

Changes in commuting to work and physical activity in the population of three municipalities in the São Paulo region in 2000 and 2010

Mudanças no deslocamento para o trabalho e na atividade física da população de três municípios da região de São Paulo nos anos de 2000 e 2010

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ABSTRACT: *Objective:* To evaluate the changes in commuting to work and physical activity (PA) in the population of three municipalities in the São Paulo region in 2000 and 2010. *Methods:* Cross-sectional study with a representative sample of 602 adults (62.3% men) carried out in the municipalities of Santo André, São Bernardo do Campo and São Caetano do Sul in 2000 (n = 304; 66.1% men) and 2010 (n = 298; 58.4% men). Physical activity was assessed by the International Physical Activity Questionnaire and participants were classified into active (≥ 150 min/week) and insufficiently active (< 150 min/week). The commuting to work was classified in active transport (walking and cycling), private (bike, car, vans and buses) and public (buses, vans, train or subway). *Results:* Average (min/week) PA walk (229.4 versus 190.6), moderate (449.1 versus 347.4), vigorous (354.4 versus 317.4) and total (552.3 versus 442.5) shows the participants were greater in 2010 than in 2000. The prevalence assets increased from 62.2 to 78.2%, respectively. A negative relationship was found between active transport and public with socioeconomic status; active transport and education level; public transport and age. Positive relationship was found only among private transport and socioeconomic status. The average of the total PA (min/week) was higher ($p = 0.024$; 32.2%) in 2010 than in 2000 for active transport. *Conclusions:* Surveillance data in full PA in the three municipalities of São Paulo indicate that the average active commuting to work increased after ten years, while public transport has decreased.

Keywords: Motor activity. Epidemiology. Health surveys. Risk factors. Developing countries.

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RESUMO: *Objetivo:* Verificar as mudanças no deslocamento para o trabalho e na atividade física (AF) na população de três municípios da região de São Paulo nos anos 2000 e 2010. *Métodos:* Estudo de coorte transversal com amostra representativa de 602 adultos (62,3% homens), realizado nos municípios de Santo André, São Bernardo do Campo e São Caetano do Sul nos anos 2000 (n = 304; 66,1% homens) e 2010 (n = 298; 58,4% homens). A AF foi analisada pelo Questionário Internacional de Atividade Física e os participantes foram classificados em ativos (≥ 150 min/sem) e insuficientemente ativos (< 150 min/sem). O deslocamento para o trabalho foi rotulado em transporte ativo (a pé e bicicleta), privado (moto, carro, vans e ônibus) e público (ônibus, vans, trem ou metrô). *Resultados:* As médias (min/sem) de AF de caminhada (229,4 versus 190,6), moderada (449,1 versus 347,4), vigorosa (354,4 versus 317,4) e total (552,3 versus 442,5) dos participantes foram maiores em 2010 do que em 2000. A prevalência de ativos aumentou de 62,2 para 78,2%, respectivamente. Foi encontrada relação negativa entre transporte ativo e público com nível socioeconômico; transporte ativo e grau de escolaridade; transporte público e faixa etária. Relação positiva foi verificada somente entre transporte privado e nível socioeconômico. A média da AF total (min/sem) foi maior (p = 0,024; 32,2%) em 2010 do que em 2000 para o transporte ativo. *Conclusão:* Os dados de vigilância em AF total nos três municípios de São Paulo indicam que a média do transporte ativo para o trabalho aumentou após dez anos, enquanto o transporte público diminuiu.

Palavras-chave: Atividade física. Epidemiologia. Inquéritos epidemiológicos. Fatores de risco. Países em desenvolvimento.

INTRODUCTION

The maintenance of physical activity (PA) is responsible for an improvement in cardiovascular health, providing protection against the development of comorbidities such as hypertension, diabetes, vascular and cardiac diseases, among others¹. Worldwide, its absence is estimated to contribute between 21 and 25% with the global burden of diseases such as breast and colon cancer; in even greater proportions, it contributes to diabetes (27%) and to ischemic heart disease (30%)². In addition, 31% of the world's adult population is estimated not to have achieved the recommended PA for health³.

