Time Trends in Physical Activity in the State of São Paulo, Brazil: 2002–2008

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ABSTRACT

MATSUDO, V. K. R., S. M. MATSUDO, T. L. ARAÚJO, D. R. ANDRADE, L. C. OLIVEIRA, and P. C. HALLAL. Time Trends in Physical Activity in the State of São Paulo, Brazil: 2002–2008. *Med. Sci. Sports Exerc.*, Vol. 42, No. 12, pp. 00–00, 2010. **Purpose**: To document time trends in physical activity in the state of São Paulo, Brazil (2002–2008). In addition, we discuss the role of Agita São Paulo at explaining such trends. **Methods**: Cross-sectional surveys were carried out in 2002, 2003, 2006, and 2008 in the state of São Paulo, Brazil, using comparable sampling approaches and similar sample sizes. In all surveys, physical activity was measured using the short version of the International Physical Activity Questionnaire. Separate weekly scores of walking and moderate- and vigorous-intensity physical activities were generated; cutoff points of 0 and 150 min·wk^{-1} were used. Also, we created a total physical activity score by summing these three types of activity. We used logistic regression models for adjusting time trends for the different socio-demographic compositions of the samples. **Results**: The prevalence of no physical activity decreased from 9.6% in 2002 to 2.7% in 2008, whereas the proportion of subjects below the 150-min threshold decreased from 43.7% in 2002 to 11.6% in 2008. These trends were mainly explained by increases in walking and moderate-intensity physical activity. Increases in physical activity were slightly greater among females than among males. Logistic regression models confirmed that these trends were not due to the different compositions of the samples. **Conclusions**: Physical activity levels are increasing in the state of São Paulo, Brazil. Considering that the few data available in Brazil using the same instrument indicate exactly the opposite trend and that Agita São Paulo primarily incentives the involvement in moderate-intensity physical activity and walking, it seems that at least part of the trends described here are explained by the Agita São Paulo program. **Key Words:** POPULATION SURVEILLANCE, MOTOR ACTIVITY, PUBLIC HEALTH, DEVELOPING COUNTRIES

The role of physically activity at improving physical and mental health is extensively documented (12). Despite this evidence, populations are still below physical activity goals worldwide (9). Recognition of physical inactivity as a population-wide problem has led to programs and policies to propose interventions aimed at changing the behavior of entire populations (13,31), as well as motivated the World Health Organization to create the Global Strategy on Diet, Physical Activity, and Health (33).

In Brazil, levels of physical activity are also low (6,10,21). This is of particular concern because the country is experiencing very rapid epidemiological and nutritional transitions (22). Surveys conducted in the Sao Paulo state in the 1990s produced estimates of 46%, 50%, and 69% of adults not meeting physical activity guidelines (26). Data on temporal trends of physical activity in Brazil are virtually nonexistent. Very recently, Knuth et al. (16) showed that the proportion of adults not meeting the 150-min threshold (12) increased from 41% in 2002 to 52% in 2007. The recently implemented surveillance system of risk factors for chronic diseases in Brazil (23) is still too new to produce time trends of physical activity because only three data points are publicly available.

The state of São Paulo is well known in the physical activity and health literature because of the existence, since 1996, of the Agita São Paulo program (20). The purposes of the program were to increase the population's knowledge on the benefits of physical activity for health (biological, psychological, and social) and to increase participation in moderate to vigorous physical activity, with special emphasis on the promotion of walking and moderate-intensity physical activity. Initially based on principles of the transtheoretical model (19), the purpose was to upgrade by one level each person's stage of change for physical activity. The program currently uses an integrated mobile ecological model for the promotion of physical activity; the Agita intervention has been described elsewhere (20). As part of the efforts to evaluate the effectiveness of the program, cross-sectional surveys were carried out every year from 2000 onward. In 2002, 2003, 2006, and 2008, surveys were representative of the whole state's population. The aim of the

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present article was to document time trends in physical activity in the state of São Paulo, Brazil, in this period. An additional objective was to discuss the role of Agita São Paulo at explaining the observed trends.

