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Original Article

Association between sedentary behavior, obesity and hypertension in public school teachers

Leandro Dragueta DELFINO[1, 2]*, William Rodrigues TEBAR[1, 2], Fernanda Caroline Staquecini Gil TEBAR[3], Jefferson Marinho DE SOUZA[3], Marcelo ROMANZINI[4], Rômulo Araújo FERNANDES[1–3] and Diego Giulliano Destro CHRISTOFARO[1–3]

[1]Physical Education Department, School of Technology and Science, São Paulo State University (Unesp), Brazil
[2]Post-graduation Program in Movement Sciences, São Paulo State University (Unesp), Brazil
[3]Post-Graduation Program in Physiotherapy, Physiotherapy Department, Sao Paulo State University (Unesp), Brazil
[4]Physical Education and Sport Center, Physical Education Department, State University of Londrina (UEL), Brazil

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Abstract: The present study aimed to verify the prevalence and association of sedentary behavior and its breaks with obesity and cardiovascular risk factors in teaching professionals. The sample was composed by 245 public school teachers (186 women and 59 men), with a mean age of 45 yr. Sedentary behavior was evaluated by self-reported screen time in different devices (television, computer, cellphone/tablet), and sedentary breaks at work and leisure were assessed by a Likert scale (never, rarely, sometimes, often, always). Cardiovascular risk factors (overweight/obesity, abdominal obesity, blood pressure, and heart rate) were objectively collected by trained individuals in the work environment of the teachers. Logistic Binary Regression models were adjusted for confounding factors (age, sex, and socioeconomic status). The prevalence of sedentary behavior was 55.3% in the sample. High sedentary behavior was associated to abdominal obesity (OR=2.21 [CI=1.23–3.97]). No association was observed between sedentary breaks at work and independent variables, however teachers with high sedentary breaks at leisure time were less likely to present high blood pressure (OR=0.58 [CI=0.32–0.98]). In conclusion, high sedentary behavior was associated with abdominal obesity, and high sedentary breaks in leisure time were associated to lower chances of high blood pressure among public school teachers.

Key words: Screen time, Sedentary breaks, Abdominal Obesity, Blood pressure, Teachers

Introduction

Sedentary behavior corresponds to activities of energy expenditure less than or equal to 1.5 metabolic equivalent, performed in a sitting or reclining position[1)]. The sedentary behavior has become a significant concern for public

*To whom correspondence should be addressed.
E-mail: ledragueta@hotmail.com

health, once its high level has been associated with an increased risk of cardiovascular diseases, obesity, adverse metabolic profiles, some cancers, and mortality[2–4].

The increase in high sedentary behavior over the years has been attributed to changes in transportation, entertainment, and work environments[5], which are related to a drastic reduction in the daily demands of physical activity[6]. Adult population spends almost 55–57% of their time in sedentary behaviors, which corresponds of almost 8 h per day[7]. An epidemiological research indicates that prevalence of high sedentary behavior ranges from 60 to 71% worldwide[8].

Nevertheless, sedentary behavior may occur in different domains of daily life, as work environment, leisure activities, and passive transport. Therefore, different strategies can be used to estimate the sedentary time: in its totality, by domain or through specific behavior[9]. Recent studies analyzed sedentary time spent at occupational activities, which represents a large part of the waking hours of workers, once many professionals have high amount of time in sitting position at their jobs[10, 11]. Otherwise, frequent breaks in sedentary time have been investigated as a way to mitigate the health impairments of sedentary behavior[4, 12].

However, is not consensual in literature the association of sedentary behavior in other domains with cardiometabolic risk factors among predominantly non-sedentary workers, as teachers. Higher physically demanding jobs has been associated with longer sitting time at leisure, however, the relationship of work activities with sedentary behavior outside the work environment is still unclear[13]. Teachers present a high workload at school environment, by remaining in orthostatic position for up to 95% of their activities[14–17], which requires prolonged isometric contraction to oppose gravity[18]. Thus, teachers are considered as having a non-sedentary profile[19] and previous studies did not investigate whether the sedentary behavior patterns outside the work environment were related to cardiovascular risk factors, as obesity and high blood pressure among teachers.

Therefore, this study aimed to verify the sedentary behavior patterns (overall sedentary behavior and breaks in sedentary behavior at work and leisure) and analyze its associations with cardiovascular risk factors in public school teachers.

