

# **Sleep Quality and Metabolic Disturbance in Public School Teachers of a Brazilian Capital**

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## **ABSTRACT**

**Introduction:** Due to high demand and different work schedules, teachers can develop metabolic and sleep disorders. **Objective:** The aim of this study, therefore, was to verify the quality of sleep and the metabolic changes of public school teachers during an academic semester. **Methodology:** Longitudinal study, data collection performed during an academic semester, in a public high school in a capital of northeastern Brazil (lifestyle and disease history, sleep quality - Pittsburgh Sleep Quality Index, blood pressure and anthropometric measurements). Blood samples were collected to determine serum glucose and the lipid profile. All variables were collected at the beginning (Step 1) and at the end (Step 2) of the academic semester with the same teachers. Data analysis was performed using SPSS software version 25.0. **Results:** The sample consisted of 27 teachers with an average age of 44,7 years. The concentration of fasting blood glucose (92,30 vs 108.85) and total cholesterol (161.00 vs 173.59), were significant ( $p < 0.025$  and  $p < 0.001$ , respectively) when comparing the blood samples at the beginning and end of the school semester. The poor sleep quality and daytime dysfunction showed changes between the values found between the stages of the study, resulting in significant values ( $p < 0.001$ ). Sleep efficiency percentage showed an improvement in the second stage ( $p < 0.004$ ). **Conclusion:** Through an analysis of the results, it was found that the lipid profile, serum glucose and some sleep variables changed during the academic semester, thus showing the need for care with this category of workers.

**Keywords:** Teachers. Sleep. Sleep quality. School Health Services. Health Promotion

## INTRODUCTION

Teachers are among the professional categories most vulnerable to the occurrence of leave from work due to vocal problems and mental disorders. Musculoskeletal problems and morbidities in general are also prevalent in this group of workers, whose mission is essential for the formation of citizens, as they contribute to the stability of societies, in addition to playing a fundamental role in the development of future generations.<sup>1</sup>

The teaching profession is considered by the International Labor Organization to be one of the most stressful ones.<sup>2</sup> Educators suffer due to both personal and professional demands that challenge them to meet external demands such as preparation of classes, ability to interact with their students and their particularities; as well as the pressing need to update their knowledge. In addition to the nature of their profession, they have to deal with overcrowding in classrooms, long working hours, limited leisure time, social and financial devaluation and bureaucracy in their services. For these reasons, teachers are emotionally and physically exhausted.<sup>3</sup>

It is also known that professionals who maintain a continuous relationship with other people for an excessive period of time and short intervals for their restoration, as with police, firefighters, health professionals and teachers, are more inclined to prolonged exhaustion and reduction interest in their trades.<sup>2</sup>

It is also noteworthy that the production and transfer of knowledge is a constant challenge that can impact sleep quality through problems such as drowsiness and insomnia<sup>4</sup>. A study carried out in Bahia found that 22.6% of teachers complained of drowsiness and 14.1% of insomnia<sup>5</sup>. Another study, with teachers from public schools, from two inland cities in the state of São Paulo (São José do Rio Preto and Campinas), showed that they reported sleeping an average of 6.8 hours and 6 hours a day, respectively<sup>6</sup>.

Sleep is governed by the biological clock, influenced by the genetics of each subject and regulated in a 24-hour cycle. This regulation occurs due to external factors such as light, noise, odors, lifestyle, environment and professional responsibilities, among others.<sup>4</sup> Poor sleep quality, including deprivation, interrupted or non-restorative sleep, is associated with several adverse consequences, such as health problems (eg impaired insulin sensitivity, increased levels of total cholesterol and low-density lipoprotein), reduced quality of life and economic costs<sup>7</sup>. According to Benvegnú et al (2016) sleep deprivation over time culminates in metabolic disorders and cardiovascular diseases<sup>8</sup>.

