) and New Zealand (23, 24). Among European children, a rate of decline in ACS ranged from 7% decrease in Switzerland between 1994 and 2005 (18) to 9% decrease in the United Kingdom between 1975 and 1994 (16). More pronounced declines in ACS rates have been reported among European adolescents ranging from 15% in Spain between 2001 and 2007 (17) to 20% in Czech Republic between 2006 and 2014 (19). However, more recent evidence is lacking. Previous study from Spain included only two measurement points (2001-2007) and was conducted 13 years ago (17). Given the global trends of decreasing levels of physical activity among children and adolescents (2) and rapid urbanisation in many countries, understanding the recent trends in ACS is essential to evaluate country-specific needs for future interventions. Decrease in physical activity of children and adolescents and rapid urbanisation have also been observed in Spain in recent decades (25). Therefore, this study analyzed the trends in the rates of ACS in a large sample of Spanish children and adolescents aged 6-18 years from 2010 to 2017. The study period also included the economic crisis in Spain (2008 to 2013) and secondary analysis was conducted to compare ACS rates during and after the economic crisis.

Methods

Study design

This study analyzed cross-sectional data on modes of commuting to and/or from school from 28 studies conducted across Spain. Data were obtained from original studies conducted by research centers and local/regional public institutions between 2010 and 2017 and included Spanish children and adolescents. This cross-sectional study is part of the PACO RCT Study ("Cycle and Walk to School Study") that focuses on designing and implementing interventions to promote ACS among Spanish children and adolescents. The Medical Ethics Committee of University of Granada approved the PACO RCT Study design, study protocols and informed consent procedure (case no. 162/CEIH/2016).

Procedure

Firstly, the potential Spanish studies that collected mode of commuting to/from school data were searched using the following three approaches: 1) electronic search of studies conducted in Spain, 2) request through an oral presentation at the National Conference "Childhood and Mobility" organized by the Spanish Ministry of Agriculture, Food and Environment in November 2016, and 3) request through and oral presentation at the National Congress "The Bike and the City" in May 2017. After the initial search for

relevant studies (June, 2017), two researchers (PC, FJHD) contacted by email 20 Spanish research centers and local/regional public institutions to invite them to participate in this study, providing information about the study and process for gathering relevant existing research data from individual studies. All 20 invited research centers and local/regional public institutions agreed to take part in the study. They were asked to provide the following data: the data collection date (month and year), city, the participants' age, gender, collected data about mode of commuting to and/or from school, as well as other relevant data about study participants including socioeconomic status, if available.

The information was requested from the studies that met the following inclusion criteria: 1) data were collected using a questionnaire, 2) participant-level data were available, 3) studies provided data collected during the 2010-2017 period, and 4) study provided data on mode of commuting to and/or from school, age, gender, school location, and data collection date. A total of 34 studies met those inclusion criteria.

Sample

The present data analysis included the participant-level data collected between 2010 and 2017 from Spanish children and adolescents aged between 6 and 18 years who also had data for gender, age, ACS and school location. In addition, researchers collected information about population density and income of the cities and towns where schools were located. Data from all the 34 studies were merged into a database with a final sample size of 55,957 children and adolescents. From this sample, a total of 19,176 (34%) participants were excluded because of data collected before 2010 (n=7,584) (i.e., 2000, n=2,182; 2004, n=814; 2006, n=509; 2007, n=3677; 2009, n=402), lacking data on gender (n=294), age (n=299), mode of commuting to and/or from school (n=4,638), and school location (n=401), participants being under 6 years of age or over 18 years of age (n=5,429) and in addition, those using a combination of active and passive modes on a single journey to/from school (n=531). From the 34 studies with the available data, only 28 studies fulfilled the inclusion criteria for this analysis. The process of merging individual-level data from multiple studies into a final dataset was checked by two researchers (PGF, FJHD). The final sample size included 36,781 children and adolescents from 294 Spanish localities; namely, 18,343 children from 6 to 11.9 years old; and 18,438 adolescents from 12 to 18 years old (Figure 1). Description of the main characteristics and data collection dates of the 28 studies included in this analysis are presented in the supplementary file 1.
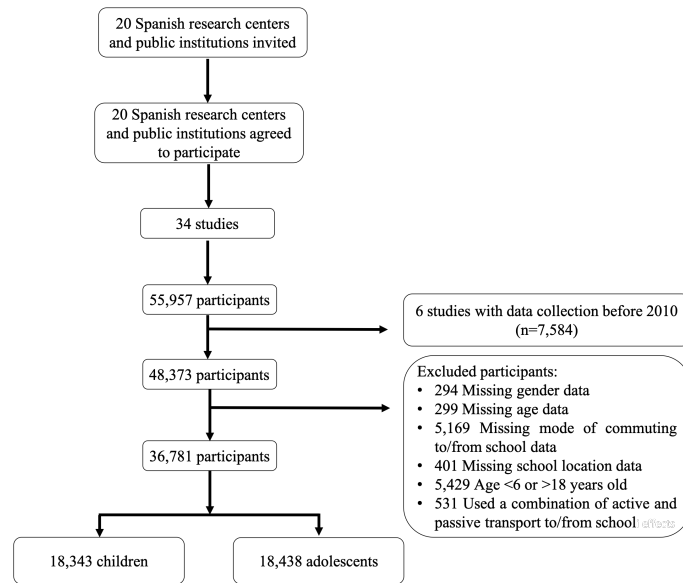
Figure 1. Flowchart of the study participants.