Considered as little susceptible to interventions from public policies in domestic and work environments⁴ and stabilized for over two decades as being performed during periods of free time⁵, strategies that promote the increase of PA time in the transportation domain have been receiving increased attention over the world^{6,7}. Also, its increase in the transportation domain is noteworthy, contributing to an increase in its total time, collaborating so that adults meet the PA recommendations in terms of public health⁸.

Besides contributing to the increase of the total PA practice⁹, active transportation (by bicycle or on foot) is also associated to other health aspects, such as the prevention and treatment of cardiovascular diseases, some types of cancer, mortality due to all general causes and body weight control¹⁰. On the other hand, the increasing use of passive transportation (public: bus, subway, or train; private: car or motorcycle) as the main means of commuting

has been causing serious problems in the urban transportation system, such as traffic jams¹¹, air and sound pollution¹². Thus, active commuting has been considered a great alternative to minimize such environmental¹¹ and health problems¹².

Brazil, as well as other emerging economies, has been fast changing in terms of urbanization and transportation over the last few years¹³. In this context, one of the most notable changes is the public and private means of transportation. As a result, there was an increase in the incidence of traffic-related deaths, in the prevalence of respiratory diseases and in the levels of stress^{14,15}. Another negative effect is the increased physical inactivity due to the lower PA values obtained through transportation¹⁶.

The evidence available in low and medium income countries show that walking and cycling are more prevalent among men and low income groups^{17,18}. In communities in the United States, walking is more prevalent among women¹⁹. In Brazil, only 17% of people use a bicycle as a means of transportation and only 8% consider it as their main means of transportation in the city²⁰. Therefore, a better understanding of the prevalence of adults using different means of transportation and of PA over the years is necessary, once that many initiatives are being developed, such as the city gym and the bike lane²¹. This study aimed to verify the changes in commuting to work and PA of the population in three locations in 2000 and 2010.

METHODS

Since 1984, the Research Institute of Universidade de São Caetano do Sul coordinates the ABC Socioeconomic Research for the regional group comprising the municipalities of Santo André (704,942 inhabitants), São Bernardo do Campo (811,489 inhabitants) and São Caetano do Sul (156,362 inhabitants), all located in the state of São Paulo. This research is conducted annually from a sampling survey of households²².

The article includes the results of the cross-sectional research for 2000 and 2010. For each survey, about 602 households were selected using the probabilistic random sampling technique. First, the postal codes (*Códigos de Endereçamento Postal* – CEP) of the municipalities were organized in ascending order. Next, the households were systemically selected. Finally, in each household selected, one resident older than 18 years of age was chosen using a random approach. All residents aged older than 18 years of age were initially considered eligible. Individuals who were unable to answer to the questionnaire were excluded and, in all surveys, participants were approached in their households. The error estimated in each survey for the results obtained was 3.0% for a 95.5% confidence interval. In case of refusal of participation, the following household was selected for the research. Previously trained professionals performed all data collection. The project was approved by the Ethics Committee of Santa Casa Hospital, in São Paulo, under protocol 2015/06. The participants signed the Informed Consent.

Of all the households analyzed in each period (2000 and 2010), 327 (54.5%) residents responded to the questionnaire on commuting in 2000, 63.9% (209) men and 36.1% (118)

women. In 2010, 349 (58.2%) residents took part in the questionnaire on means of commuting, 54.4% (190) men and 55.6% (159) women aged older than 18 years of age.

The instrument used to measure the PA of walking, at moderate and vigorous intensity, was the International Physical Activity Questionnaire (IPAQ), in its short version, duly tested and validated in the adult Brazilian population²³. It was applied as an individual interview with an explanation of all questions for better understanding. PA practice was measured based on the answers to the IPAQ questionnaire, which consisted of questions about the frequency and duration of the activities in different domains. For each one of the domains evaluated, scores were determined by multiplying the weekly frequency by the time of duration in days on which the PA was carried out. The questions in the questionnaire were related to walking at moderate and vigorous intensity for at least ten minutes the week prior to its application.