In addition, evidence of significant changes was found in individuals exposed to a few hours of sleep per day. These include serum elevations of cortisol and ghrelin, which contribute to a considerable increase in appetite and, on the other hand, increase the risk of developing metabolic diseases, such as diabetes mellitus (DM), arterial hypertension (AH) or obesity<sup>9</sup>. With regard to cardiovascular diseases, workers who sleep less than 6 hours a day have a quadrupled risk of stroke.<sup>10</sup>

Despite the growing recognition of the consequences of sleep problems, particularly for professionals who maintain a continuous relationship with other people, research on the associations between psychosocial work stressors and sleep quality has been limited. Because of this, the importance of checking the sleep quality of high school teachers and possible metabolic changes that may occur during an academic semester was verified. Studying the possible causes and health problems during an academic semester is extremely important for the prevention of chronic non-communicable diseases and thus helping these professionals.

## **METHODS**

### **Kind of study**

It is a longitudinal study with data collections carried out at the beginning (Stage 1) and at the end (Stage 2) of the academic semester.

### **Study period and place**

The research took place during 2018 at a state school in the city of São Luís, in the state of Maranhão, Brazil.

### **Sample / Sampling**

The study population consisted of teachers from a public school. Teachers who signed the Informed Consent Form (ICF), of both genders, were included, regardless of age, ethnicity and socioeconomic level. Teachers needed to have an employment relationship with the school (attested by the unit's director) in the morning and afternoon shifts.

Teachers who worked in other school units, who worked the night shift, who had extra jobs and / or who self reported insomnia or difficulties sleeping were not included in this research. Teachers who did not participate in any data collection stage were excluded from the sample. The sample was non-probabilistic consisting of 30 teachers, after the inclusion and exclusion criteria, three participants were excluded from this sample (due to the non-participation of the second stage of the study - end of the academic semester), with a quantity of 27 participants remaining.

The data analyzed for each participant were: lifestyle and disease history, sleep quality - Pittsburgh Sleep Quality Index (PSQI), blood pressure, heart rate, body weight, height and body fat quantification - bioimpedance polar polarity Maltron brand, waist circumference, serum concentrations of glycemia and components of the lipid profile. All variables were collected at the beginning of the semester and at the end of the semester with the same professors and the same team of researchers (standardized processes to guarantee the quality of data collection and decrease of possible bias).

### **Statistical processing**

For the data file and the statistical analysis, the SPSS software (Statistical Package for the Social Sciences, Inc., Chicago, IL, USA) version 25.0 was used. The data were treated using descriptive procedures (mean or median, standard deviation and percentage). The Kolmogorov-Smirnov test was used to verify the normality of the data. For comparisons between groups, Student's t test for independent samples was used. The Mann-Whitney U test for variables that do not have a normal data distribution. The results were considered statistically significant at  $p < 0.05$ .

### **Ethical aspects**

Participants were included in this research after being informed in detail about the study, understanding the purpose of the study and signing the Informed Consent Form. The present study was conducted according to the National Health Council resolution - CNS no. 466/2012, with Opinion No. 2,673,791.

## **Results**

The socio-demographic characteristics, health histories and life habits of the 27 teachers are shown in Table 01, where there was a prevalence of females with 70.4% (19/27) of participation. The age group of this population averaged 44.70 years ( $\pm 8.416$ ). Regarding the presence of a partner, 77.8% (21/27)

reported having a partner living in the same residence. Regarding the self-declared skin color, 63.0% (17/27) were white. Table 1 also shows a higher prevalence - 66.7% (18/27) of teachers with a history of arterial hypertension and 63.0% (17/27) without a history of diabetes mellitus.

Most of the participants reported not smoking - 77.8% (21/27), not drinking alcoholic beverages - 51.09% (14/27) and not using medications that aid sleep - 96.3% (26/27). Regarding the practice of physical activities, it was observed that this sample is characterized by a higher prevalence of people who do not practice any type of physical activity, with 70.4% (19/27).

