



Temporal trend of inactive commuting to school in adolescents from Sergipe, Brazil

Tendência temporal de deslocamento inativo para a escola em adolescentes de Sergipe, Brasil

L. S. Santos^{1*}; D. S. S. Ribeiro²; Í. D. C. Barreto³; V. H. F. Oliveira⁴; D. R. P. da Silva⁵; A. S. Menezes^{5,6}

¹Departamento de Educação Física, Universidade Paulista – UNIP, 49050-680, Aracaju, SE, Brasil

²Departamento de Educação Física, Faculdade de Ciências Humanas e Sociais do Centro Universitário AGES (UniAGES), 48430-000, Paripiranga, Bahia, Brasil

³Programa de Pós-Graduação em Biometria e Estatística Aplicada, Universidade Federal Rural de Pernambuco, 52171-900, Recife, PE, Brasil

⁴Programa de Pós-graduação em Educação Física, Universidade Estadual de Londrina, 86057-970, Londrina-PR, Brasil

⁵Programa de Pós-Graduação em Educação Física, Universidade Federal de Sergipe, 49680-0000, São Cristóvão-SE, Brasil

⁶Instituto Federal de Educação, Ciência e Tecnologia de Sergipe-IFS, 49500-000, Itabaiana, Sergipe, Brasil

*lucas_souzza@hotmail.com

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Our purpose was to identify the trend of inactive commuting to school and to verify the associated factors (demographic, socioeconomic, school and environmental) to this outcome. The study compared data from two cross-sectional epidemiological surveys with samples of 3,984 (in 2011) and 4,139 (in 2016) adolescents from public schools of Sergipe, Brazil. Inactive commuting comprised the adolescents who did not walk or cycle to school on any day of the week. Raw and adjusted logistic regression were used to analyze the association between independent variables and outcome. The findings revealed that, in 2011, there was observed a greater probability of inactive commuting among students from the urban area (OR=3.91; 95% CI=3.37-4.45), enrolled in the day shift (OR=1.20; 95% CI=1.04-1.40), with a family income of up to one minimum wage (OR=1.39; 95% CI=1.15-1.68) and between one and two minimum wages (OR=1.20; 95% CI=1, 00-1.43), which took up to 29 minutes (OR=1.82; 95% CI=1.47-2.25) and 30 to 59 minutes when commuting from home to school (OR=1.73; 95% CI=1.36-2.21). In 2016, male adolescents (OR=1.18; 95% CI=1.03-1.36), living in the urban area (OR=3.78; 95% CI=3.23-4.41), living on paved streets (OR=1.18; 95% CI=1.00 -1.39), which took up to 29 minutes (OR=2.24; 95% CI=1.82-2.77) and 30 to 59 minutes when commuting (OR=1.35; 95% CI=1.05-1.72) showed higher prevalence of inactive commuting to school. Some socioeconomic and demographic factors influenced the stability of the high prevalence of inactive commuting to school.

Keywords: adolescents, active commuting, temporal trend.

O objetivo foi identificar a tendência de deslocamento inativo para escola e verificar os fatores associados (demográficos, socioeconômicos, escolares e ambientais) ao referido desfecho. O estudo comparou dados de dois inquéritos epidemiológicos transversais com amostra de 3.984 (em 2011) e 4.139 (em 2016) adolescentes das escolas públicas de Sergipe, Brasil. O deslocamento inativo compreendeu os adolescentes que não caminhavam ou pedalavam até a escola em pelo menos um dia da semana. Regressão logística bruta e ajustada foram utilizadas para analisar a associação entre as variáveis independentes e o desfecho. Os achados revelaram que, em 2011, observou-se maior probabilidade de deslocamento inativo em estudantes da área urbana (OR=3,91; IC 95%=3,37-4,45), matriculados no turno diurno (OR=1,20; IC 95%=1,04-1,40), com renda familiar de até um salário mínimo (OR=1,39; IC 95%=1,15-1,68) e de um a dois salários mínimos (OR=1,20; IC 95%=1,00-1,43), que passaram até 29 minutos (OR=1,82; IC 95%=1,47-2,25) e 30 a 59 minutos em deslocamento entre a casa e a escola (OR=1,73; IC 95%=1,36-2,21). Em 2016, adolescentes do sexo masculino (OR=1,18; IC 95%=1,03-1,36), residentes em área urbana (OR=3,78; IC 95%=3,23-4,41), residentes em ruas asfaltadas (OR=1,18; IC 95%=1,00 -1,39), que passaram até 29 minutos (OR=2,24; IC 95%=1,82-2,77) e 30 a 59 minutos no deslocamento (OR=1,35; IC 95%=1,05-1,72) apresentaram maior prevalência de deslocamento inativo para a escola. Alguns fatores socioeconômicos e demográficos influenciaram na estabilidade das elevadas prevalências de deslocamento inativo para a escola.