Mode of commuting to and from school

In all studies, children and adolescents self-reported their mode(s) of commuting to and from school, using a range of survey questions across studies which are summarized in Figure 2. Four out of 28 studies (14.3%) collected data on the *frequency of commuting to/from school* (i.e., 1 study collected data on the number of school days (from 0 to 5) using each mode of commuting to and from school separately; 1 study collected data on the number of weekly days (from 0 to 5) using ACS (such as walking, cycling or skating); and 2 studies collected data on the number of weekly travels (from 0 to 10) using each mode of commuting to and from school separately). Twenty-four studies (85.7%) collected data on the *usual mode of commuting to/from school* (i.e., 12 studies asked about the usual mode of commuting to and from school separately and 12 studies of asked about the usual mode of commuting to or from school).

Based on their responses options on how they travelled to and/or from school, participants were categorized into either active or passive commuters (Figure 2). Participants who reported walking, cycling, and/or using a non-motorized scooter to travel to/from school were categorized as active commuters. Participants who reported travelling to/from school by school bus, public bus, train/metro, taxi, moto, and/or by car were categorized as passive commuters. Participants using multiple modes as part of their school journey (i.e. using two or more different modes of commuting for the same trip) were included in this analysis only if both modes could be included in the same category (i.e., active or passive), as described above.
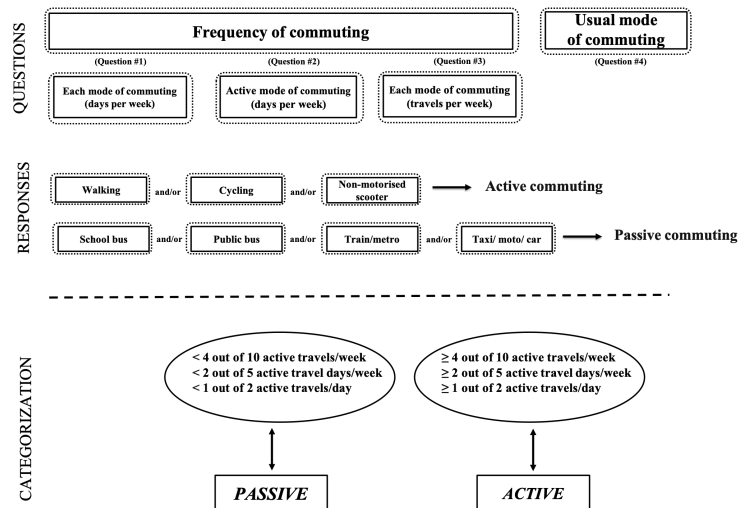
Figure 2. Categorization of the self-reported questions of modes of commuting to/from school, into active and passive commuting modes.

The *frequency of commuting to/from school* questions were re-categorized according to the number of active days or travels. Consequently, participants were categorized as "active" if reported (see figure 2): ≥2 active travel days out of 5 school days (questions #1 and #2) and ≥4 active travel trips out of 10 school trips per week (4) (question #3). The *usual mode of commuting to/from school* were categorized as active when participants reported ≥1 active travel per day out of 2 daily school trips (26) (question #4). Those who were not categorized as "active commuting", were categorized as "passive commuting" users.