**Table 01** - History of health and life habits of teachers, from high school, from a public school in São Luís/MA.

Variables	Average and percentage (%)
<b>Genre</b>	
Male	29,6% (08/27)
Female	70,4% (19/27)
<b>Age*</b>	44,70 ( $\pm 8,416$ )
<b>Skin color</b>	
White	63,0% (17/27)
Not white	37,0% (10/27)
<b>Unity</b>	
<b>With partner</b>	77,8% (21/27)
<b>Without partner</b>	22,6% (06/27)
<b>History of Hypertension</b>	
<b>Yes</b>	66,7% (18/27)
<b>No</b>	33,3% (09/27)
<b>History of Diabetes Mellitus</b>	
<b>Yes</b>	37,0% (10/27)
<b>Not</b>	63,0% (17/27)
<b>Physical activity</b>	
<b>Yes</b>	29,6% (8/27)
<b>Not</b>	70,4% (19/27)
<b>Smoking</b>	
<b>Yes</b>	22,2% (6/27)
<b>Not</b>	77,8% (21/27)
<b>Alcohol consumption</b>	
<b>Yes</b>	48,1% (13/27)
<b>Not</b>	51,09% (14/27)
<b>Sleeping medication</b>	
<b>Yes</b>	3,7% (01/27)
<b>Not</b>	96,3% (26/27)

\* Data represented as mean and standard deviation.

The appreciation of anthropometric data showed that teachers were classified as overweight in Steps 1 and 2 of this study, as well as an increase in waist circumference. When performing the analysis of these data referring to Steps 1 and 2, no statistically significant results were obtained (Table 02).

**Table 02** - Comparison between Stage 1 and 2, of anthropometric data of teachers, from high school in a public school in São Luís / MA.

Variables	Stages	Mean and standard deviation	p-value
<b>Weight*</b>	Stage 1	71,68 ± 17,855	< 0,900
	Stage 2	72,71 ± 17,514	
<b>BMI*</b>	Stage 1	28,333 ± 4,671	< 0,500
	Stage 2	29,037 ± 7,401	
<b>CC*</b>	Stage 1	88,63 ± 11,981	< 0,500
	Stage 2	90,83 ± 13,307	
<b>Body fat*</b>	Stage 1	34,13 ± 8,199	< 0,500
	Stage 2	33,19 ± 7,603	

BMI - Body Mass Index; WC - Waist circumference. Data represented as mean and standard deviation.

\*Student t test.

When considering serum concentrations for laboratory determinations, high fasting blood glucose values were observed in Step 2, exceeding the limits considered normal ( $108.85 \pm 45.640$ ). Regarding blood pressure, there was an increase in the mean systolic ( $132.04 \pm 27.855$ ) and diastolic pressure ( $80.78 \pm 16.092$ ).

When comparing these data in Steps 1 and 2, it was found that there was a significant difference in the blood concentration of fasting glucose and total cholesterol ( $p < 0.025$  and  $< 0.001$ , respectively). However, the same was not observed for the serum determination of triglycerides, blood pressure and heart rate (Table 03).

**Table 03** - Comparison between laboratory data, blood pressure and heart rate, in Stage 1 and Stage 2, of teachers, from high school in a public school in São Luís / MA.

Variables	Stage	Mean (standard deviation)	p value
<b>Fasting blood glucose (mg/dL)*</b>	Stage 1	92,30 ± 19,177	<0,025
	Stage 2	108,85 ± 45,640	
<b>Total cholesterol (mg/dL)*</b>	Stage 1	161,00 ± 32,821	<0,001
	Stage 2	173,59 ± 97,708	
<b>Triglycerides (mg/dL)*</b>	Stage 1	211,74 ± 101,956	<0,604
	Stage 2	194,56 ± 115,435	
<b>PAS (mmHg)*</b>	Stage 1	122,11 ± 18,713	<0,291
	Stage 2	132,04 ± 27,855	
<b>PAD mmHg)*</b>	Stage 1	73,96 ± 11,302	<0,500

	Stage 2	80,78 ± 16,092	
<b>FC (bpm)*</b>	Stage 1	74,00 ± 10,817	<0,542
	Stage 2	71,67 ± 8,481	

SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; HR: Heart rate. mmHg: millimeters of mercury; mg: milligrams per deciliter; bpm: beats per minute. Data represented as mean and standard deviation. \*Student *t* test.