Palavras-chave: adolescentes, deslocamento ativo, tendência temporal.

1. INTRODUCTION

In the last years, low levels of Physical Activity (PA) have been associated with increased rates of all-cause mortality [1], overweight and obesity [2], cardiovascular disease [3], mental disorders, [4] and some types of cancers [5] all around the world, becoming a major public health concern. Therefore, changing some daily habits, like walking or cycling when commuting instead of driving automobiles, have been suggested as an effective strategy to increase PA levels and to prevent the development of health disorders [6]. Although the literature describes the health benefits of Active Commuting (AC) to school or work (*i.e.* walking or cycling), the arrangement of our modern cities does not stimulate the adoption of such behavior [6].

In this context, systematic reviews indicate a decline in AC use in developed countries, which is also associated with a decline in students daily PA over the last 50 years [6, 7]. It highlights the importance of temporal investigations aiming to identify influencing factors on the relationship between AC and health indicators in different countries [8]. However, even though a decline in AC is also observed in Brazil, notably in the country's main cities [9], we lack investigations on demographic, socioeconomic, school and environmental factors which influence PA levels over time in adolescents, ignoring any temporal gaps that may suggest strategies for the adoption of active habits, especially when commuting.

Considering that health implications due to low levels of PA manifest during adult life, evidences have emphasized that active habits are adopted since early ages [10]. Thus, giving that adolescents move daily from home to school, public health agencies have suggested AC as a strategy to increase daily PA in young people [11]. This strategy could reduce the occurrence of diseases related to low levels of PA in the medium and long term.

Among the possible correlates of AC, besides sex and age [12, 13], social factors appear to be important barriers to the adoption of AC, especially in middle- and low-income countries [14]. In Brazil, environmental characteristics such as lack of bike path and heavy traffic, have stood out as barriers to the adoption of bicycle use in adults [15]. In Sergipe, a state in Northeast Brazil, only 16.7% of the adolescents meet the overall health recommendations of PA (it is suggested that adolescents should accumulate at least 60 minutes of moderate-to-vigorous PA daily) [16], but the prevalence of Inactive Commuting (INAC) of these adolescents is still unknown. Therefore, it is necessary to focus attention on other domains of PA, especially the commuting to school, given its positive association with health benefits [17]. Thus, our purpose was to identify the trend of INAC to school and to verify the associated factors (demographic, socioeconomic, school and environmental) to this outcome in school adolescents from Sergipe, Northeast Brazil.

2. METHODS

2.1 Design and Sample

Our study compared data from two epidemiological surveys with a cross-sectional design, conducted in 2011 and 2016, through the research project "CRiS_adolescents study", which was approved by the Ethics Research Committee of Sergipe Federal University (177/2010/CEP/CONEP/CNS/UFS) and Federal Institute of Education, Science and Technology of Sergipe (1522.876/2016/CEP/CONEP/CNS/IFS).

Sergipe is a Brazilian state located in Northeast Brazil, with an area of approximately 22,000 km² and a population slightly over two million people. Sergipe has 75 cities and it is divided into eight regions [18, 19]. The study included school adolescents aged between 14- to 19-years-old, being regular students at the state education system. Information from State Department of Education pointed out that enrollment in 2011 and 2016 reached about 58,000 students. This number comprises about 80% of all Sergipe high school students (other 20% are enrolled in the private system).

For sample estimation, simple random stratification was used, estimating the maximum expected prevalence at 50%, acceptable error of five percentage points and 95% confidence intervals. The methodology also respected the number of students per territory, respecting possible errors in the design ($def=1.5$). Then, we added 20% of students as safety margin in sample

representativeness, comprising a total of 3,875 adolescents. This calculation was performed in the software StatCal, Epiinfo.