In the present study, participants were classified into active and insufficiently active, based on the recommendation of PA for adults²⁴. In order to be considered active, they should carry out ≥ 150 min/week of PA; and in order to be considered insufficiently active, < 150 min/week.

As a means of commuting, we considered active (on foot or by bicycle), private (motorcycle, car, van and bus, either carpooling or company car) and public transportation (bus, van, train or subway). The way of commuting to work (self-reported) of the participants of the research was known through their answer to the following question: What is the main means of transportation you use to go to work? This question was made for each of the means of transportation considered in the present study²².

The variables of gender, age range, socioeconomic level (SEL) and education were also considered for the analyses. The age range was categorized into four groups: 18 to 29, 30 to 44, 45 to 60 and > 60 years of age. The Brazilian Socioeconomic Classification questionnaire²⁵ was used to classify the SEL. Brazil's Economic Classification Criterion takes into account the score system and the education degree of the head of the household. The former identified the possessions and the number of items considered "assets" in the household, those being between zero and four or more. The latter presents the education degree and goes from illiterate (zero points) and complete higher education (eight points). After scoring and identification, the SEL is calculated and classified between "A1" and "E", according to the cutoff points of Brazil's Criterion²⁵. Participants were classified into three groups: A+B (high), C (intermediate) and D+E (low). The degree of education was measured according to: ≤ 8 , 9 to 11 and ≥ 12 years of study. All questions were exactly the same within the different years of evaluation.

STATISTICAL ANALYSIS

The descriptive statistic with mean, standard deviation, frequency and percentage was used. The χ^2 test was used in order to compare categorical variables and the Student's *t*-test for independent samples for the comparison of means of the quantitative variables.

In 2000 and 2010, the proportion and their respective 95% confidence interval (95%CI) was estimated for each means of commuting to work (active, private, and public transportation) according to age, SEL, education, gender, and PA. The variation between 2010 and 2000 was assessed by delta percentage ($\Delta\%$), the calculations were performed by the Statistical Package for the Social Sciences (SPSS) software, version 20.0, and the significance level adopted was $p < 0.05^{26}$.

RESULTS

The sample analyzed included 602 participants, 375 (62.3%) males. The descriptive statistic of the results is presented in Table 1, and no significant differences were found between the frequencies of gender and age in the periods evaluated (2000 and 2010). In both cases, most of the sample was male, aged between 10 and 34 years old and of intermediate socio-economic level. Regarding education, most of the sample had ≤ 8 years of study in 2000 and ≥ 12 in 2010 (Table 1).

The mean PA for walking at moderate and full intensity were statistically higher in 2010. Besides, the prevalence of active individuals showed a significant increase from 62.2% in 2000 to 78.2% in 2010 (Table 1).

In relation to commuting to work, the proportion of individuals using active transportation increased from 17.8 to 24.2% in a 10-year period. On the other hand, the proportion using public transportation to go to work decreased from 35.9 to 23.8% (Table 1).

Figure 1 presents the different means of commuting to work according to age range, SEL and education.

In all age ranges, there was an increased proportion of individuals using active and private transportation, and decreased proportion of those using public transportation between 2000 and 2010. In the range of 18 to 29 years, most individuals used public transportation in 2000 and 2010. However, in other age ranges (30 to 44, 45 to 60 and > 60), the private transportation was the most often one used in both periods. In addition, the results showed a negative relation between age range and commuting to work via public transportation, considering that the older the individual is, the lesser it is used (Figure 1A).