Regarding the comparative analysis of Steps 1 and 2 on bedtime, there was no statistical difference ( $p < 0.521$ ). The variable good subjective quality of sleep, which deals with the perception of the individual's quality of sleep, showed that in the 1st stage with 63.0% (17/27) and in the 2nd stage with 66.7% (18/27) and showed no statistical difference ( $p < 0.500$ ). However, the poor quality of sleep proved to be relevant when it comes to the difference between Steps 1 and 2, as it increased from 66.7% to 81.5%, with a statistically significant value ( $p < 0.001$ ). In the daytime dysfunction there is also a statistical difference between one stage and another, with  $p$  value  $< 0.001$ . Regarding sleep efficiency, there was an improvement in its percentage with values greater than 85% ( $p < 0.004$ ) (Table 04).

The variable that obtained the greatest difference between their percentages was the use of sleeping pills, in step 1 only 3.7% used sleeping pills while in step 2 85.2% started using them.

**Table 04** - Comparative analysis, between Stage 1 and Stage 2, about hours in bed, subjective quality of sleep, quality of sleep, daytime dysfunction, sleep efficiency and use of medication by teachers, from a high school in a public school in São Luís/MA.

Variables	Stage	Mean (standard deviation)	<i>p</i> -value
<b>Bed hours*</b>	Stage 1	6,82 ± 1,245	<0,521
	Stage 2	6,52 ± 1,431	
<b>Good subjective sleep quality</b>	Stage 1	63,0% (17/27)	<0,500
	Stage 2	66,7% (18/27)	
<b>Poor sleep quality</b>	Stage 1	66,7% (18/27)	<0,001
	Stage 2	81,5% (22/27)	
<b>Presence of daytime dysfunction</b>	Stage 1	70,4% (19/27)	<0,001
	Stage 2	62,7% (18/27)	
<b>Sleep efficiency*</b>	Stage 1	88,85 ± 14,298	<0,004
	Stage 2	89,90 ± 11,456	
<b>Use of sleeping medications</b>	Stage 1	3,7% (01/27)	<0,472
	Stage 2	85,2% (23/27)	

\**Teste t – student.*



## DISCUSSION

Professional occupation has important psychosocial functions, which are commonly related to the biopsychosocial context. Employment facilitates social contacts and appreciation and is often an important part of an individual's identity. Despite this, the social characteristics of work can be an important source of health problems<sup>11</sup>. According to the American Academy of Sleep Medicine, normal sleep is essential for individuals to have a productive waking period and a feeling of permanent well-being. However, there is a difficulty in finding a definition for normal sleep since each person has their particularities, whether of biological or mental origin<sup>12</sup>. In this context, it is known that teaching is an activity that has numerous social relationships and, in general, it is highly stressful, with repercussions on physical and mental health which can affect sleep quality and professional performance, which justifies studies with this professional category<sup>13</sup>.

This study showed a higher prevalence of females, being in collusion with other studies with teachers/professors, who report that the teaching staff has a higher percentage of women. A cross-sectional census epidemiological study carried out in the municipal education networks of Vitória da Conquista (Bahia/Brazil) in 2002, showed that of the 794 teachers, 747 (94%) were women.<sup>14</sup> This fact was also observed in a study published by UNESCO,<sup>15</sup> in which in a population of almost five thousand teachers, from different levels of education, 81.3% of these were female. It appears that in the capitalist patriarchal model the presence and, currently, predominance of women in the exercise of teaching has been guided by the sexual division of labor. Therefore, women would be taken to the teaching profession because of their "nature", prone to the maintenance of human relationships and care practices.<sup>16</sup>

In this study, there was a prevalence of overweight in the 1st and 2nd stages. However, data from a school in the Jequié (Bahia/Brazil), with 251 teachers, showed that the overall mean BMI was 24.93 kg/m<sup>2</sup>. Perhaps this difference between the studies is due to the sample size, proportionality between the genders or cultural and food customs of each location, for, despite being cities in the northeast of Brazil, they have different eating habits. In turn, the high prevalence of overweight/obesity among teachers in the present study points to the need for preventive measures and control of this morbidity in order to avoid health problems resulting from overweight in the adult population<sup>17</sup>.