For sample selection, a two-stage stratification was used, proportionally obeying the territory and the size of school, which corresponded to (1) schools with up to 199 students, (2) schools between 200 and 499 students, and (3) schools equal to or greater than 500 students. Thus, 25% of the state public schools were selected (considering a total of 160 teaching units), being 39 schools in 2011 and 42 schools in 2016 [20]. Finally, the research adopted the simple random process to select the classes according to grade (1st, 2nd and 3rd grade) and study time (day or night), weighing 20 students per class.

The questionnaire used was a Portuguese version of the Global School-Based Student Health Survey (GSHS/WHO) [21], already used in previous studies [16]. Data was collected by researchers with a degree in physical education, previously trained to questionnaire application. The questionnaire was administered on a school day and in the classroom, with the presence of two researchers in each class to help filling the answers. Students spend 45 minutes on average to complete the questionnaire.

2.2 Dependent variable

INAC to school was obtained from the question: “*On how many days of the last week did you walk or bike to school?*” Adolescents who did not commuted to school by foot or bicycle on any day of the last week were considered inactive commuters.

2.3 Independent variables

Sociodemographic and economic factors were investigated from the variables gender, age, study shift and family income. To define the study shift, those students who studied during the morning and afternoon shifts were classified as ‘day shift’, and those who studied at night were classified as ‘night shift’. To define the family income, we considered the number of family minimum wages. To analyze the urban conditions, street pavement and street lighting were investigated. According to the presence of paving and lighting, it was classified as a good condition of urbanization to those adolescents who reported the presence of asphaltic paving and public lighting in the way from home to school. The time spent from home to school was investigated from the question: “*During the past seven days, how much time on average did you spend to go from home to school and back to your home (add up the time it takes you to go and to come back)?*” The questionnaire presented seven possible answers: (1) 0 to 10, (2) 10 to 19, (3) 20 to 29, (4) 30 to 39, (5) 40 to 49, (6) 50 to 59, (7) 60 minutes or more. For analysis purpose, we recoded the possible answers into three categories: (1) up to 29 minutes, (2) 30 to 59 minutes, (3) 60 minutes or more.

2.4 Statistical analysis

Data was typed into the computer electronically, followed by a manual conference to correct possible errors. During statistical analysis, we used descriptive analysis to examine sample composition. Then, bivariate analysis was performed using the chi-square test to verify the association between INAC and explanatory variables. Lastly, multivariable analysis was performed using logistic regression to verify the association between INAC and independent factors. After raw analysis, variables with p -value <0.20 were inserted in the adjusted model, using a backward method to variable selection. We adopted a significance of $p<0.5$. All analyses were conducted on SPSS software for Windows (Version 22.0).

3. RESULTS

A total of 9,438 adolescents ($n=4,717$ in 2011 and $n=4,721$ in 2016) from the state public school system of Sergipe answered the questionnaire. We excluded subjects younger than 14 years old ($n=8$ in 2011 and $n=12$ in 2016), over 19 years old ($n=709$ in 2011 and $n=549$ in 2016), who did not provide information like age ($n=2$ in 2011 and $n=6$ in 2016) and sex ($n=3$ in 2011 and $n=12$ in

2016), and who did not answer questions related to the dependent and independent variables ($n=11$ in 2011 and $n=03$ in 2016). After considering all the above criteria, the sample was composed of 3,984 adolescents in 2011 and 4,139 adolescents in 2016.

Table 1 shows the students sociodemographic characteristics. The percentage of female adolescents in sample composition remained higher than boys in 2011 (61.3% of females) and 2016 (57.6% of females). Also, in both surveys there were more adolescents who reported living in urban areas (61.0% in 2011 and 57.7% in 2016), who were enrolled in day time study shift (66.5% in 2011 and 70.6% in 2016), and who lived in paved streets (66.9% in 2011 and 68.1% in 2016) and streets public lighting (91.2% in 2011 and 91.4% in 2016). Furthermore, there was an increase in the prevalence of students with a family income up to one minimum, from 32.8% in 2011 to 60.0% in 2016.

Table 1. Sociodemographic characteristics of school adolescents from Sergipe, northeast Brazil, in 2011 ($n=3,984$) and 2016 ($n=4,139$).