METHODS

At the beginning of the intervention, the São Paulo state comprised a population of 36,969,476 inhabitants in a 248,178.70-km^2 area with 645 municipalities. The city and metropolitan region of São Paulo were the second largest in the world, with 16,446,000 inhabitants. Comparable cross-sectional surveys were carried out in the state of São Paulo in 2002, 2003, 2006, and 2008. Sample sizes were around 2000 individuals in each survey. Sampling approaches were comparable across the four surveys. First, cities were randomly selected within each geographical region of the state. Second, census tracts (delimited areas comprising approximately 300 households each) were listed in each sampled city, and a random sample of tracts was selected. In each tract selected, a random starting point was sampled, and households were systematically selected. In each selected household, one resident was sampled using a random approach.

In all surveys, physical activity was assessed using the short version of the International Physical Activity Questionnaire (IPAQ) (4). Subjects were asked about frequency and duration of vigorous and moderate physical activities and walking during the last week. A physical activity score was created through the multiplication of weekly frequency and session duration of each physical activity reported. After that, vigorous physical activity scores were multiplied by two and summed to walking and moderate activity scores to obtain a total physical activity score (12). Cutoff points of 0 and 150 min·wk^{-1} were used in the analyses. In addition, we present physical activity data in the four categories proposed by the IPAQ group (14).

Independent variables included sex, age, and socioeconomic position. Individuals were asked about household assets, and a standardized protocol was used to classify families into three groups: A + B (wealthiest), C (intermediate), and D + E (poorest). Age was categorized into three groups (18–29, 30–44, or ≥45 yr). Data on the independent variables were collected using exactly the same questions in the four surveys.

TABLE 1. Description of the samples in sex, age, and socioeconomic status (São Paulo State, Brazil: 2002, 2003, 2006, and 2008).

Variables	Survey Year, n (%)			
	2002	2003	2006	2008
Sex		$P^a = 0.66$		
Men	1187 (48.0)	1211 (48.6)	1063 (49.8)	1052 (48.8)
Women	1287 (52.0)	1279 (51.4)	1070 (50.2)	1103 (51.2)
Age (yr)		$P^a = 0.001$		
18–29	897 (36.3)	882 (35.4)	719 (33.7)	731 (33.9)
30–44	902 (36.4)	909 (36.5)	735 (34.5)	725 (33.7)
45–65	675 (27.3)	699 (28.1)	679 (31.8)	699 (32.4)
Socioeconomic status		$P^a < 0.001$		
A + B (wealthiest)	1030 (41.7)	692 (27.8)	777 (37.8)	812 (37.8)
C (intermediate)	968 (39.1)	891 (35.8)	942 (45.8)	1090 (50.7)
D + E (poorest)	476 (19.2)	907 (36.4)	336 (16.4)	247 (11.5)
Total sample size	2474	2490	2133	2155

[a] χ^2 test.

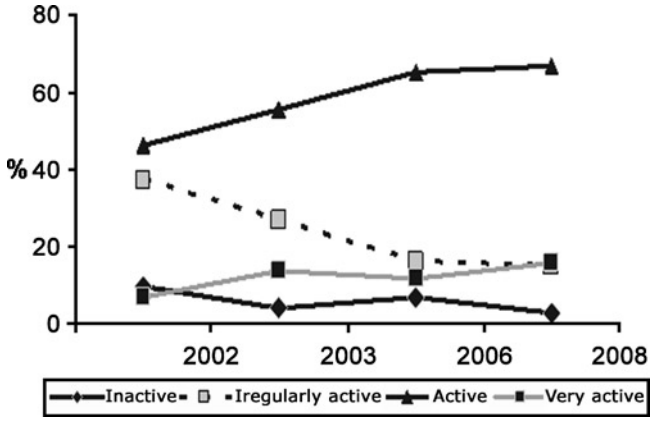

FIGURE 1—Trends of physical activity categories in the state of São Paulo, Brazil (2002, 2003, 2006, and 2008).