Last, a dichotomous variable "active commuting" versus "passive commuting" was created for the statistical analysis: "active" (including children and adolescents who actively commuted to school, from school or to/from school) and "passive" (including children and adolescents who passively commute to school, from school or to/from school).

Time period

This study included data collected between 2010 and 2017. The time period was divided into 2-year periods: 2010-2011, 2012-2013, 2014-2015, and 2016-2017 according to other studies (27, 28) to guarantee a similar sample size in each period and to provide four time periods to examine the trends. Additionally, the economic crisis in Spain was from 2008 to 2013. Therefore, data in this study were analyzed for the periods before the economic crisis (2010-2013) and after the crisis (2014-2017)(29).

Sociodemographic characteristics

Individual data included age and gender of the participants. The characteristics of the school location used in the current statistical analyses were population density and income. The population density (number of inhabitants per locality area in km^2) was obtained from the Ministry of Finance and Public Administration of Spain, using the available data closest to the data collection year in each locality. The income of the data collection year was obtained from the Tax Agency Spanish Public (https://www.agenciatributaria.es/). The population density and income were categorized into a dichotomous variable (low/high) using the median.

Statistical analysis

Descriptive statistics were reported for the participants data (i.e., age, gender, ACS) and for the schools´ locations data (i.e., population density and income), separately for each age group (i.e., children and adolescents) and each time period (i.e., 2-year periods). All analyses were conducted separately for children and adolescents due to previous evidence of different patterns of commuting to school in those two age groups (30, 31), greater home-to-school distances to high schools versus primary schools (32) and different barriers for ACS among children versus adolescents (33). Means and standard deviations were reported for continuous variables, and frequencies and percentages were reported for categorical variables. To analyze the P-trend of each variable by the time period, one-way ANOVA for continuous variables and chi squared for categorical variables were performed. The association between ACS and time period was assessed using multilevel logistic regressions, to take in account that participants come from heterogeneous schools´ locations. In this analysis, participants (level 1) were nested in schools´ locations (level 2). Age, gender, ACS, and time period were included at the level 1 whereas population density and income were included at the level 2. After testing the goodness of fitness of the model, the multilevel model fitted better without population density and income variables from the level 2. The multilevel logistic regression models were fitted and conducted separately for children and adolescents, where ACS was entered into the models as the dependent variable and the time period as independent variable. Age and gender were included as covariates. To analyze the potential relationship of age, gender and localities´ income in the previous multilevel logistic regressions, the individual interaction effects between each of these variables with time period in relation to ACS were separately examined for children and adolescents.

Moreover, an additional analysis was performed to analyze the associations between ACS and the localities´ income in the period studied (2010-2017) using logistic regression. Finally, two additional logistic regression analyses were performed to study the relationship between the time period, organized as before and after the economic crisis (i.e., 2010-2013 and 2014-2017, respectively), with the ACS and the localities' income, in separate models. Database management and the analyses were performed using STATA v.13 and statistical significance was set at p<0.05.

Results

Data from 18,343 children (6 to 11.9 years old; 50.5 % girls) and 18,438 adolescents (12 to 18 years old; 49.5 % girls) were analyzed. In both age groups, 60% of participants used ACS. Across four time periods, there were significant differences in participants' age, gender, rates of ACS and schools´ locations data (i.e., population density and income) (all, p<0.001; Table 1). Rates of ACS across the four time periods ranged between 58-65% in children and between 55-66% in adolescents.

The results of the multilevel logistic regression between ACS and time period, controlled by age and by gender, and clustered by children and adolescents, are shown in the Figure 3. In children, there was no association between ACS and the time period. In adolescents, there was one significant association, and they were more likely to commute actively in 2012-2013 than in 2016-2017 (OR: 1.30, 95% CI: 1.06 – 1.58, p≤0.01). There were no interactions between age, gender, and localities´ income with the time period (all p>0.1; data not shown).

