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Time Trends of Physical Activity Among Brazilian Adolescents Over a 7-Year Period

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A B S T R A C T

Purpose: To evaluate time trends in physical activity among adolescents aged 10 to 19 years living in southern Brazil over a 7-year period.
Methods: Two population-based cross-sectional surveys with similar methodologies were carried out in the city of Pelotas, Brazil, in 2005 and 2012. Leisure-time and transport-related physical activity were measured using a validated questionnaire. A cut-off point of 300 minutes per week was used to classify adolescents as active or not. We also analyzed the two domains of physical activity (leisure time and transportation) separately.
Results: The prevalence of physical inactivity was 69.6% (95% CI 66.5–73.2) in 2005 and 69.9% (95% CI 66.5–72.7) in 2012. The percentage of active adolescents in leisure time also remained stable in the period (26.3% in 2005 [95% CI 23.3–29.2] vs. 28.1% in 2012 [95% CI 24.9–31.4]). Among boys, we observed an increase in the practice of some leisure-time activities—weight lifting (87%) and running (78%)—and a decline in others—volleyball (61%) and basketball (56%). Among girls, the only significant difference was an increase in the practice of weight lifting (271%). The prevalence of active commuting to and from school declined from 69% (95% CI 65.6–72.4) in 2005 to 56.5% (95% CI 52.5–60.2) in 2012.
Conclusions: There was a significant decline in active commuting to school among adolescents. Interventions promoting active commuting modes to school are urgently needed in Brazil.

IMPLICATIONS AND CONTRIBUTION

The prevalence of physical inactivity remained stable, but there was a significant decline in active commuting to school over time. Furthermore, we observed changes in the preference of physical activities practiced during leisure time. These findings emphasize the importance of the analysis of physical activity in its different domains.

Information on time trends in health-risk behaviors is essential to guiding the planning of effective policies and programs. Physical inactivity is currently one of the major risk factors for chronic diseases, being responsible for 5.3 million deaths per year worldwide [1]. Given this scenario, surveillance of population physical activity levels has become a public health priority [2,3].

Changes in physical activity patterns over time are being studied increasingly in Europe, Australia, and the United States [4]. Among adults, the literature has shown a trend of stability or slight increase in leisure time physical activity, with a concomitant decline in occupational activities [4]. Among youth, however, the studies are less frequent, and due to heterogeneous methods, it is difficult to reach a clear conclusion regarding the time trends worldwide. On one hand, a literature review concluded that the available evidence points to a stability of total physical activity and sports participation among adolescents in recent decades [5]. On the other hand, there seems to be a trend of declining physical activity during physical education classes [4] and declines in active commuting to school [6–10].

Although surveillance of physical activity has progressed substantially in recent years, most existing data comes from

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high-income countries. In low- and middle-income countries, studies of time trends are still scarce, especially with youth populations [2]. In Brazil, a surveillance of physical activity in adolescents aged 13 to 15 years was initiated by the National Survey of School Health in 2009 [11], but no data on time trends are available so far. This study evaluates trends in physical activity practice among adolescents living in southern Brazil, during a 7-year period.

Methods

Data analyzed here are part of two similar cross-sectional population-based surveys performed in 2005 and 2012, in the city of Pelotas, Brazil. The first study was conducted between October and December 2005 (spring and early summer) [12] and the second from February to June 2012 (summer and fall). According to data provided by the Center for Weather Forecasts and Research of the Federal University of Pelotas, average temperatures during the period of data collection were 20.8°C in the first study and 20.3°C in the second study, and the average accumulated rainfall was 54.7 mm and 56.7 mm of rain, respectively.

The sampling processes of the two studies were virtually identical. First, all census tracts (delimited areas comprising approximately 300 households each) were systematically selected. Subsequently, a systematic selection of households was conducted in each sampled tract. The number of households selected in each census tract was proportional to their sizes. In each household sampled, all individuals aged 10 to 19 years were eligible to participate in the study, except those with physical or mental incapacity to respond to the questionnaire. The total number of households visited was 1,507 in 2005 and 1,723 in 2012, accounting for 873 and 786 eligible adolescents, respectively. Nonresponse rates (losses and refusals) were 1.8% in 2005 and 5.7% in 2012. Therefore, the final sample included 857 adolescents in 2005 and 743 adolescents in 2012.