In all surveys, individuals were approached in their households. Trained interviewers collected the data. The number of subjects sampled in each city was not uniform. Also, it does not represent a standard fraction of each city's population. As a consequence, we weighed the data to guarantee correct sampling fractions. Data analyses included calculations of χ^2 tests for heterogeneity and linear trend and logistic regression models. In the regression, adjustment for sex, age, and socioeconomic position was done to guarantee that differences in proportions over time represent the time trends instead of the different compositions of the samples. Variations in physical activity levels from 2002 to 2008 were expressed as "deltas."

Study protocols were approved by the Ethics Committee of Santa Casa Hospital in São Paulo. Informed consent was obtained before the interviews.

RESULTS

Nonresponse rates were below 5% in all surveys. Table 1 compares the four samples according to sex, age, and socioeconomic position. The distribution of sex was very similar in all surveys. In contrast, there was some variability

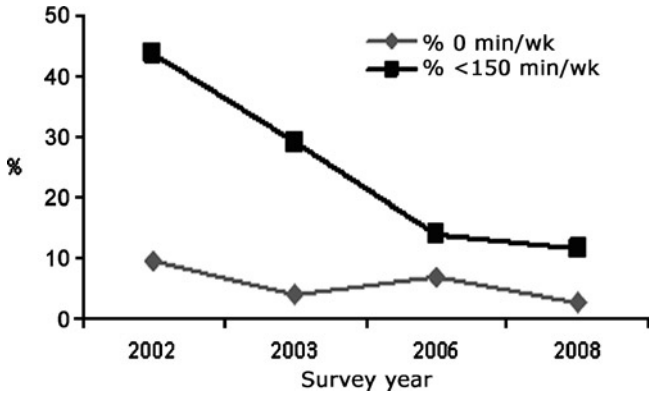

FIGURE 2—Trends of inactive people and insufficiently active people in the state of São Paulo, Brazil (2002, 2003, 2006, and 2008).

TABLE 2. Evolution of physical activity (PA) indicators over time (São Paulo State, Brazil: 2002, 2003, 2006, and 2008).

PA Indicators	Survey Year				Δ2002–2008 (%)	P[a]
	2002	2003	2006	2008		
Walking						
% 0 min·wk^{-1}	24.5	17.1	21.3	13.4	−45.3	<0.001
% <150 min·wk^{-1}	74.6	58.9	51.5	53.8	−27.9	<0.001
Moderate-intensity PA						
% 0 min·wk^{-1}	39.9	28.7	21.3	16.2	−59.4	<0.001
% <150 min·wk^{-1}	85.4	79.6	42.5	38.5	−54.9	<0.001
Vigorous-intensity PA						
% 0 min·wk^{-1}	71.4	61.6	73.5	56.8	−20.4	0.78
% <60 min·wk^{-1}	77.9	65.0	75.9	62.1	−22.1	0.001

[a] *P* value for linear trend.

regarding age ($P = 0.001$) and socioeconomic position ($P < 0.001$) across the four investigations.

F1 Figure 1 shows time trends in physical activity according to the IPAQ algorithm. The proportion of inactive subjects declined from 9.6% in 2002 to 2.7% in 2008 (a 3.5-times decrease). For the same period, the prevalence of very active subjects doubled from 7.0% to 15.7%. An increase in the proportion of active subjects and a reduction in the prevalence of irregularly active individuals were also evident.

Changes in the prevalence of physical activity practice according to cutoff points of 0 and 150 min·wk^{-1} F2 were also investigated. Figure 2 presents a significant ($P < 0.001$) reduction in the proportion of individuals scoring <150 min·wk^{-1} from 43.7% in 2002 to 11.6% in 2008.