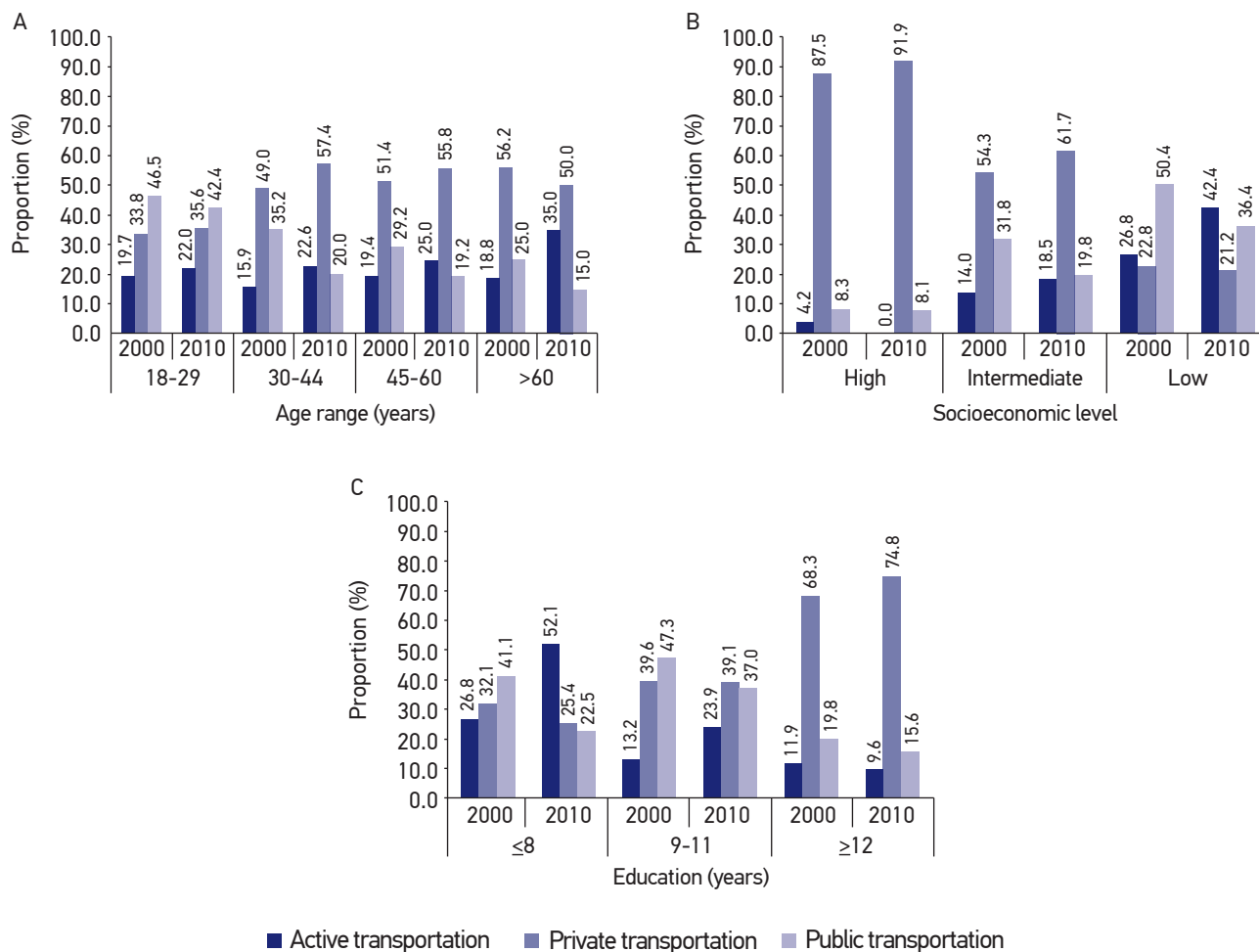
There was a decrease in all SELs for use of public transportation in commuting to work. Among individuals of high SEL, a drop in the proportion of people using active transportation in commuting to work was observed, as well as a rise in the proportion of the ones using private transportation. Among individuals with intermediate SEL, there was an increase in the proportions of people who use active and private transportation when commuting to work. And among individuals of low SEL, an increased proportion of people using active transportation was verified, as well as a decrease in the proportions for private transportation. In high and intermediate SELs, private transportation was the most often one used in 2000 and 2010; among individuals with low SEL, public transportation was the most used one in 2000 and active transportation in 2010. Also, results show a negative relation between SEL and the use of active transportation.