Regarding the associations between ACS and localities´ income during the study period (2010-2017), children attending schools in localities with low income had lower odds of use ACS than their counterparts attending schools in localities with high income (odds ratio (95% CI): 0.80 (0.75-0.86), p<0.001). In adolescents, those attending schools in low income localities had higher odds of ACS compared to those attending schools in high income localities (1.22 (1.15-1.31), p<0.001) (Table 2). No significant association between the ACS and the economic crisis time period in either children or adolescents were found. Using the post-economic crisis period (2014-2017) as a reference, the odds of ACS were not significantly different during the economic crisis period (2010-2013) in either children (1.06 (0.99-1.14), p=0.080) or adolescents (1.04 (0.97-1.12), p=0.252) (Table 3). Significant association between the localities´ income and the economic crisis

time period in either children or adolescents were found (all, p<0.001) (data not shown, see supplementary file 2).

Discussion

This study analyzed the trends of ACS between 2010 and 2017 in a large sample of Spanish children and adolescents, using cross-sectional data from 28 studies. The rates of ACS in Spanish children and adolescents did not change significantly during the 2010-2017 period, except a sporadic increase in the rate of ACS in adolescents in 2012-2013. Globally, the prevalence of ACS varies across countries ranging from 11% to 53% in children (19, 34-36) and from 28% to 70% in adolescents (13, 34-37). In the present study, 60% Spanish children and adolescents were using ACS in during the 2010-2017 period. The findings in the current study showed higher rates of ACS compared to those reported in most other countries. Available evidence suggests a wide range of individual, social, environmental, and policy factors influence ACS in children and adolescents (38), with distance to school being one of the major determinants of ACS (39). In addition, factors such as the heterogeneity of research questions and methods of assessing the mode of commuting to school differ between countries (40). These differences may contribute to cross-country variations in prevalence of ACS among children and adolescents observed in this and other studies (13, 19, 34-36). Therefore, evaluations of interventions aiming to keep higher rates of ACS are necessary from a public health perspective to achieve increasing physical activity and reducing time spent in sedentary behaviors among Spanish children and adolescents.

In the present study, no significant trends for changes in ACS rates among Spanish children and adolescents during the 2010-2017 period. Although several studies reported decline in ACS rates among children and adolescents prior to 2010 (14-18, 20-23), only two studies reported ACS rate changes in children and adolescents after 2010 (19, 24). Specifically, a study from Czech Republic that collected data up to 2014 reported a general decreasing trend of 20% between 2006 and 2014 (19). A recent research from New Zealand which analyzed ACS rates during the 2014-2018 period based on national surveys (24) reported a trend of declining ACS rates. This general decreasing trend observed in the previous studies in children and adolescents is in contract to the results of this study, where the rates of ACS in Spanish children and adolescents have not changed significantly during the 2010-2017 period, with an exception of a significant increase in ACS rates in adolescents in the years 2012/2013 compared to 2016/2017. No

significant change ACS rates among Spanish children and adolescents during the 2010-2017 period is a promising result given the declines in ACS rate reported in other countries during the similar time period (19, 24). No decline in ACS rates in Spain during the 2010-2017 may reflect the changes that Spanish society had adopted into potentially more healthy and sustainable behaviors on a population level (http://www.estilosdevidasaludable.mscbs.gob.es), attenuating the previously reported and conclusive descent trend (14-18, 20-23). Several educational and socioeconomical reasons that may explain the present findings are discussed below.

No significant changes in ACS rates in children and adolescents might be a result of an educational process based on the recent concern related to healthy and environmental issues in our society (41). As a result, it is possible that Spanish families are adopting more healthy and sustainable behaviors, such as physically active lifestyle and reduced reliance on car transport (42). In fact, the Government of Spain has been aiming to promote health in children and adolescents in the recent years, with strategies such as the Nutrition, Physical Activity and Obesity Prevention (http://www.aecosan.msssi.gob.es). The increasing number of strategies targeted to promote ACS carried out in Spain in the recent years seems to have had a positive influence (43, 44). For example, the national educational law (45) launched in 2013, included as a novel content to promote ACS within educational curriculum, which facilitates promoting healthy behaviors in educational centers. Another example is the STARS Project (http://www.starsespaña.com), launched by the Spanish Directorate General of Traffic and local governments in 2016, that aims to empower and reward schools to promote sustainable and safe commuting among their students, including both walking and cycling. The program still continues nowadays in some schools across Spain (121 (1.5%) primary and 73 (2.0%) secondary public schools). Moreover, the Traffic Snake Game (https://www.trafficsnakegame.eu) originated in Belgium and Spain in 2014 has involved 226 (6%) Spanish primary schools to date. This game encourages children, their parents and teachers to use forms of sustainable mobility when traveling to school including walking, cycling, using public transport or sharing the car among several. Therefore, these interventions may have contributed to stabilising the proportion of children and adolescents who use ACS in the 2010-2017 period in Spain.

