ORIGINAL ARTICLE

Prolonged sitting and physical discomfort in university students

Fátima Aparecida Caromano[1], Cristina Aparecida Padoin de Amorim[2], Cristina de Fátima Rebelo[2], Adriana Maria Contesini[3], Francis Meire Fávero[4], Jecilene Rosana Costa Frutuoso[5], Milena Missa Kawai[6], Mariana Callil Voos[7]

ABSTRACT

The evolution of man promoted the adoption of the sitting position for prolonged periods, inducing biomechanical and physiological changes in the body. In an educational setting, adopting this posture can induce musculoskeletal disorders and physical discomfort associated or not with learning. **Objective:** To quantify and characterize prolonged sitting for college students and to correlate the time spent sitting with complaints of pain and/or discomfort. **Method:** A qualitative and quantitative study. Data collection done by a diary, where 47 participating college students reported the number of hours they spent sitting, their activities, pain and/or discomfort, and answered an open question about their observations on the study. Descriptive statistical analysis was performed with the Spearman correlation coefficient calculated between the two factors. The answers to the open question were categorized and grouped according to their frequency and similarity. **Results:** The students evaluated remained seated for long periods (13.4 SD 1.5 hours). Their perception of discomfort related to the furniture was relevant. Complaints of discomfort and/or pain may be related to prolonged sitting. The body parts with more complaints of pain were the head, neck, shoulders, and lumbosacral region. The longer they remained sitting, the greater the incidence of pain complaints. One cannot say that the pain causes or increases the stress level. **Conclusion:** The diary was a useful tool for data collection and served as an instrument of interference in self-observation and self-care. This study contributed to the understanding of how prolonged sitting affects college students and provided indicators for future interventions.

Keywords: Posture, Pain, Fatigue, Sedentary Lifestyle

[1] PhD, Professor, Department of Physiotherapy, Phonoaudiological and Occupational Therapy at the University of São Paulo Medical School.
[2] Physiotherapist, scientific initiation student at the Laboratory of Physical Therapy and Behavior of the Physical Therapy Course at the University of São Paulo Medical School.
[3] Physiotherapist, Masters degree in Rehabilitation Sciences from the University of São Paulo Medical School.
[4] Full Professor in the Stricto-Sensu Graduate Program at the Universidade Ibirapuera - UNIB.
[5] Coordinator of the Graduate Course of Interdisciplinary Sciences in Health at Universidade Ibirapuera - UNIB.
[6] Physiotherapy student and scientific initiation student at the Laboratory of Physical Therapy and Behavior of the Physical Therapy Course at the University of São Paulo Medical School.
[7] Researcher, Graduate Program in Rehabilitation Sciences at the University of São Paulo Medical School.

Mailing address:
Universidade de São Paulo
Fátima Aparecida Caromano
Rua Cipotânea, 51
CEP 05360-000
São Paulo - SP
E-mail: caromano@usp.br

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INTRODUCTION

Ergonomics has contributed to the well--being of individuals in different occupations, especially with regard to the use of proper furniture for sitting.[1] Anthropometric and biomechanical studies have observed that the type of conventional chairs used in schools, by not being adjustable, are inappropriate for the physical type of the majority of the students who remain seated during a large part of the day. Furniture is an essential element in the school organization, because it has an influence on the physical and psychological well-being of the students, affecting their health and learning.[2] Therefore it should offer comfort, safety, and be suitable to the anthropometric dimensions of its users. The adoption of incorrect postures for prolonged periods causes bodily discomforts, associated with pain.[3-5]

Computers, which have become indispensable in work, educational, and recreational activities, have transformed a large part of professional activities that were previously performed standing, into activities performed while sitting. Nowadays, a large part of the day is spent sitting, also during transportation, when studying, and in times of rest and leisure.[6,7]