Regarding education, an increase in the proportion of individuals using active transportation when commuting to work was observed among those with < 8 and 9 to 11 years of study, as well as a decrease among the ones with ≥ 12 years between 2000 and 2010. The use of private transportation recorded a decrease among those with < 8 and 9 to 11 years of study; and an increase between those with ≥ 12 years of study. The use of public transportation had an increase among those who had < 8 years of study and

Table 1. Descriptive analysis (mean [SD] or n [%]) of the sample according to the period evaluated: 2000 and 2010.

| Variables | 2000 (n = 304) n (%) | 2010 (n = 298) n (%) | p-value |
|-------------------------------|-------------------------|-------------------------|----------|
| Gender | | | |
| Male | 201 (66.1) | 174 (58.4) | 0.050* |
| Female | 103 (33.9) | 124 (41.6) | |
| Age (years) | | | |
| 18 to 29 | 71 (23.4) | 59 (19.8) | 0.013* |
| 30 to 44 | 145 (47.7) | 115 (38.6) | |
| 45 to 60 | 72 (23.7) | 104 (34.9) | |
| > 60 | 16 (5.3) | 20 (6.7) | |
| Socioeconomic level | | | |
| High | 48 (15.8) | 37 (12.4) | 0.014* |
| Intermediate | 129 (42.4) | 162 (54.4) | |
| Low | 127 (41.8) | 99 (33.2) | |
| Education (years) | | | |
| ≤ 8 | 112 (36.8) | 71 (23.8) | 0.001* |
| 9 to 11 | 91 (29.9) | 92 (30.9) | |
| ≥ 12 | 101 (33.2) | 135 (45.3) | |
| Physical activity | | | |
| | min/week | | |
| Walking | 190.6 \pm 190.3 | 229.4 \pm 192.6 | 0.045** |
| Moderate | 347.4 \pm 312.7 | 449.1 \pm 341.0 | 0.003** |
| Vigorous | 317.4 \pm 293.6 | 354.4 \pm 293.5 | 0.369** |
| Total | 442.5 \pm 328.3 | 552.3 \pm 338.9 | 0.001** |
| Recommended physical activity | | | |
| Active | 189 (62.2) | 233 (78.2) | < 0.001* |
| Insufficiently active | 115 (37.8) | 65 (21.8) | |
| Commuting to work | | | |
| Active transportation | 54 (17.8) | 72 (24.2) | 0.004** |
| Private transportation | 141 (47.4) | 155 (52.0) | |
| Public transportation | 109 (35.9) | 71 (23.8) | |

p < 0.05; * χ^2 test; **Student's t-test.



A: active transportation; B: private transportation; and C: public transportation.

Figure 1. Proportion of participants who use different means of commuting to work according to age range, socioeconomic level and education in three municipalities in the region of São Paulo in 2000 and 2010.

an increase among those who had 9 to 11 and ≥ 12 years of study. Moreover, results show a negative relation between education and the use of active transportation, once that the higher the education, the lesser the use (Figure 1B).

Table 2 describes the changes occurred in different means of commuting to work between 2000 and 2010 according to gender and PA level. Data show that, in the period analyzed, the use of active transportation increased proportionally and similarly in both genders (30.8% in males and 29.6% in females). Private transportation had an increase only among males, while the use of public transportation decreased for both genders.

As for PA levels, the proportions of active and insufficiently active individuals who used active and private means for commuting to work increased between 2000 and 2010. On the other hand, the proportion of active and insufficiently active people using public transportation in commuting to work decreased between 2000 and 2010.

Figure 2 compares the changes in overall PA (min/week) according to the year evaluated (2000 and 2010) and the means of transportation used in commuting to work. The mean overall PA of the ones using active transportation has significantly increased ($p = 0.024$; 32.2%) in the period analyzed. No significant differences were found between years 2000 and 2010 in private transportation. In public transportation, on the other hand, there was a significant decrease in the mean PA in min/week (-2.9%).

In 2000, the highest PA mean in min/week was among the ones who used public transportation when commuting to work. In 2010, it was among the ones who used active transportation.