A part of the time period of the present study included a financial crisis in Spain between 2008-2013 (29). Despite existence of a national survey about mode of commuting to work in adults between 2001 to 2011, there is no previous national data about the changes of

ACS during the financial crisis in Spain. Cross-sectional data collected in 2011 showed that Spanish youth whose parents did not work had higher levels of ACS than their peers whose parents were employed (46).

When the associations between ACS and localities´ income were analyzed for the 2010-2017 period, children attending schools in localities with low income were less likely to use ACS than whose with high income. Contrasting findings were observed in adolescents with those from low income localities being more likely to commute actively than whose from high income localities. In the present study, when ACS rates were compared between the financial crisis time (2010-2013) and after-crisis time (2014-2017), no significant differences in the odds of ACS were observed between the two periods in either children or adolescents. Even so, the odds ratio of reporting ACS were higher for the crisis time period than for the after-crisis time period although not significantly and borderline significantly in children. These results might show a lower use of private transportation compared to after-crisis, due to both the financial crisis time affecting most of the Spanish families or other personal decisions (47). These results must be interpreted with caution since the present study was not based on nationally representative samples of children and adolescents. However, using the current data in this study, we verified that in the crisis time period there was a lower income in the localities participants compared to the after crisis time period. Consequently, this financial crisis in Spain during the 2008-2013 period may have contributed to the stable trend observed in the ACS patterns compared to the previous reported decreased trends of ACS from previous studies (15, 18, 19).

Moving forward, it would be helpful to monitor country-level ACS trends prospectively using data from nationally representative samples of children and adolescents (24) and the global monitoring of the country-level ACS which is already in progress as part of the Global Matrix project (12, 30). In fact, encouraging active commuting in general (including ACS) is aligned with the global policies aimed at promoting physical activity, such as, the World Health Organization's Global Action Plan on Physical Activity (GAPPA) 2018-2030 (48) and the Sustainable Development Goals (SDG) launched by United Nations (49). There needs to be a set of guidelines within and across countries on how the different methodological approaches and available data sources for monitoring and promoting ACS are handled (24). A specific key recommendation for future research might be to use a unique valid and reliable questionnaire for ACS data collection (50).

Use of standardized questionnaire might help researchers to assess this ACS behavior with a valid measurement, allowing appropriate comparisons between studies.

The main strengths of this study are a large sample size with participants from different locations within a country, a systematic and rigorous process for merging data from different studies, a novel and useful approach to combine response from a variety of survey questions used to assess the ACS across different studies (40) (see Figure 2 for details). The outlined process for merging ACS data from multiple studies may help researchers, health promoters, transport planners and policy makers in their efforts to combine data related to mode of commuting to/from school from multiple sources of data. We previously reported the high heterogeneity in self-report questionnaires in studies assessing the mode of commuting to/from school conducted to date (40). This article provides a potential solution to standardize these diverse measurements.

The main limitations of this study are the use of data from nationally non-representative sample and lack home-to-school distance data. Other limitations include a diversity of questions used to self-report modes of commuting to school, the lack of individual level socioeconomic status, differences in sample size, sociodemographic characteristics of study participants as well as population density and income of school locations where data were collected each year. Further action-oriented research is needed to understand how social and infrastructure changes fit together to achieve healthy, equitable and sustainable transport and urban planning in modern cities and towns.

Conclusion

In the period 2010-2017, the rates of ACS in Spanish children and adolescents have remained stable. These findings are in contrast to recently reported declines in ACS rates in other countries. This might reflect the changes that Spanish society is acquiring into more healthy and sustainable behaviors maybe due to educational and socioeconomical changes. Strong partnerships between researchers, public health practitioners, policy-makers and communities as well as long-term commitment and evaluations of interventions aiming to increase ACS are necessary to ensure positive results in the long term.