T2 Table 2 shows the evolution of physical activity indicators over time. The proportion of individuals with scores of 0 of <150 min·wk^{-1} regarding walking or moderate-intensity physical activity practice reduced markedly from 2002 to 2008 ($P < 0.001$). The proportion of individuals failing to reach 60 min·wk^{-1} in vigorous-intensity physical activity decreased significantly from 77.9% in 2002 to 62.1% in 2008. On the other hand, no significant change was observed regarding vigorous-intensity physical activity practice using the cutoff of 0 min·wk^{-1} ($P = 0.78$).

Analyses stratified by sex and age showed similar results to those presented for the total sample and, therefore, were not shown. The only exception was that increases in moderate-intensity physical activity practice were stronger among women compared with men. Regarding socioeconomic position (Table 3), the greatest increases were observed among the poor, regarding any walking. T3

Table 4 presents logistic regression models on the association of several physical activity indicators according to survey year. All outcome variables presented inverse associations with both survey year and failure to reach physical activity thresholds both in the crude and in the adjusted analyses. For example, an odds ratio of 0.21 (95% confidence interval = 0.18–0.24) to practice <150 min·wk^{-1} was observed for 2008 year in comparison to 2002. T4

DISCUSSION

Analyzing time trends in physical activity in the state of São Paulo, Brazil, is highly relevant in public health because, in addition to the unique value of addressing time trends of activity in a middle-income country, which is rare, our study enables us to comment on the role of Agita São Paulo, a widely known physical activity promotion program started in 1996, at explaining the trends observed. Regardless of the indicator used and of the subgroup of the population analyzed, physical activity levels are clearly increasing in the state, although trends are not all perfectly linear, probably because of sampling fluctuation.

Data on the effectiveness of large-scale physical activity interventions are lacking, particularly in Latin America (13). Existing evaluation studies do not address interventions similar to the Agita São Paulo, making it impossible to draw

TABLE 3. Evolution of physical activity (PA) indicators over time by socioeconomic status (SES; São Paulo State, Brazil: 2002, 2003, 2006, and 2008).

PA Indicators	SES	Survey Year				Δ2002–2008 (%)	P[a]
		2002	2003	2006	2008		
Walking							
% 0 min·wk^{-1}	A + B (wealthiest)	26.9	20.9	22.7	17.0	−36.8	0.003
	C	21.1	17.0	20.4	11.4	−46.0	0.016
	D + E (poorest)	26.2	14.6	21.5	9.2	−64.9	0.947
% <150 min·wk^{-1}	A + B (wealthiest)	73.3	60.7	49.2	59.0	−19.5	<0.001
	C	74.8	64.5	53.7	49.6	−33.7	<0.001
	D + E (poorest)	76.9	52.3	53.5	52.7	−31.5	<0.001
Moderate-intensity PA							
% 0 min·wk^{-1}	A + B (wealthiest)	41.3	28.2	22.1	14.5	−64.9	<0.001
	C	36.7	28.7	19.6	15.3	−58.3	<0.001
	D + E (poorest)	43.3	29.4	22.5	13.0	−70.0	<0.001
% <150 min·wk^{-1}	A + B (wealthiest)	86.9	79.2	43.5	41.5	−52.2	<0.001
	C	82.8	78.9	42.9	35.3	−57.4	<0.001
	D + E (poorest)	87.1	80.7	39.4	44.2	−51.5	<0.001
Vigorous-intensity PA							
% 0 min·wk^{-1}	A + B (wealthiest)	71.0	66.1	69.5	56.4	−20.6	0.059
	C	68.6	63.6	73.5	57.9	−15.6	0.735
	D + E (poorest)	77.9	57.0	81.8	51.2	−34.3	0.042
% <60 min·wk^{-1}	A + B (wealthiest)	77.6	70.4	72.6	62.4	−19.6	0.001
	C	74.6	70.9	76.1	62.8	−15.8	0.015
	D + E (poorest)	84.8	65.3	83.0	55.1	−35.0	0.838

[a] *P* value for linear trend.

TABLE 4. Logistic regression models on physical activity (PA) indicators according to survey year (São Paulo State, Brazil: 2002, 2003, 2006, and 2008): unadjusted and adjusted analyses.