Table 2. Proportion of participants who used different means of commuting to work (active, private and public transportation) according to gender, physical activity and year of assessment in three municipalities in the region of São Paulo in 2000 and 2010.

| Variables | Active transportation* | | | | Private transportation** | | | | Public transportation*** | | | |
|-------------------------|------------------------|---------|-------------|---------|--------------------------|---------|--------------|---------|--------------------------|---------|-------------|---------|
| | 2000 (n=54) | | 2010 (n=72) | | 2000 (n=141) | | 2010 (n=155) | | 2000 (n=109) | | 2010 (n=71) | |
| | % | 95%CI | % | 95%CI | % | 95%CI | % | 95%CI | % | 95%CI | % | 95%CI |
| Gender | | | | | | | | | | | | |
| Male | 13 | 8 – 18 | 17 | 11 – 22 | 51 | 44 – 58 | 63 | 56 – 70 | 36 | 30 – 43 | 20 | 14 – 26 |
| Female | 27 | 19 – 36 | 35 | 26 – 43 | 38 | 28 – 47 | 36 | 28 – 45 | 35 | 26 – 44 | 29 | 21 – 37 |
| Physical activity level | | | | | | | | | | | | |
| Active | 22 | 16 – 28 | 24 | 20 – 28 | 40 | 33 – 47 | 44 | 40 – 49 | 38 | 31 – 44 | 32 | 27 – 36 |
| Insufficiently active | 10 | 5 – 16 | 13 | 8 – 18 | 57 | 47 – 66 | 61 | 53 – 68 | 33 | 24 – 42 | 26 | 20 – 33 |

n: number of commuting to work in each period assessed; 95%CI: 95% confidence interval; *participants who went to work on foot or by bicycle; **participants who went to work by motorcycle, car, van and bus, carpooling or company car; ***participants who went to work by bus, van, train or subway.

DISCUSSION

This study aimed to describe the main means of commuting to work and the PA among adults of three municipalities in the São Paulo region in 2000 and 2010. The use of active transportation has increased for both genders in the period analyzed, being higher among women. The use of private transportation had a growth among men and dropped among women. Public transportation has suffered a decrease for both genders, being lower among men. Between 2000 and 2010, the proportion of active and insufficiently active individuals increased among those who commuted using active and private transportation, but decreased among those who used public transportation. The mean overall PA in min/week had a significant increase among those commuting with active transportation, and a significant decrease among the ones commuting with public transportation. In addition, the results show a negative relation between education, SEL and the use of active transportation, considering that the higher the education or SEL, the lesser the use of active transportation.

Active transportation is understood as commuting from one point to another by walking, running, cycling, skating, skateboarding, and using non-motorized wheelchairs. It offers a number of benefits, such as promoting health through regular PA practice, improving social interactions, reducing traffic jams, contributing to the reduction of the greenhouse and gas emission effects and saving money with fuel and parking^{27,28}.