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Table 1. Descriptive characteristics of the study participants by time period.

	Total sample	2010/2011	2012/2013	2014/2015	2016/2017	p (Trend)
Children	n=18,343	n=4,007	n=3,053	n=9,438	n=1,845	
Age ($\bar{X}\pm$SD)	8.93 ± 1.68	8.95 ± 1.57	9.15± 1.86	8.82 ± 1.66	9.06 ± 1.72	< 0.001
Female [n (%)]	9,255 (50.5)	2,044 (51.1)	1,559 (51.1)	4,729 (50.1)	923 (50.0)	0.672
ACS						
All [n (%)]	11,062 (60.3)	2,488 (62.1)	1,926 (65.6)	5,186 (58.7)	1,075 (58.2)	< 0.001
Female [n (%)]	5,528 (59.7)	1,276 (62.2)	960 (64.47)	2,710 (57.5)	542 (58.7)	< 0.001
Male [n (%)]	5,534 (60,9)	1,276 (61,8)	1,000 (66,5)	2,796 (59,4)	532 (57.7)	< 0.001
Population density (median)	682.859	16448.73	650.537	152.872	3093.23	< 0.001
Income (median)	20,861	24,906	19,625	19,206	21,751	< 0.001
Adolescents	n=18,438	n=4,356	n=7,755	n=5,014	n=1,313	
Age ($\bar{X}\pm$SD)	14.11 ± 1.58	14.26 ± 1.70	14.38 ± 1.41	13.56 ± 1.48	14.32 ± 1.93	< 0.001
Female [n (%)]	8,782 (49.1)	2,099 (48.2)	3,787 (48.8)	2,469 (49.4)	702 (53.3)	0.008
ACS						
All [n (%)]	11,104 (60.2)	2,603 (60.1)	4,776 (61.9)	2,526 (55.6)	855 (66.2)	< 0.001
Female [n (%)]	5,389 (59,5)	1,229 (58.5)	2,349 (61.9)	1,352 (54.9)	459 (65.5)	< 0.001
Male [n (%)]	5,715 (60,9)	1,391 (61,3)	2,462 (62.0)	1,452 (57.1)	410 (67.1)	< 0.001
Population density (median)	917.565	16448.73	389.982	184.220	911.615	< 0.001
Income (median)	20,861	24,906	16,625	20,512	21,005	< 0.001

ACS= Active commuting to and from school.

$\bar{X}$ = mean. SD= Standard deviation.

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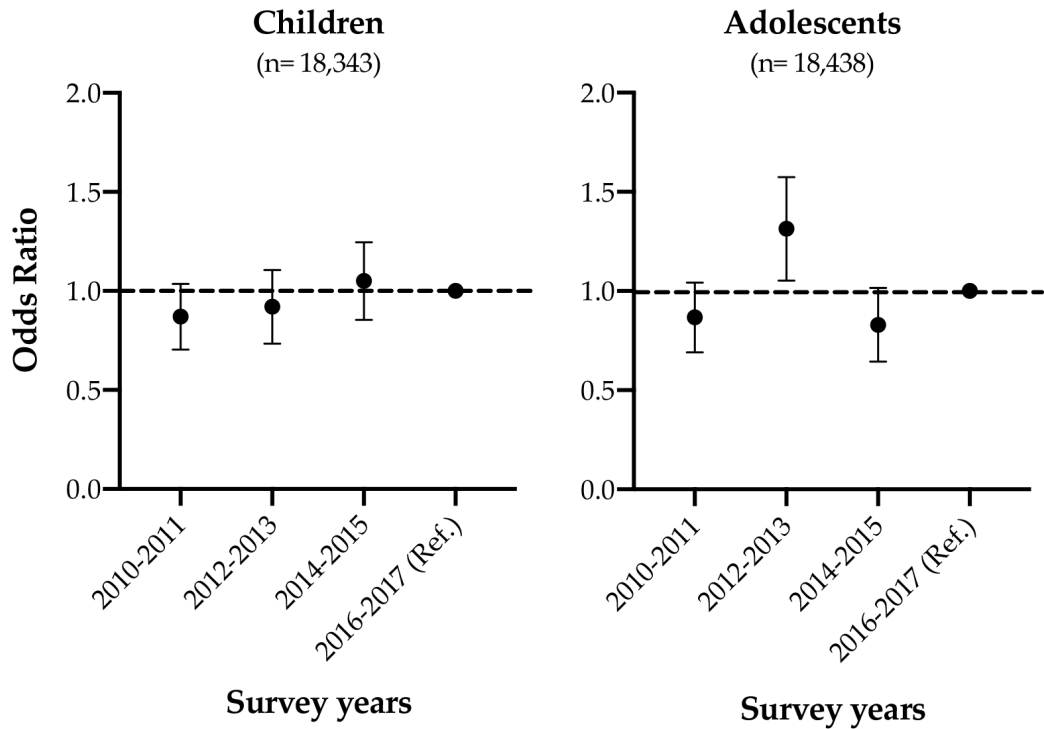
Figure 3. Associations between ACS and time period for children and adolescents adjusted by age and gender.