Methods

This observational study has a cross-sectional design and was developed by the Group of Studies in Physical Activity and Health of the Faculty of Sciences and Technology from Sao Paulo State University, Campus of Presidente Prudente. All procedures performed in the study were approved by the Institution's Ethics and Research Committee (process number 72191717.9.0000.5402). All the participants were informed about the procedures and objectives of the research and those who agreed to participate signed the Informed Consent Term.

Sample selection and inclusion criteria

The study was conducted in the city of Presidente Prudente, located in the Southeast region of Brazil, which had an estimated population of 207,625 inhabitants and a Human Development Index (HDI) of 0.846[20].

According to the Education Department of the city, there are approximately 650 teachers distributed in 23 public schools. All these schools were visited and invited to participate in the research. The data collection was performed during the collective pedagogical work class, at time when all teachers were present, in a previous scheduled date, at the work environment of the teachers, so as not to interfere in the pedagogical activities of the schools.

In addition, the details of the study were communicated by the coordinator to the teachers at least one week in advance and the following inclusion criteria were defined: i) be an effective teacher of the school; ii) not have performed exhaustive exercises for at least 24 h prior to evaluation of hemodynamic variables; iii) participate in all procedures of research (questionnaires, anthropometry, and measurement of cardiovascular parameters); iv) signed the Informed Consent Term.

Sample calculation

The calculation of minimum sample size considered a prevalence of outcome (high sedentary behavior) of 50%, used in epidemiological studies (Agranonik and Hirakata)[21], the population of 650 public school teachers, confidence interval of 95%, a power of test of 80%, and a maximum tolerable error of 5%, which provided a minimum simple random sample of 242 teachers. For the sample selection, all the 23 schools in the city were contacted, but only 13 allowed the collection of data and all these schools were assessed.

Organization of data collection

The collection of data was performed at the school environment by previously trained researchers, so that any doubts were promptly resolved. Measurements of anthropometry (weight, height, and waist circumference), resting

heart rate, and blood pressure were performed in specific rooms provided by the management of the schools participating in the study. In order to avoid possible constraints in the anthropometric evaluation, the male teachers were evaluated by male researchers and female teachers by female researchers.

Sedentary behavior

The subjective model used to assess sedentary behavior was based on the questionnaires provided by The Sedentary Behavior Research Network (SBRN)[22], by the number of daily hours in a typical weekday in which the teachers spent watching television, using computer or cellphone/tablet, and spent in sitting position. The total sedentary behavior was obtained by the sum of the responses for each sedentary behavior, which were classified as follows: i) less than 1 h (0 h computed); ii) more than 1 h but less than 2 h (1 h computed); iii) more than 2 h but less than 3 h (2 h computed); iv) more than 3 h but less than 4 h (3 h computed); v) more than 4 h but less than 5 h (4 h computed); and vi) more than 5 h (5 h computed). Individuals who reported the sum of television, cell/tablet, computer, and sitting time equal to or greater than 8 h per day were classified as "high sedentary behavior". This cut-off point was adopted as it is in accordance with the criteria recommended by Van der Ploeg *et al* [23].

The breaks in sedentary behavior at work and leisure were obtained through the following questions:

-In your work environment, how often do you get up to go to the bathroom, drink water, or perform another activity that requires standing or walking for at least a short time?

-In your leisure time, how often do you get up to go to the bathroom, drink water, or perform another activity that requires standing or walking for at least a short time?

The response options were presented using a Likert scale, considering the options: never; rarely, sometimes, often, and always. According to the response, the sample was further classified as "high breaks in sedentary behavior" ('often' and 'always'), and as "low breaks in sedentary behavior" ('never', 'rarely', and 'sometimes') for both domains of work and leisure time.

Anthropometry

Anthropometric variables were measured with participant barefoot and wearing light clothing on the day of the assessments. Body mass, height, and waist circumference were evaluated. Body mass was measured using a digital scale (Plenna®, Sao Paulo, Brazil) with an accuracy of 0.1 kg and height was measured by means of a portable stadiometer (Sanny®, American Medical of Brazil, Sao Paulo, Brazil) with a maximum extension of 2.2 meters and a precision of 0.1 cm. After taking these two measures, the body mass index (BMI) was calculated by division of body mass by the height squared. Subsequently, the teachers were classified as: I) eutrophic; II) with excess weight, subjects with a BMI equal to or greater than 25 kg/m^2.

Waist circumference was collect in the middle-point between the iliac crest and the last rib, by an inextensible tape with precision in millimeters (mm). The participants were classified as with or without abdominal obesity, according to gender, using the National Cholesterol Education Program (NCEP)[24] cut-off points of 102 cm for men and 88 cm for women.