Physical activity practice was measured using a questionnaire administered face-to-face to the adolescents in their homes, by previously trained interviewers. The instrument used in both studies was identical and contained seven questions concerning the mode of commute to school and work, and eleven questions addressing physical activities practiced during leisure time (both organized and nonorganized). For each leisure-time activity, the question structure was: "Over the past 7 days, excluding physical education classes, have you played _____?" If the answer was yes, participants were questioned regarding the number of days and the duration of the activity each day.

Reliability of the instrument was tested in a survey conducted in 2005 in a sample of 92 adolescents. The questionnaire was administered to the adolescents twice (2-week interval). The reliability of the instrument was good, the Spearman correlation coefficient comparing the visits was .62 ($p < .001$) and 73% of adolescents were classified in the same groups in the first and second visits. The kappa coefficient was .58.

The total physical activity score was generated by the sum of minutes per week spent on leisure-time and commuting activities. Individuals with physical activity practice below 300 minutes per week were considered inactive, in accordance with the recommendations of physical activity for adolescents [13]. Physical activity was also analyzed separately by domain. The same 300 minutes per week criterion was used to estimate the percentage of adolescents active in leisure time. In the transport domain, we simply divided adolescents into those using active transportation to school versus the others.

Independent variables used in the analysis were sex, age, and socioeconomic status (defined according to the criterion of the Brazilian Association of Research Companies, which takes into account the purchasing power of individuals as well as the education of household head, where A represents the richest and E represents the poorest families) [14]. For comparison purposes, the independent variables collected in 2012 were identical to those collected in 2005.

Data analyses included the description of the frequency of independent variables for both studies. Subsequently, a comparison of the prevalence of physical inactivity and active commuting to school according to the subgroups of the independent variables was made. In multivariable analysis, Poisson regression model was used and the effect of each variable was adjusted for other variables. In leisure time, the percentage of active adolescents and the prevalence of each activity practiced were compared between studies. For activities whose change was statically significant, analysis was performed stratified by sex. Finally, the prevalence of active and inactive commuting to school and work was also compared. Statistical significance was calculated using *Chi*-square tests for heterogeneity. All analyses were conducted using Stata version 12.0 (StatCorp LP, College Station, TX) and took into account the effect of the sample design, using the command group "svy".

The study was approved by the ethics committee of the medical school of the Federal University of Pelotas. The interviews were conducted only after written consent of the interviewee, and individuals were granted the right of refusal and the confidentiality of the data reported.

Results

In both studies, 48% of adolescents were boys and the mean age was 14.4 years in 2005 and 14.6 years in 2012. In the first study, 36.3% of adolescents were part of the lowest socioeconomic status (D + E), and this percentage was only 11% in the second study. In 2005, 84% of adolescents were attending school or university and 15.4% worked. In 2012, these percentages were 89% and 14.8%, respectively.

The prevalence of physical inactivity remained stable in the period (69.6% [95% CI 66.5–73.2] in 2005 and 69.9% [95% CI 66.5–72.7] in 2012) and did not change in any of the subgroups analyzed. Using the cutoff point of 420 minutes per week (60 minutes, 7 days of the week), the prevalence of physical inactivity also remained stable: 76.6 (95% CI 73.8–79.5) in 2005 and 76.6 (95% CI 73.5–79.6) in 2012. Both in 2005 and 2012, physical inactivity was higher in girls and did not differ according to age groups. Regarding socioeconomic status, in 2005, adolescents from the lowest socioeconomic groups were more inactive compared with adolescents from the highest socioeconomic levels, but this difference was not observed in 2012 (Table 1). However, the proportion of adolescents who do not exercise (zero minutes in the total score) increased from 26.4% (95% CI 23.4–29.4) in 2005 to 31.5% (95% CI 28.1–34.8) in 2012.