All odds ratios were not significant, except the period 2012-2013 in adolescents (p=0.009).

Table 2. Associations between ACS and localities´ income for children and adolescents adjusting by age and gender in the period studied (2010-2017).

ACS	Children (n=18,005)				Adolescents (n=18,392)		
	OR	95% CI	p value		OR	OR	OR
High	1	Reference		High	1	Reference	
Low	0.80	0.75 - 0.86	**0.001**	Low	1.22	1.15 - 1.31	**0.001**

OR= Odd Ratio
IC= Confidence Interval

Table 3. Associations between ACS and crisis time period (2010-2013) and after economic crisis time period (2014-2017) for children and adolescents adjusting by age and gender.

ACS	Children (n=18,343)				Adolescents (n=18,438)		
	OR	95% CI	p value		OR	95% CI	p value
2014-2017	1	Reference		2014-2017	1	Reference	
2010-2013	1.06	0.99 – 1.14	0.080	2010-2013	1.04	0.97 - 1.12	0.252

OR= Odd Ratio
IC= Confidence Interval

Supplementary file 1

S1. Description of the main characteristics of each study included.

Research center or Local/Regional Public Institution	Research Centre	Local/Region al Public institution	Collected Data (year)	Children (sample)	Adolescents (sample)
Agenda21.	x		2010	297	
Agenda21.	x		2010		338
UP&DOWN Study Group.	x		2011	555	955
University of Valencia.			2011		153
Barcelona Institute of Regional and Metropolitan Studies.	x		2011	2,483	2,910
University of Granada.	x		2011	672	
Torrelodones Council / GEA21		x	2012	144	261
University of Granada.	x		2012	156	
University of Jaen.	x		2013		986
University of Granada.	x		2013	1,462	5,496
University of Zaragoza.	x		2013		1,012
University of Castilla La Mancha.	x		2013	522	
Zaragoza Council / Camino Escolar.		x	2013-2015	1,419	
IES Coruxo.		x	2014		97
University of Granada.	x		2014	95	
University of the Balearic Islands.	x		2014	675	1,513
La Biciclante.		x	2015		108
University of Granada.	x		2015	102	1
La ciclería.		x	2015	84	23
University of Valencia.	x		2015	198	111
University of Castilla La Mancha.	x		2015	7,241	2,673
University Jaume I.		x	2015-2016		272
Generalitat Cataluña.		x	2015-2016	787	578
University of Granada.	x		2016	379	746
Laboratorio Auguria.	x		2016	175	1
Autonomous University of Barcelona.	x		2017	758	
University of the Balearic Islands.	x		2017	139	49
University of Zaragoza.	x		2017		155
Total 28			2010-2017	18,343	18,438

Supplementary file 2

S2.   Odds ratios of being low according to crisis time period (2010-2013) and after economic crisis time period (2014-2017) for children and adolescents adjusting by age and gender.

Localities´ income	Children (n=18,005)				Adolescents (n=18,392)		
	OR	95% CI	p value		OR	OR	OR
2014-2017	1	Reference		2014-2017	1	Reference	
2010-2013	3.02	2.77 - 3.29	**0.001**	2010-2013	2.13	1.96 - 2.32	**0.001**

OR= Odd Ratio
IC= Confidence Interval