In the analysis carried out on the percentage of body fat, there was a high prevalence of body fat at the beginning of the semester and in the second stage this high percentage remained, which shows the need for activities that can contribute to the teachers' energy expenditure, such as encouraging physical activity. In a study carried out with 760 teachers, from Basic Education (Elementary and High School) distributed in schools of the State Education Network in the urban area of Montes Claros (Minas Gerais/Brazil), there was also a high prevalence of excess body fat (57%).<sup>18</sup> A similar result was found in a survey carried out with individuals of both sexes from an Integrated Health Service of a Higher Education Institution located in the city of Teresina (Piauí/Brazil), with individuals aged 20 to 59 years, where it was observed that 74.68% of the population had a high percentage of fat, and 37.97% of the sample had a high risk for obesity<sup>19</sup>.

In this context, it is known that obesity has reached epidemic proportions worldwide and, in parallel, there has been an increase in the prevalence of obesity-related comorbidities, such as insulin resistance (IR), type 2 diabetes mellitus (DM2) and metabolic syndrome (MS), collectively called cardiometabolic risk<sup>20</sup>. The underlying etiology of the increase in the frequency of these conditions is multifactorial, with well-recognized contributions from the diet (large portions, nutrient-rich foods and others) and physical inactivity; however, these factors alone do not explain the significant obesity epidemic, which is why there is a need to establish programs to encourage the practice of physical activities and healthy eating, aiming at reducing health problems.

The multiple work demands of teachers can constitute physical and mental health as risk factors for health<sup>21</sup>. In this study, a significant difference was observed in the poor quality of sleep between the two stages of the research, which corroborates the findings of the literature, such as, for example, data from a Swedish research where a positive association between high work demands, disturbed sleep and non-restorative sleep<sup>22</sup> was demonstrated. An analysis of sleep quality carried out with teachers from a private college in Valparaíso (Goiás/Brazil), resulted in 57.9% of poor sleep quality. The scientific literature has shown that among the various factors that impact the quality of sleep, the high workload and the need to work beyond business hours and outside institutional spaces, are directly associated with a teaching career<sup>24, 25</sup>.

Among the data obtained, it was also observed that disorders related to sleep quality, daytime dysfunction, sleep efficiency and sleep quality obtained statistically significant values when compared between the different Steps (1 and 2), which corroborates with a survey carried out with 279 teachers from elementary school I, in the state network of a municipality in the state of São Paulo/Brazil. In this, among the participants 53.8% had poor sleep quality associated with the presence of physical and emotional symptoms, the need to perform multiple activities and the feeling of difficulty to complete all tasks.<sup>16</sup>

Another study involving 270 university professors identified excessive daytime sleepiness in 35.2% of them (using the Epworth sleepiness scale).<sup>26</sup> It is known that impaired sleep, without favoring rest, causes consequences that are often imperceptible, but highly threatening to physical integrity (eg, muscle pain and gastrointestinal problems), emotional (eg, anxiety disorders and depression), relational (eg, irritability and high absenteeism) and productive (eg, lack of attention and lower productivity at work), becoming, in general, a public health problem that deserves further investigation<sup>27</sup>. It should be noted that teaching involves frequent interactions with students, colleagues, administrators and parents, which can result in emotional dissonance<sup>28</sup> and this is also relevant to the excessive wear of teachers and changes in their quality of life<sup>29</sup>.