Blood pressure

A digital oscillometric device (OMRON brand, model HEM-742) was used to collect the measurements of systolic blood pressure (SBP) and diastolic blood pressure (DBP). All the measurements were taken in the left arm, with the individuals seated at rest for a minimum of five minutes. The cut-off points recommended by the VI Guidelines for Hypertension[25] were adopted, in which individuals with blood pressure equal to or greater than 140/90 were considered as presenting high blood pressure. Teachers were questioned about diagnostic of hypertension and use of blood pressure lowering drugs. Those teachers who report to have medical diagnostic of hypertension and/or to take lowering blood pressure drugs were considered as having high blood pressure, independently of their blood pressure values at data collection.

Heart rate

The digital oscillometric device (OMRON brand, model HEM-742) was also used to assess the resting heart rate, with the participant seated at rest for at least five minutes prior the collect. The resting heart rate was divided into quartiles and teachers in the highest quartile (Q4) were considered as presenting high resting heart rate.

Socioeconomic condition

The Brazilian Economic Classification Criteria[26] was used to assess the socioeconomic condition of the sample. This instrument considers the level of education, and the presence and quantity of certain rooms and consumer goods at home (i.e. television, DVD player, bathrooms, car, washing machine, freezer) and classifies the sample into economic classes according its specific scoring, from

higher to lower: A1, A2, B1, B2, C1, C2, D, and E. For the characterization of sample, the socioeconomic condition was classified according to the power of consumption criteria of instrument in socioeconomic classes high (A1, A2), medium (B1, B2, C1), and low (C2, D, E).

Statistical analysis

Characterization variables of the sample are expressed as mean and standard deviation for continue variables and as frequency for categorical variables. The mean differences were analyzed by *t*-test for independent samples and the association between high sedentary behavior and sedentary breaks with independent variables (obesity, high blood pressure, high resting heart rate) was assessed by the χ^2 test. All variables were considered as independent variables in the multiple model, evaluated by binary logistic regression, in its unadjusted and adjusted form (sex, age, and socioeconomic condition). The statistical significance adopted was 5% and a confidence interval of 95%. The statistical package SPSS version 15.0 was used for all analyses.

Patient and public involvement

Patients and or public were not involved in the research.

Results

The sample consisted of 245 individuals (approximately 38% of the city's teachers), of which 186 were female (76%) and 59 male (24%), with a mean age of 45.20 ± 10.42 yr. The prevalence of socioeconomic status in the sample was 5.7% of high, 91.0% of medium, and 3.3% of low socioeconomic class. The prevalence of sedentary behavior in the teachers participating in this study was 55.3%, and this prevalence was higher in male teachers, 69.5%; in women the prevalence was 50.8% (p=0.018). The characterization variables of sample were stratified according to the level of sedentary behavior (low or high) and are presented in the Table 1. Teachers with high sedentary behavior presented lower age (43.5 yr vs. 47.3 yr, p=0.006) and higher waist circumference (89.6 cm vs. 85.8 cm, p=0.038) than those teachers with low sedentary behavior.

Table 2 presents information of association between high sedentary behavior and independent variables. Teachers with abdominal obesity presented a prevalence of high sedentary behavior higher than teachers without abdominal obesity (65.2% vs. 46.6%, p=0.005). Abdominal obesity was observed in 112 teachers, which corresponds to 45.7% of sample.

Table 3 presents information on the magnitude of associations between sedentary behavior and independent variables. Teachers with high sedentary behavior were more than twice as likely to have abdominal obesity when compared to teachers with low sedentary behavior, regardless sex, age, and socioeconomic status (Odds ratio= 2.21, 95% CI: 1.23; 3.97, p=0.008). No association was observed of high sedentary behavior with overweight, high blood pressure, and high heat rate among teachers.

Table 4 presents information about high breaks in sedentary behavior at work and independent variables. No association was observed between high breaks in sedentary behavior at work and overweigh, abdominal obesity, high blood pressure, and high heart rate for both unadjusted and adjusted analysis.

Table 5 presents the association of high breaks in sedentary behavior at leisure time with independent variables. Teachers who report high sedentary breaks at leisure were 44% less likely to have high blood pressure than those teachers who report low sedentary breaks in unadjusted analysis. This association remained significant even after adjustment for sex, age, and socioeconomic status (Odds ratio=0.58, 95% CI: 0.32; 0.98, p=0.042). There was no association between high breaks in sedentary behavior and overweight, abdominal obesity, and elevated heart rate among teachers.