Body posture involves a dynamic relationship in which the parts of the body, mainly the skeletal muscles, adapt in response to stimuli received. Sitting [I'm fixing it for the authors... even the original is out to lunch!] is defined as a position in which the body weight is mainly borne by the ischial tuberosities of the pelvis and their adjacent soft tissues. The human column biomechanical model was not built to stay for long periods in the sitting position, to maintain static postures, or to perform repetitive movements.[8] It has been known for decades that prolonged sitting may cause biomechanical problems due to the overload of stabilizing muscles in the vertebral column, reduction of venous return from lower limbs, and compression of the viscera and diaphragm.[9]

The effects of sitting became progressively interesting due to the increase in the number of occupational diseases caused by sedentary work, by the speed of the industrialization and automation processes, by the absence of proper training, and by the non-use of ergonomic criteria.[1,10]

In a frightening way, research has demonstrated that the time spent sitting has increased in a relevant way and, even with the practice of physical activity, prolonged sitting may seriously compromise the body metabolism, with a reduction in insulin sensitivity, favoring the development of obesity and type 2 diabetes.[11] These alterations are in addition to cardiopulmonary losses and point to a risk factor for high morbidity,[12] similar to smoking and poor nutrition.[13]

Levine[14] affirms that prolonged sitting kills. Although drastic, this affirmation reflects the reality of this practice. What is worse, prolonged sedentarism has been shown to be associated with the deterioration of health, regardless of any physical activity practiced.[15]

One of the most frequent school activities is to remain seated, and this is often associated with the transportation of excessively heavy school materials. The excessive workload of studying in and outside the classroom and the frequent exposure of the students to inadequate accommodations and carrying heavy weights can cause postural problems that cause discomforts such as pain and the sensation of weight and tingling in different parts of the body, and which can also lead to problems in the vertebral column such as lordosis, kyphosis, scoliosis, or disc herniation. Many students complain of pain after sitting for long periods.[16,17]

It is necessary to understand the relationship between prolonged sitting and the presence of discomfort/pain in university students in order to acquire subsidies for the development of physiotherapeutic interventions that allow the adaptation of the furniture used by these individuals, as well as for a proposal for behavioral modifications.[18]

OBJECTIVE

In view of this situation, the objectives of this study were to quantify and characterize the time university students spend in the sitting posture in different activities throughout the day and to evaluate and describe their complaints of pain or discomfort associated with prolonged sitting.

METHOD

A quali-quantitative study, carried out by means of data collection using directed diaries prepared for this study.

This study was evaluated and approved by the Ethics Committee of the Hospital das Clínicas of the University of São Paulo Medical School (protocol no. 0478/09).

This is the sample of convenience. The students from the first and second years of university courses were invited. For this research, 105 students accepted to participate and, according to the inclusion criteria, 85 students were selected. Of these, 36 students did not conclude the study, and 2 were excluded for filling out their diaries incorrectly. The study was concluded by 47 students who filled out their diaries correctly, with 42 females and 5 males, with an average age of 19.52 SD 1.79 years, average weight of 55.99 7.73 SD kg, and average height of 1.61 SD 0.07m.

The inclusion criteria were: not having any professional activity simultaneously with the studies, not presenting with any osteomyoarticular or neurological lesion or dysfunction, being a full-time student, aged between 17 and 25 years, and presenting BMI between 18.5 and 24.9 Kg/cm^2. All participants signed the Free and Informed Consent Term.

Materials

The research was conducted by analyzing the data collected from each student's diary, specially developed for this study. The diary was composed of:

- A cover sheet with the following information: study title, brief register of subjects with name, age, weight, height, a yes-no question to know whether the subject had already felt some discomfort/pain before starting the study along with the location of this pain/discomfort, in addition to the identification of the researcher's contact information to clarify any doubts during the research period.

- A page of guidelines with information on the objectives of this study, on the filling in of the data, and the definition of stress to be considered for this study.