Variables	2011	2016	<i>p</i> -value
	<i>n</i> (%)	<i>n</i> (%)	
Sex			0.001
Male	1,540 (38.7)	1,753 (42.4)	
Female	2,444 (61.3)	2,386 (57.6)	
Age			0.287
14-15	721 (18.1)	743 (18.0)	
16-17	2,069 (51.9)	2,216 (53.5)	
18-19	1,194 (30.0)	1,180 (28.5)	
Place of residence			0.002
Urban	2,384 (61.0)	2,343 (57.7)	
Rural	1,524 (39.0)	1,721 (42.3)	
Student level			0.001
1 st grade	1,645 (41.3)	1,586 (38.3)	
2 nd grade	1,341 (33.7)	1,372 (33.1)	
3 rd grade	998 (25.1)	1,181 (28.5)	
Study shift			<0.001
Day	2,648 (66.5)	2,922 (70.6)	
Night	1,336 (33.5)	1,217 (29.4)	
Family income			<0.001
Up to 1 MW	1,278 (32.8)	2,327 (60.0)	
1 to 2 MW	1,552 (39.9)	1,107 (28.6)	
>2 MW	1,067 (27.4)	443 (11.4)	
Street pavement			0.261
Asphalt	2,626 (66.9)	2,773 (68.1)	
Unpaved	1,297 (33.1)	1,298 (31.9)	
Street lighting			0.408
Yes	3,624 (91.2)	3,782 (91.4)	
No	351 (8.8)	343 (8.3)	
Commute duration			0.036
Up to 29 minutes	2,610 (65.5)	2,816 (68.0)	
From 30 to 59 minutes	846 (21.2)	792 (19.1)	
60 minutes or more	528 (13.3)	531 (12.8)	

MW=Minimum wage. Data are expressed as absolute (relative frequency) and analyzed using Chi-Squared Tests.

Table 2 presents INAC prevalence, where overall INAC prevalence was 65.0% in 2011 and 63.7% in 2016. Male adolescents presented higher prevalence of INAC in 2016 (66.8%) compared to females. In addition, higher prevalence was found among adolescents living in urban areas in 2011 (76.4%) and 2016 (77.9%), adolescents enrolled in daytime study shift in 2011 (67.4%) and 2016 (64.9%), adolescents who reported living on paved streets in 2011 (72.1%) and 2016 (74.9%),

adolescents living in streets with public lighting in 2011 (70.4%) and 2016 (70.3%), and adolescents with a commute time of up to 29 min in 2011 (68.7%) and 2016 (69.8%).

Table 2. Prevalence of inactive commuting to school and associated factors among adolescents from Sergipe, northeast Brazil, in 2011 (n=3,984) and 2016 (n=4,139).

Variables	2011		2016	
	n (%)	p-value	n (%)	p-value
Sex				
Male	994 (66.0)	0.294	1,151 (66.8)	<0.001
Female	1,532 (64.4)		1,449 (61.4)	
Age				
14-15	460 (65.1)	0.705	455 (61.5)	0.287
16-17	1,327 (65.6)		1,410 (64.6)	
18-19	739 (64.1)		735 (63.3)	
Place of residence				
Urban	1,781 (76.4)	<0.001	1,803 (77.9)	<0.001
Rural	694 (46.7)		747 (44.0)	
Student level				
1 st grade	1,061 (66.3)	0.274	982 (62.9)	0.514
2 nd grade	848 (64.8)		877 (64.9)	
3 rd grade	617 (63.2)		741 (63.3)	
Study shift				
Day	1,746 (67.4)	<0.001	1,872 (64.9)	0.014
Night	780 (60.3)		728 (60.8)	
Family income				
Up to 1 MW	786 (62.9)	0.166	1,406 (61.1)	<0.001
1 to 2 MW	998 (66.0)		747 (68.0)	
>2 MW	689 (66.1)		302 (69.7)	
Street pavement				
Asphalt	1,801 (70.4)	<0.001	1,924 (70.3)	<0.001
Unpaved	698 (55.0)		645 (50.3)	
Street lighting				
Yes	2,349 (66.4)	<0.001	2,423 (64.9)	<0.001
No	171 (50.4)		170 (50.4)	
Commute duration				
Up to 29 minutes	1,771 (68.7)	<0.001	1,955 (69.8)	<0.001
From 30 to 59 minutes	522 (62.8)		429 (54.8)	
60 minutes or more	233 (49.2)		216 (43.4)	

MW=Minimum wage. Data are expressed as absolute (relative frequency) and analyzed using Chi-Squared Tests.