Discussion

The results of this study showed a predominance of female teachers, and a prevalence of sedentary behavior of 55.3%. High sedentary behavior was related to abdominal obesity, with teachers who reported this behavior being 2 times more likely to present abdominal obesity. Regarding breaks in sedentary behavior: at work, there were no significant associations with any of the studied variables; however, in leisure, it was observed that teachers who interrupted sitting time more often were 42% less likely to present high blood pressure, even after adjustment for confounders.

The prevalence of high sedentary behavior in the present study was lower than findings reported by a systematic review of Rezende *et al.*[27], who observed a general prevalence of 62% of high sedentary behavior in a wide sample of adults from 54 countries. This difference may be related to the high prevalence of female teachers in the present study, which was also observed in a previous study among teachers[15]. Women tend to be less sedentary than men due to a double journey between work and domestic tasks[15].

Table 1. Characterization of the sample

Variables	Low SB Mean (SD)	High SB Mean (SD)	*p*-value*
Age (yr)	47.27 (9.93)	43.53 (10.53)	0.006
Weight (kg)	72.09 (15.97)	75.91 (17.41)	0.078
Height (cm)	163.25 (7.95)	165.23 (8.89)	0.070
Body mass index (kg/m^2)	27.03 (5.50)	27.66 (5.32)	0.360
Waist circumference (cm)	85.80 (13.73)	89.58 (14.63)	0.038
SBP (mmHg)	126.05 (17.58)	125.39 (17.72)	0.771
DBP (mmHg)	78.09 (11.22)	79.56 (11.21)	0.310
HR (mmHg)	77.68 (12.23)	78.83 (12.05)	0.462

*p-value of t-test for independent samples. SB: sedentary behavior; SD: standard deviation; SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate.

Table 2. Prevalence of cardiovascular risk factors according to high sedentary behavior in public school teachers

Variables	Total (n=245) N	High SB (n=135) n (%)	*p*-value*
Body mass index			
Normal	98	51 (52.0)	0.512
Overweight	147	84 (57.1)	
Waist circumference			
Normal	133	62 (46.6)	0.005
Abdominal obesity	112	73 (65.2)	
Blood pressure			
Normal	140	78 (55.7)	0.926
High	105	57 (54.3)	
Heart rate			
Normal	180	101 (56.1)	0.702
High	65	34 (52.3)	

*p-value for χ^2 test. SB: Sedentary behavior.

It was observed at the present study that teachers with high sedentary behavior presented significantly lower age than teachers with low sedentary behavior. A possible hypothesis may be related to the type of sedentary behavior assessed in the present study, which was in regard screen time. It was observed that younger adults use more breadth of technology than older adults[28, 29], which may result in a wide range of daily tasks through screen devices, for both work and entertainment activities, increasing their screen time in different devices and, consequently, overall sedentary behavior.

Sedentary behavior can occur in different domains of daily life, in leisure, work, or travel. In our study, it was observed an association between high sedentary behavior and abdominal obesity. This finding was in accordance to previous studies in literature among teachers[30] and overall adult population[6, 31–33]. Thorp *et al.*[34] observed that just a 1-h increase in daily TV viewing has already been associated with increased waist circumference. A possible hypothesis for this association is that sedentary activities promotes a lower energy expenditure and take place of other daily activities even of light intensity, as well as encourages the consumption of high caloric foods[35], which may result in higher adiposity.

Although previous studies showed that sedentary behavior was associated with an increased risk of hypertension[36] and higher mortality rates for cardiovascular diseases[37], the present study observed no association between high sedentary behavior and high blood pressure among teachers. Otherwise, teachers who report high breaks in sedentary behavior al leisure time were less likely to have high blood pressure than teachers who reported low sedentary breaks. Convergently with our findings, other studies previously observed benefits of sedentary breaks

Table 3. Association between high sedentary behavior and cardiovascular risk factors in public school teachers

Variables	Not adjusted			Adjusted		
	OR	95%CI	*p*-value	OR	95%CI	*p*-value
Body mass index						
Normal	1.00	Reference		1.00	Reference	
Overweight	1.22	0.73–2.05	0.432	1.33	0.78–2.30	0.296
Waist circumference						
Normal	1.00	Reference		1.00	Reference	
Abdominal obesity	2.14	1.27–3.59	0.004	2.21	1.23–3.97	0.008
Blood pressure						
Normal	1.00	Reference		1.00	Reference	
High	0.94	0.56–1.57	0.824	1.08	0.63–1.85	0.780
Heart rate						
Normal	1.00	Reference		1.00	Reference	
High	0.85	0.49–1.51	0.597	0.90	0.49–1.64	0.896

Analysis adjusted by sex, age, and socioeconomic status. OR: odds ratio; CI: confidence interval.