PA Indicator	Unadjusted Analysis	Adjusted Analysis[a]
Walking (% 0 min·wk^{-1})		
2002	1.00	1.00
2003	0.81 (0.71–0.93)	0.83 (0.73–0.95)
2006	0.75 (0.65–0.87)	0.74 (0.64–0.85)
2008	0.77 (0.67–0.89)	0.77 (0.67–0.89)
Walking (% <150 min·wk^{-1})		
2002	1.00	1.00
2003	0.73 (0.65–0.82)	0.75 (0.67–0.85)
2006	0.41 (0.37–0.47)	0.41 (0.37–0.47)
2008	0.45 (0.40–051)	0.45 (0.40–0.50)
Moderate-intensity PA (% 0 min·wk^{-1})		
2002	1.00	1.00
2003	0.51 (0.45–058)	0.49 (0.43–0.56)
2006	0.49 (0.43–0.56)	0.45 (0.39–0.51)
2008	0.34 (0.29–0.39)	0.31 (0.27–0.36)
Moderate-intensity PA (% <150 min·wk^{-1})		
2002	1.00	1.00
2003	0.65 (0.57–0.76)	0.67 (0.58–0.78)
2006	0.15 (0.13–0.17)	0.14 (0.12–0.16)
2008	0.09 (0.08–0.11)	0.09 (0.08–0.10)
Vigorous-intensity PA (% 0 min·wk^{-1})		
2002	1.00	1.00
2003	0.61 (0.55–0.69)	0.57 (0.50–0.65)
2006	1.13 (0.99–1.28)	1.12 (0.97–1.28)
2008	0.72 (0.63–081)	0.66 (0.58–0.75)
Vigorous-intensity PA (% <60 min·wk^{-1})		
2002	1.00	1.00
2003	0.56 (0.50–0.64)	0.52 (0.46–0.60)
2006	0.93 (0.81–1.06)	0.90 (0.78–1.05)
2008	0.59 (0.52–0.68)	0.53 (0.46–0.61)
Total PA (% 0 min·wk^{-1})		
2002	1.00	1.00
2003	0.43 (0.33–0.54)	0.45 (0.35–0.57)
2006	0.81 (0.65–1.01)	0.79 (0.63–0.98)
2008	0.42 (0.32–0.55)	0.41 (0.32–0.53)
Total PA (% <150 min·wk^{-1})		
2002	1.00	1.00
2003	0.61 (0.54–0.69)	0.63 (0.56–0.71)
2006	0.27 (0.23–0.31)	0.27 (0.23–0.31)
2008	0.21 (0.18–0.25)	0.21 (0.18–0.24)

Values are presented as odds ratio (95% confidence interval).
[a] Adjusted for sex, age, and socioeconomic status.

recommendations about this type of intervention (2,8,15,18, 25,29,32). Previous studies addressed the cost-effectiveness of Agita São Paulo and other physical activity promotion programs (24,27), but at the best of our knowledge, no data evaluating physical activity levels at different time points, with physical activity interventions, are available in Latin American areas.

Two recent estimates of physical activity levels worldwide have included data from Brazil (1,9). Both surveys found prevalence estimates of insufficient physical activity in the Brazilian sample much higher than those reported here for the state of São Paulo in our most recent data point. Previous studies on time trends of physical activity (5,30), mainly in the United States (26–31), detected nonsignificant or slightly changes in physical activity over time. The magnitude of the increase observed in our sample is unique in the physical activity field for a period of only 6 yr. A recent systematic review on temporal trends of physical activity worldwide detected the need for studies in low- and middle-income countries on this issue because time trends observed in high-income countries may be different from those observed in transitional societies (17).

Let us now discuss the role of Agita São Paulo at explaining the trends detected in our study. We have several reasons to believe that Agita is the main explanation for the increased physical activity levels in São Paulo.