The percentage of adolescents active during leisure time also did not change (26.3% [95% CI 23.3–29.2] in 2005 and 28.1% [95% CI 24.9–31.4] in 2012) (Table 2). Regarding the activities practiced in leisure time, there was an increase of 128% in the practice of weight lifting and a 55% increase in running. We also

Table 1
Prevalence of physical inactivity and adjusted prevalence ratios according to sex, age, and socioeconomic status, Pelotas, Brazil, 2012

Variables	2005			2012			7-year change[b] %
	%	RR (95% CI)	p[a]	%	RR (95% CI)	p[a]	
Sex			<.001			<.001	
Male	56.1	1.00		54.0	1.00		−3.8
Female	82	1.47 (1.32–1.63)		84.6	1.57 (1.40–1.77)		+3.2
Age (years)			.12			.29	
10–14	68.1	1.00		67.1	1.00		−1.5
15–19	71.1	1.06 (.99–1.14)		72.3	1.05 (.95–1.16)		+1.7
Socioeconomic status			.02			.52	
Highest (A + B)	68.5	1.00		72.0	1.00		+5.1
Intermediate (C)	65.2	.95 (.84–1.09)		66.6	.95 (.85–1.07)		+2.1
Lowest (D + E)	75.4	1.11 (.99–1.25)		72.8	1.03 (.89–1.19)		−3.5
Total	69.6	(66.5–73.2)		69.9	(66.5–72.7)		+.4

[a] Wald test for heterogeneity.
[b] No changes were statistically significant.

observed a decline of 34% in volleyball and 58% in basketball practice in the total sample. When these changes were analyzed separately by sex (Figure 1), this pattern continued for boys. Among girls, however, only a significant increase in weight lifting practice was observed.

Active commuting to school by walking or biking declined from 69% (95% CI 65.6–72.4) in 2005 to 56.5% (95% CI 52.7–60.2) in 2012. In relation to the mode of commuting to work, although we observed this same pattern of change, these differences were not statistically significant (Table 3).

Both in 2005 and 2012, the prevalence of active commuting to school was higher among boys, adolescents aged 10 to 14 years and among those belonging to the lowest socioeconomic status (Table 4). Regarding the changes in the subgroups analyzed, there was a significant decline of active commuting in both sexes, being more pronounced among girls than among boys (23.3% vs. 13.9%), in both age groups (18% in the 10–14 years group and 15.7% in the 15–19 years group) and between the richest adolescents (30.4%). There has been no change in the prevalence of active commuting among adolescents belonging to intermediate and lowest socioeconomic groups.

Discussion

The prevalence of physical inactivity did not change in the 7-year period. However, there was an increase in the proportion of adolescents who do not exercise at all (zero minutes per week) and a marked decline in active commuting to school. With respect to physical activities practiced during leisure time, there was an increase in weight lifting and running and a decline in the practice of volleyball and basketball for boys, as well as an increase in weight lifting practice among girls.

The lack of surveillance data on time trends of physical activity among adolescents from low- and middle-income countries makes it difficult to compare our findings with the literature. This is particularly relevant because it is known that the trends observed in studies conducted in high-income countries tend to be different from those observed in middle-income countries, like Brazil [2].

In studies conducted in high-income countries, time trends are often investigated in different domains of physical activity. In the United States, for example, there was observed stability in the prevalence of adolescents aged 15 to 18 years who reach the recommended daily physical activity and also in vigorous physical activity practice from 1991 to 2007. However, daily participation in physical education classes increased [15]. In New South Wales, Australia, there was an increase in overall physical activity in adolescents aged 12 to 15 years, from 1985 to 2004 [16]. In the same place, in the period from 1971 to 2003, the mode of commute to school changed markedly from active (walking) to inactive (car) in adolescents aged 10 to 14 years [6].

The findings of these studies support the notion that assessing different domains of physical activity is essential for a better understanding of global changes over time. In our study, looking only at the results of total physical activity, we would say that there was no change during the study period, but important changes related to the physical activities practiced during leisure time and mode of commute to school were observed.