Table 4. Association between high breaks in sedentary behavior at work and cardiovascular risk factors in public school teachers

	Not adjusted			Adjusted		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Body mass index						
Normal	1.00	Reference		1.00	Reference	
Overweight	0.74	0.42–1.29	0.299	0.78	0.49–1.39	0.409
Waist circumference						
Normal	1.00	Reference		1.00	Reference	
Abdominal obesity	0.99	0.58–1.72	0.987	0.92	0.51–1.68	0.810
Blood pressure						
Normal	1.00	Reference		1.00	Reference	
High	0.90	0.52–1.55	0.713	1.00	0.57–1.76	0.983
Heart rate						
Normal	1.00	Reference		1.00	Reference	
High	0.93	0.53–1.78	0.931	0.89	0.47–1.69	0.732

Analysis adjusted by sex, age, and socioeconomic status. OR: odds ratio; CI: confidence interval.

Table 5. Association between high breaks in sedentary behavior at leisure and cardiovascular risk factors in public school teachers

	Not adjusted			Adjusted		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Body mass index						
Normal	1.00	Reference		1.00	Reference	
Overweight	0.65	0.36–1.15	0.139	0.67	0.37–1.20	0.176
Waist circumference						
Normal	1.00	Reference		1.00	Reference	
Abdominal obesity	0.69	0.40–1.20	0.195	0.70	0.38–1.28	0.252
Blood pressure						
Normal	1.00	Reference		1.00	Reference	
High	0.56	0.32–0.97	0.042	0.58	0.32–0.98	0.042
Heart rate						
Normal	1.00	Reference		1.00	Reference	
High	0.65	0.36–1.19	0.170	0.55	0.29–1.03	0.063

Analysis adjusted by sex, age, and socioeconomic status. OR: odds ratio; CI: confidence interval.

in cardiometabolic health[4, 19, 35, 38]. A possible hypothesis is that individuals who perform more breaks in sedentary activities have higher total energy expenditure than those who break less, which may prevent body fat gain and increase muscular contractions, lowering risk of developing harmful alterations in metabolic markers[19].

The breaks in sedentary behavior at work environment was not associated with cardiovascular risk factors in the present study. A possible reason may be due to teachers has the majority of their workload standing[14–17], which represents a predominantly non-sedentary work activities and could not be significantly affected by breaks in this domain (work). Otherwise, leisure time activities of teachers may be more susceptible to sedentary choices, as television viewing, computer and cellphone use, and consequently be significantly affected by sedentary breaks at this domain. Another factor is that sedentary behavior has been associated with unhealthy metabolic health, regardless of physical activity levels[39] and high sedentary breaks at leisure may be able to mitigate the health impairments of sedentary behavior by reducing its accumulation in longer periods and by decreasing the sedentary time overall. Healy *et al.*[40] suggest that reductions of 1–2 h in sedentary time can already result in substantial reductions in the risk of cardiovascular disease.

As limitations, the cross-sectional design of the study does not allow to infer about cause and effect relationships. Another limiting factor is that self-report information of sedentary behavior may be subject to biases, although has been able to assess the specific sedentary behavior of a domain (e.g., work-related, entertainment)[41]. Besides that, the use of lowering heart rate drugs was not assessed in the sample and may compromise the findings.

Otherwise, among the strength of the study, is important to highlight the randomly selected sample and analysis adjusted for confounding factors, as sex, age, and socioeconomic status. Besides that, the present study focused on different patterns of sedentary behavior (sedentary behavior and sedentary breaks), as well as different domains of occurrence (at work and at leisure) and analyzed its association with cardiometabolic risk factors among teachers, while majority of studies at school environment were focused only in students. It should also be noted that the data collection was performed at the work environment (school) and cardiovascular risk factors were objectively measured.

In summary, a prevalence of high sedentary behavior of 55.3% was observed. High sedentary behavior was related to the high prevalence of abdominal obesity, and the teachers who reported this behavior were 2 times more likely to present abdominal obesity. Regarding breaks in sedentary behavior at work, there were no significant associations with any of the studied variables. However, teachers who report high sedentary behavior at leisure time were 42% less likely to present high blood pressure, even after adjustment for confounders. As practical applications, encouraging frequent breaks in sedentary activities, even brief periods of light intensity physical activities, may be a viable and effective approach to reducing cardiovascular risk factors among teachers.

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