Table 3 shows the association between INAC and demographic and socioeconomic variables. In 2011, we observed higher odds of INAC among adolescents living in urban areas (OR=3.91; 95% CI=3.37-4.54) and adolescents enrolled in day time study shift (OR=1.20; 95% CI=1.04-1.40). Regarding family income, adolescents who reported having a family income up to one minimum wage (OR=1.39; 95% CI=1.15-1.68) or one to two minimum wages (OR=1.20; 95% CI=1.00-1.43) also presented higher odds of INAC. Likewise, adolescents who reported commute duration up to 29 minutes (OR=1.82; 95% CI=1.47-2.25) and from 30 to 59 minutes (OR=1.73; 95% CI=1.36-2.21) were more likely for INAC. In 2016, we observed that male students had a higher odds of INAC (OR=1.18; 95% CI=1.03-1.36), as well as adolescents living in urban areas (OR=3.78; 95% CI=3.23-4.41) and in paved streets (OR=1.18; 95% CI=1.00-1.39). Moreover, adolescents who reported commute duration up to 29 min (OR=2.24; 95% CI=1.82-2.77) and from 30 to 59 min (OR=1.35; 95% CI=1.05-1.72) also presented a higher odds of INAC.

Table 3. Raw and adjusted analysis on the association between inactive commuting to school and demographic and socioeconomic factors among adolescents from Sergipe, northeast Brazil, in 2011 (n=3,984) and 2016 (n=4,139).

Variable	2011			2016		
	OR ^b 95% CI	OR ^a 95% CI	p- value	OR ^b 95% CI	OR ^a 95% CI	p- value
Sex						
Male	1.07 (0.94-1.23)	-----		1.26 (1.11-1.44)	1.18 (1.03-1.36)	0.021
Female	1			1	1	
Age						
14-15	1.04 (0.86-1.27)	-----		0.92 (0.76-1.12)	-----	
16-17	1.07 (0.92-1.24)			1.06 (0.91-1.23)		
18-19	1			1		
Place of residence						
Urban	3.71 (3.22-4.26)	3.91 (3.37-4.54)	<0.001	4.47 (3.90-5.13)	3.78 (3.23-4.41)	<0.001
Rural	1	1		1	1	
Student level						
1 st grade	1.14 (0.97-1.35)	-----		0.99 (0.84-1.15)	-----	
2 nd grade	1.07 (0.90-1.27)			1.07 (0.91-1.26)		
3 rd grade	1			1		
Study shift						
Day	1.36 (1.19-1.57)	1.20 (1.04-1.40)	0.015	1.19 (1.04-1.37)	-----	
Night	1	1		1		
Family income						
Up to 1 MW	0.87 (0.73-1.04)	1.39 (1.15-1.68)	0.001	0.68 (0.54-0.85)		
1 to 2 MW	1.00 (0.85-1.18)	1.20 (1.00-1.43)	0.044	0.92 (0.72-1.17)		
>2 MW	1	1		1		
Street pavement						
Asphalt	1.94 (1.69-2.23)	-----		2.33 (2.04-2.68)	1.18 (1.00-1.39)	0.045
Unpaved	1			1	1	
Street lighting						
Yes	1.94 (1.55-2.43)	-----		1.82 (1.45-2.27)	-----	
No	1			1		
Commute duration						
Up to 29	2.27 (1.86-2.76)	1.82 (1.47-2.25)	<0.001	3.02 (2.48-3.67)	2.24 (1.82-2.77)	<0.001
From 30 to 59	1.75 (1.39-2.20)	1.73 (1.36-2.21)	0.008	1.58 (1.26-1.98)	1.35 (1.05-1.72)	0.017
60 or more	1	1		1	1	

MW=Minimum wage; OR^b=Unadjusted Odds Ratio; OR^a=Adjusted Odds Ratio; 95% CI=95% confidence interval.

4. DISCUSSION

Our main results indicate that some sociodemographic correlates influenced INAC prevalence among school adolescents of Sergipe, Northeast Brazil. The results also highlight specific subgroups with high prevalence of INAC. This may contribute to the development of government policies aiming to increase PA levels when commuting to school, especially among young people living in countries similar to the Latin America context.