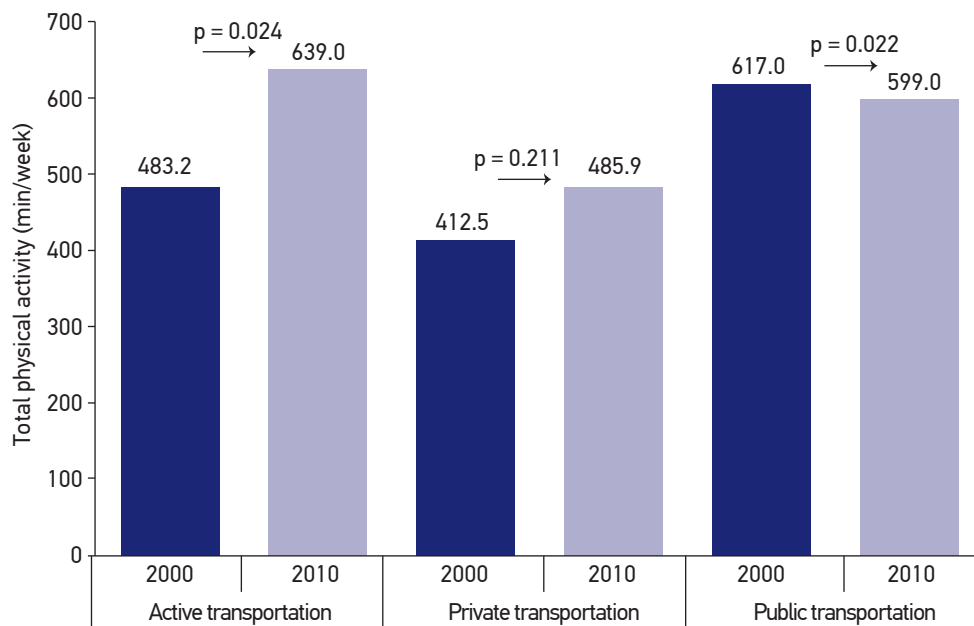


Figure 2. Changes in physical activity in minutes/week for the different means of commuting to work in three municipalities in the region of São Paulo in 2000 and 2010.

A cross-sectional study which evaluated the type of transportation with adults in Sweden in years 2008 and 2009 shows that 63% of adults preferred using private transportation, while only 8.3% preferred using active transportation. However, despite using private transportation most of the time, the subjects reported performing PA during their free time²⁹. These data are different from the ones in the present study, in which 24.2% of the sample used an active means transportation, and 52.0% used private ones. The difference may be explained by many factors, such as culture, availability of built environments and, mainly, the distance to be covered.

A study carried out in Atlanta showed that 89.2% of the subjects interviewed used active transportation in the region, but only 2.6% of this sample met the recommendations of PA for walking, since most of them would choose this kind of transportation due to living close to their destination and using private transportation when commuting to farther locations³⁰. These data are different from the ones in the present study, in which 22% met the recommended PA goals when using active transportation, proving that environmental and social factors may influence it and therefore should be taken into account in such researches.

As for the total PA in min/week, the results of the present study are similar to the ones found in others, showing that adults who use active transportation when commuting to work have higher total PA values (min/week) when compared to those who choose public transportation³¹⁻³³.

A survey carried out by the National Traffic Department (*Departamento Nacional de Trânsito* – DENATRAN) showed an improvement in car fleet between 2000 and 2010, going from approximately 29 million to 64 million³⁴. These data may be related to the results in the present study, in which a decrease in the use of public transportation and an increase in private transportation was observed.

Throughout the period analyzed in this study, the ABC region went through some changes and the implementation of public policies for the promotion of PA practice. However, the increased commuting by active transportation is hard to be explained, since the present study did not analyze all the necessary variables. In the municipality of Santo André, for example, the city hall implemented bicycle lane projects and created the program *Santo André em Movimento* (“Santo André on the Move”), with the objective of offering educational guidance on the conscious use of bicycles, skateboards and skates as both means of commuting and leisure³⁵. In São Caetano do Sul and Santo André, there were some changes in built environments, such as widening of sidewalks and the construction of bike lanes^{36,37}. In addition, it is noteworthy that all three municipalities are part of the Regional Health Directorate 1 (*Diretoria Regional de Saúde 1*) – São Paulo (DRS 1) and are partners of the *Programa Agita São Paulo* (“Bustling São Paulo Program”), of the State Health Bureau of the state of São Paulo, which is committed to fighting a sedentary lifestyle and increasing PA levels in the population aged 14 years old or older, including students, elderly and workers³⁸.

Despite being a representative study of household interviews, some limitations must be considered, such as the use of IPAQ’s short version and of self-report, which may overestimate

PA levels; the assessment of just two periods in a 10-year gap, which may prevent the interpretation of the Evolution and the tendency of the results; and the lack of standardization in data collection regarding active transportation, which may hinder the comparison and discussion of the results.

CONCLUSION

After analyzing the results, it may be concluded there was a change in the way of commuting to work in the municipalities studied between 2000 and 2010. The use of active transportation increased for both genders; the use of private transportation expressed an increase among men and a decrease among women; and public use suffered a drop, considering both genders. The total mean PA in min/week had an increase among individuals commuting with active transportation and a decrease among those commuting with public transportation. In addition to that, results showed the higher the education or SEL, the lesser the use of active transportation. These data evidence a positive result in relation to the increased active transportation use and PA level. Thus, the continuous encouragement and the improvement of the knowledge on the positive effects of PA among the population are essential and must be extended, including public policies for health promotion and the construction of favorable environments for the maintenance of healthy life habits.

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