The increasing practice of physical activities such as weight training and running reflects a shift of interest in the type of physical activity performed by adolescents in leisure time. The search for an ideal body, greatly emphasized in contemporary society, is possibly influencing the choice of these kinds of practices. In a study conducted in Pelotas in order to

Table 2
Comparison of physical activities practiced in leisure time in 2005 and 2012, Pelotas, Brazil, 2012

	2005 N (%)	2012 N (%)	7-year change %	p[a]
Activities practiced in leisure time				
Football	210 (24.5)	177 (23.8)	−2.9	.78
Cycling	178 (20.8)	130 (21.5)	+3.4	.77
Walking	140 (16.3)	160 (17.5)	+7.4	.67
Soccer	94 (11.0)	71 (9.6)	−12.7	.38
Running	53 (6.2)	71 (9.6)	+54.8	.02
Weightlifting	31 (3.6)	61 (8.2)	+127.8	<.001
Basketball	40 (4.7)	15 (2.0)	−57.5	.01
Volleyball	79 (9.2)	45 (6.1)	−33.7	.04
Dance	41 (4.8)	26 (3.5)	−27.1	.24
Caçador[b]	35 (4.1)	39 (5.3)	+29.3	.33
Gymnastics	18 (2.1)	23 (3.1)	+47.6	.30
Active according to the recommendation				
300 min/wk in leisure time	26.3	28.1	+6.8	.51

[a] *Chi*-square test for difference in proportions in the period between studies.
[b] A ball game with no appropriate translation in English.

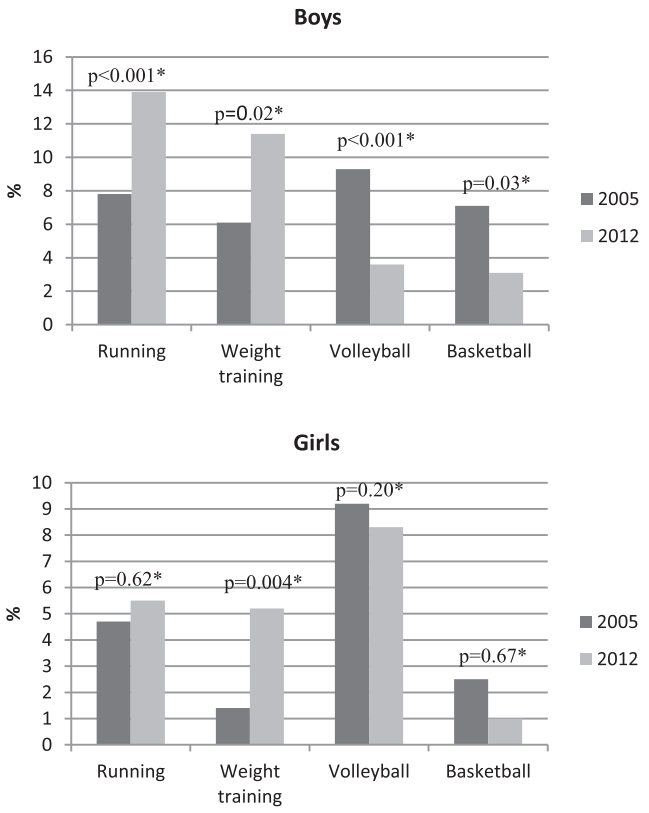

Figure 1. Comparison of physical activities practiced in leisure time in 2005 and 2012 stratified by sex, Pelotas, Brazil, 2012. *Chi-square test for difference in proportions in the period between the studies.

identify preferences for physical activities and sports during adolescence, an increase in preference for gyms activities such as gymnastics and weight training was observed [17]. The authors believe that the growing increase in the number of gyms and knowledge about the benefits of physical activity for health, along with the concern with body, seem to be important factors in the search for this type of activity.

The decrease in volleyball and basketball practice among boys seems to be part of the same changing context. It is possible that these modalities, since they may be less widespread in society as compared with soccer, for example, are being replaced by other activities such as weight training and running. Because sports practice in Brazil is mainly spread through physical education classes, schools become an important space for promoting physical activity in adolescence.

The decline in active commuting to school shows the same phenomenon that has been observed in several time trend studies conducted in high-income countries [6–10]. Given that physical activity has an important socioeconomic component, the change in travel mode is not independent of the changes that Brazil is experiencing in the last decade, where a sharp decline in poverty and an increase in the power of consumption of the population are observed due to cash transfer and other types of programs from the Federal government [18]. According to the State Traffic Department of Rio Grande do Sul [19], the fleet of private vehicles in the city of Pelotas grew by 60.6% in the period from 2005 to 2012. This increase in ownership of vehicles is one of the likely explanations for the decline in active transportation. These megatrends that affect the society as a whole might also impact the lifestyle of people.