Regarding laboratory data, it was found that in the second stage there was a higher prevalence of increases in serum analyte concentrations. The analysis of the results of the exams for Stage 1 and 2 showed statistically significant results for fasting blood glucose and total cholesterol, thus showing that, during the academic semester, there were negative metabolic changes for the teachers' health. Metabolic changes that were possibly influenced by the context surrounding the school environment, work relationships and sleep disorders. Epidemiological evidence, although they cannot determine causality, attributes an important role for sleep in the modulation of metabolic homeostasis<sup>30</sup>. Thus, as sleep restriction (<7 hours/night) and potentially excessive duration (> 8 hours/night) seem to increase the risk of insulin resistance and type 2 diabetes mellitus, this relationship being modulated by age, race and ethnicity, although the degree to which these differences have underlying biological and non-socioeconomic bases remains uncertain<sup>31</sup>.

Given the different evidences that show the association between insufficient or prolonged sleep duration and cardiovascular risk factors, it is not surprising that there is an effective association. Several large prospective cohort studies published in recent decades have indicated that insufficient and long sleep duration are associated with an increased risk of coronary heart disease and its predisposing risk factors<sup>31</sup>. The Whitehall II study (with 10,308 adult English men and women aged 35 to 55 years, with a follow-up for approximately 15 years) found that participants with short sleep duration ( $\leq 6$  hours) and restless and disturbed sleep had the highest reason for chance (RR: 1.55, 95% CI)<sup>32</sup> for cardiovascular disease. Likewise, in the Cohort of Health Nurses (with 71,617 health professionals in the USA, aged between 45 and 65 years and with 10 years of follow-up), adjusted odds ratio (RR) values (95% CI) for disease cardiovascular for individuals who report 5 or less, 6, and 7 hours of sleep per night, on average, were 1.45 (1.10-1.92), 1.18 (0.98-1.42) and 1.09 (0.91-1.30), respectively<sup>33</sup>. Several other studies have found similar



results in a variety of different adult populations of varying ages and ethnic backgrounds: some found associations only between insufficient sleep (with or without poor sleep quality) and risk and / or mortality from coronary heart disease while others found associations in U-shape, with short sleep and excessive sleep associated with an increased risk of coronary heart disease<sup>34</sup>.

In this context, the importance of this study is emphasized, which aimed to verify the quality of sleep and metabolic changes during the academic semester in high school teachers. With the results obtained, there is a need for attention about the health of teachers, who are essential to society and are exposed to a wide range of work stressors, which increase the likelihood of health risk and well-being.

The strengths of the study include the use of well-trained interviewers, the data set (sleep questionnaire, anthropometric data and laboratory tests) and longitudinal planning - two steps (beginning - post-vacation and end of the school semester), which makes it possible to understand changes in variables over time. And despite the short time (1 academic semester) of this research, it encourages future studies to verify causality. It is understood, however, that the limitations must also be considered in the interpretation of the results. First, the sample size that makes it impossible to infer results for the population of this occupational niche. According to the nature of self-report, because although self-report data are predominant in a study evaluating sleep quality, the integration of self-report and objective measures of sleep disorders would strengthen the design and the results obtained. Finally, here we used only one item to measure sleep quality that does not allow us to differentiate sleep characteristics in such a complex way and that previous studies have found to be related to sleep and metabolic changes and the teaching profession.

## **CONCLUSION**

Through an analysis of the results, it was found that the lipid profile, serum glucose and some sleep variables changed during the academic semester, thus showing the need for care with this category of workers. Thus, we suggest further studies in this area, as informing teachers about their health status and changes in their sleep favors the early diagnosis of diseases and the development of health promotion and prevention policies.

## **ABBREVIATIONS**

IR - insulin resistance

HA – Hypertension

DM - Diabetes Mellitus

MS - Metabolic Syndrome

CNS - National Health Council

UNESCO - The United Nations Educational, Scientific and Cultural Organization

SBP - Systolic Blood Pressure

DBP - Diastolic Blood Pressure

HR - Heart Rate

BMI - Body Mass Index

WC - Waist Circumference

GC - Body Fat

PSQI - Pittsburgh Sleep Quality Index

FICF - Informed Consent Form

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