A national survey conducted among Brazilian adolescents living at the country's state capitals investigated overall PA in different domains, and its results demonstrated a decline in AC to school from 43.1% in 2009 to 34.4% in 2015 [21, 22]. This decline in AC prevalence shows, to some extent, that INAC needs to be further investigated in surveys across the country. Overall, INAC prevalence observed in our study did not significantly change between the two time points analyzed. However, it remained high, with a prevalence of 65.0% in 2011 and 63.7% in 2016. When stratifying the analysis, it is noticed that male adolescents presented a higher INAC prevalence. This is interesting given that previous studies have shown that boys are more active in other PA domains, such as leisure time PA and practice of sports activities [23], and are also involved in more intense activities [24]. So, the association between sex and PA can vary according to the domain and context analyzed [24].

There is a consensus that the infrastructure of cities with better economic conditions, such as street connectivity, aesthetics and safety to destinations, can favor the use of non-motorized transportation [25]. However, other correlates associated to great urban centers, like dangerous street intersections, can become barriers for the adoption of AC [26]. In Sergipe, adolescents living in urban areas were approximately twice as likely to INAC in both 2011 and 2016 surveys (rural=46.7%; 44.0% and urban=76.4%; 77.9%, respectively). The greater prevalence of AC in rural areas can be partially explained by the lack of schools in those areas. Thus, adolescents have to walk to the bus stations, in order to take the bus to the city center. It is worth emphasizing the importance of public educational policies that focus on the construction of schools near to the students' homes, contributing to global health aspects and promoting greater use of AC in adolescents, as positive association between short distance and AC are well established in the literature [27].

Our results also indicated that INAC is more prevalent among adolescents enrolled in daytime study shift. This can be due to the intense flow of cars in the roads during the day, generating unsafety for cyclists and pedestrians, as reported in a previous study [26]. Furthermore, economic factors are positively associated with PA levels, where young people who are richer are more physically active [28]. In Sergipe, economic factors underwent significant changes between the two time points analyzed. In 2011, family income above one minimum wage was a protective factor for INAC; it means that the adolescents more physically active when commuting to the school had higher family income. On the other hand, after five years, the number of adolescents living with a family income of up to one minimum wage doubled, and contrary to the literature where the prevalence of physical inactivity is highest among the poorest, which indicates that richer are more active [29], INAC was not associated with this factor. It is worth mentioning that adopting an AC to school does not require a high economic support by the adolescents. However, public policies should favor better use of urban soils with the building of cycle paths and giving social incentives to the population, thus giving conditions to people to commute actively, even in developing countries. These incentives can make the use of active transportation a person's choice, saving the money that otherwise would be spent in public transportation, as observed by Tassitano et al. (2013) [30] in a study with industrialists in the city of Caruaru, Pernambuco, Brazil.

The school commuting duration appears in the literature as an important issue when choosing the AC [25]. It is observed that the time spent when commuting influences the choice of transportation. Overall, adolescents have more chance to choose AC with shorter commute duration, even walking or cycling [31]. Different from the literature, the results observed in our study pointed out that, among Sergipe adolescents, the ones who spend less time commuting from home to school presented the highest INAC prevalence. After adjustment in the analysis, among Sergipe adolescents, those who spend less time from home to school tend to use other means of transportation such as cars, motorcycles or buses instead of walking or cycling. Regarding AC,

future studies with GPS analyses can contribute to identifying the relationship between distance and type of commuting.

Considering the above, the results may collaborate with government programs that focus on AC and make possible interventions of improvements in the city pavement, public lighting and traffic behavior, especially in the urban centers. Such policies could increase AC among adolescents. It is important because of the inverse relationship between AC (resulting in a higher PA level) and the development of non-communicable diseases, where more physically active adolescents present lower prevalence of obesity [2] and hypertension [32], especially in small cities with similar socioeconomic and demographic characteristics.

This study has limitations, such as the lack of an objective measurement of PA. When measuring PA, the results can be confused because the self-report does not present the same trustworthiness of other more accurate methods [33]. Moreover, we investigated only students from public schools (which comprised about 80% of the overall number of students), and the results could be different when including adolescents enrolled in private education, a fact reported in a national survey involving adolescents from both education networks [22]. The results should be analyzed within this context and these limitations should be addressed in future studies.

In conclusion, our study revealed temporal changes in socioeconomic factors, demonstrating a decline in the adolescent's family income from 2011 to 2016. INAC prevalence remained high in boys, especially in those living in urban areas, both in 2011 and 2016. A shorter time when commuting was associated with the choice of motorized means of transportation. There is a need for government policies that can make the home-school route more attractive by offering bike paths, lighting and safety, promoting new commuting habits for adolescents living near to the schools.

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