Interestingly, the decline in active commuting was more marked among those with higher socioeconomic status. Among the poor, active commuting is still a common habit, and in most cases, a matter of necessity and not of choice, unlike in other countries such as the Netherlands and Germany, where walking and cycling is attractive, safe, and pleasant [20].

Regarding gender differences, it is known that boys are more active than girls [21]. However, there is no evidence for the declining trend being more pronounced among girls. Girls are culturally more protected by their parents, and perhaps a greater perception of violence, traffic, insecurity, and other crimes in the

Table 3
Comparison of commuting to school and work in 2005 and 2012, Pelotas, Brazil, 2012

Mode of travel	2005 N (%)	2012 N (%)	7-year change %	p[a]
To school				
Walking/Cycling	497 (69.0)	372 (56.4)	−18.1	<.001
Car/Motorcycle/Bus	223 (31.0)	287 (43.5)	+40.3	
To work				
Walking/Cycling	77 (58.3)	53 (48.2)	−17.3	.14
Car/Motorcycle/Bus	55 (41.7)	57 (51.8)	+24.2	

[a] *Chi*-square test for difference in proportions in the period between studies.

Table 4
Prevalence of active commuting to school and adjusted prevalence ratios according to sex, age, and socioeconomic status, Pelotas, Brazil, 2012

Variables	2005			2012			7-year change %	p[b]
	%	RR (95% CI)	p[a]	%	RR (95% CI)	p[a]		
Sex			.04			.01		
Male	73.2	1.00		63	1.00		−13.9	.02
Female	65.3	.89 (.80–.99)		50.1	.84 (.74–.96)		−23.3	<.001
Age (years)			<.001			<.001		
10–14	76.5	1.00		62.7	1.00		−18.0	<.001
15–19	58.5	.80 (.70–.91)		49.3	.80 (.69–.92)		−15.7	.07
Socioeconomic status			<.001			<.001		
Highest (A + B)	51.3	1.00		35.7	1.00		−30.4	.01
Intermediate (C)	72.7	1.38 (1.15–1.66)		71.1	1.98 (1.59–2.48)		−2.2	.75
Lowest (D + E)	79.7	1.48 (1.23–1.80)		80.9	2.22 (1.73–2.85)		+1.5	.87
Total	69.0	(64.3–73.8)		56.4	(50.7–62.2)		−18.1	<.001

[a] Wald test for heterogeneity.
[b] *Chi*-square test for differences in proportions in the period between the studies.

current context, is reinforcing this protection. However, the study is limited to understanding this difference.

Considering that a crucial aspect of monitoring studies is the need to use comparable methods over time, the rigorous methodological comparability between the surveys can certainly be considered the strongest point of this study. Using an instrument that allows the characterization of changes by physical activity domain is another advantage of the study, because the combined estimate of physical activity limits the comparisons and complicates the interpretation and understanding of the findings. The similarity of the climate data collection period of the studies should also be highlighted, as distinct climatic periods could have influenced the estimates found.

Some limitations of this study should be discussed. Instruments based on self-reporting, such as the ones used in this study, are subject to overestimation of physical activity [5]. However, this bias was present in both studies and, therefore, did not impair comparability. Another possible limitation is the fact that we did not collect data on the neighborhood environment, a known correlate of physical activity. It should be noted also that some differences in physical activities practiced in leisure time may not have been detected due to too small a sample size to perform the analysis separately for each activity.

Recommendations

Although stable, the prevalence of physical inactivity is high and less than one third of the adolescents studied attain the recommended levels. Moreover, the proportion of adolescents who do not practice any weekday physical activity increased. It is known that active adolescents tend to become active adults, thus the low levels of physical activity observed are even more worrisome. The changing preference of physical activities practiced during leisure time and the decline of active commuting should be considered in efforts to promote physical activity in this population group.

The promotion of active commuting requires intersectoral action with emphasis on urban planning and traffic safety, with the aim of reducing the environmental and structural barriers to the adoption of this behavior among adolescents. Future studies should continue to analyze physical activity in its various domains to enable a better understanding of the changing patterns of this behavior over time.

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