First, the only published data available on time trends of physical activity in Brazil come from Pelotas, a southern Brazilian city. Using exactly the same instrument we administered, the authors detected an 11% point increase in the proportion of adults below the 150-min threshold during a 5-yr period (2002–2007) (16). Data from the Brazilian surveillance system showed a very modest increase in the proportion of adults practicing 150 min·wk^{-1} or more of leisure time physical activity from 2006 to 2008: 14.9% in 2006, 15.5% in 2007, and 16.4% in 2008 (23). It is important to highlight, however, that these data are not directly comparable to ours because we are showing results for the four domains of physical activity combined, whereas the surveillance data presented leisure time physical activity only.

Second, the message of the Agita São Paulo is directed toward the practice of moderate-intensity physical activity, including walking. Our results clearly show that these types of activity were exactly those that changed more markedly during the period studied, suggesting that the Agita message is likely to be well disseminated.

In addition, since 2002, the state of São Paulo has officially celebrated the Physical Activity Day every April 6, wherein several cities promote mega events aimed at highlighting the need to incorporate physical activity in the daily routine. For example, in 2002, 888 events took place in 175 cities in the state. In 2008, 2030 events were carried out. Also, since 2006, the Brazilian Ministry of Health has funded cities in the country to carry out physical activity promotion strategies. Of the 35 cities in the state of São Paulo, which have been funded in 2006, 54% were partners of Agita. In 2007, 51% of the 49 funded cities were Agita partners. A recent study showed that 102 cities in the state have a local physical activity promotion program named Agita, and overall, 226 cities in the state had a physical activity–related intervention.

Finally, the population's recall on the Agita name and main message increased during the last years. In 2002, 37% of the state's population was aware of Agita. This proportion increased to 60% in 2008, and up to this date, 49% of the state's population was aware of the main message of the program: "accumulate 30 minutes per day of physical activity."

We found no major differences in time trends between males and females. In obesity, however, Monteiro et al. (22) reported sex differences in time trends between 1975 and 2003. Our surveys did not find different trends across the age groups, suggesting that the evolution of physical activity in the state of São Paulo, Brazil, is independent of age. An interesting finding was the minimization of social inequalities in physical activity over time because low-income individuals presented the greatest increases in physical

activity levels during the 6 yr analyzed. This is different from the findings of Knuth et al. (16) in Pelotas, southern Brazil, which showed that physical activity levels declined more among the poor in comparison to the rich between 2002 and 2007. Again, Agita São Paulo is a likely explanation because it disseminates the physical activity message to everyone, differently from traditional health knowledge, which tends to be concentrated among the rich (3).

Some limitations of the present study need to be acknowledged. Although sampling strategies had the same principle, some differences in the composition of the samples were found. To overcome such a limitation, we adjusted our estimates for these differences, and time trends were mainly unaltered or were even stronger after such adjustment. Therefore, it is not likely that the trends described here are due to the different sociodemographic compositions of the samples. The short version of IPAQ also has some limitations. The main limitation is that we were unable to differentiate time trends by domains of physical activity (leisure time, occupational, housework, and commuting). However, the use of the same instrument in all data collections maximizes comparability across surveys. We observed some instability in some physical activity estimates across surveys, which are probably explained by sampling fluctuation. Most importantly, the trends of increasing physical activity over time were clear cut regardless of the indicator used. Finally, the lack of baseline data on physical activity in the state of São Paulo before the beginning of the intervention prevents us to traditionally evaluate the effectiveness of Agita São Paulo using typical intervention evaluation techniques such as before and after comparisons.

In conclusion, although it is difficult to formally estimate the fraction of the trends observed due to Agita São Paulo, it is fair to consider that, at least, part of them are directly or indirectly reflecting the success of the intervention. Physical activity levels are clearly increasing in the state of São Paulo, Brazil.

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The authors have no conflict of interest to declare.

Results of the present study do not constitute endorsement by the American College of Sports Medicine.

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AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES

AQ1 = Please supply author V.K.R. Matsudo's highest academic degree obtained.

AQ2 = Please provide the citation of references 7 and 11; otherwise, delete them from the list and renumber accordingly.

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