- Fifteen pages with questions to be answered at two times of day (lunch time and evening) during the research period, recording the number of hours they had remained seated in different activities such as studying, driving, or in transit, working, during meals, at the computer - during work or leisure time, and in other leisure activities. A place to report any discomfort or pain during this period and to observe whether the furniture had contributed to these sensations, checking the yes or no option. If any pain/discomfort occurred, they were to quantify this sensation in accordance with the numerical pain scale, which consists of a 10 cm straight line with numbers from zero to ten, where zero equals the absence of discomfort/pain and ten, great discomfort/pain, putting the value equivalent to this sensation in each area on the body map,

not being necessary to make any annotation if the level of pain was zero. The level of stress was quantified using the visual analogue scale.[19-21]

One open question with which the subjects could report their observations in the experimentation period was answered in writing immediately after the end of the experiment: "In these past 15 days filling in the diary, did anything in your routine call your attention?" This question allowed the students, in their daily routine, to express their observations on the theme being researched.[22,23]

Procedure

The diary was chosen because it was a standardized data collection method that enabled participants to make proper notes every day.

They all received a two-hour training on how to correctly fill in the diary, which had to be done at the location of their choice at the pre-established times, and they were given the *e-mail* and telephone of the researchers to answer any questions. All participants received emails every three days with reminders about filling in the diary and were thanked for their participation in the study.

At the end of the experiment, the students answered the open question directed to the research theme and where they could comment on their observations.

Data Analysis

A descriptive statistical analysis was performed (total, average, and standard deviation) of hours reported in the sitting posture.

The perception of discomfort caused by the furniture was analyzed by means of aggregating the affirmative answers.

The scores of discomfort/pain and stress were summed per body segment, thereby obtaining the relative percentages values.

The visual analogue scale (VAS) was divided into 4 ranges with the meanings of mild (0 - 2.5), moderate (2.6 - 5.0), high (5.1 - 7.5), and very high (7.6 - 10.0).

The *SPSS software* version 13.0 was used to perform the Kolmogorov-Smirnov and Shapiro-Wilk normality tests, to analyze the type of sample distribution. As not all variables presented normal distribution, the Spearman correlation coefficient was computed between them, two by two. From the results obtained, a descriptive analysis of the data was conducted.

A content analysis was performed by category from the students' answers to the open question.[24] For the thematic analysis, the contents of these answers were organized and structured following the sequential phases proposed by Gomes,[25] obeying the pre-analysis, material exploration, and treatment of results. It was considered that the same student could participate in more than one category of response.[23]

RESULTS

With respect to the use of the hours sitting in different activities, it was found that in the morning period, 29.53% of the time spent sitting was used studying, 11.57% in transport, 1.37% doing some form of work, 10.25% eating, 2.50% using a computer to study, 37.59% using a computer for leisure, and 7.17% in leisure activities in general.

In the afternoon, the following distribution was seen: 34.06% of time was used to study, 15.89% in transportation, 1.47% working, 13.26% eating, 7.83% using a computer to study, 10.40% using a computer for leisure, and 17.15% in leisure activities in general. It draws attention the number of hours that each participant has spent sitting per day, which was 13.4 SD 1.5 hours (Table 1).

The perception of discomfort caused by the furniture was referred to by the group 572 times, with 261 times (45.791.99 min%) in the morning and 311 times (54.37%) in the afternoon. Only 2 participants (4.26%) reported no discomfort in any of the periods analyzed during the search.

From the values of pain recorded by students on the body map, it was possible to obtain the values inside the graduated pain scale. The values of the areas most referred-to were found in the morning period (Table 2).

The subjective sensation of stress reported by the visual analogue scale showed what was considered mild by 8 students (17.02%), moderate by 15 (31.91), high by 16 (34.04%) and very high by 8 students (17.02%). As for the open question, it was possible to obtain 7 categories of answers (Table 3).

Of the variables analyzed, "pain", "time," and "stress", the normality tests (with significance of $p < 0.5$) and correlation ($r > 0$) showed that there was a correlation and the closer this value was to 1, the more clear the indication that there was a positive linear relationship. Statistically significant relationships were found between pain and time with $p = 0.009$, with a significant relationship and with $r = 0.371$ showing a moderate positive linear correlation between pain and stress with $p = 0.049$, showing a relative significance and with $r = 0.286$ which demonstrated a weak positive linear correlation. Between time and stress, no statistically significant relationship was found ($p = 0.281$ and $r = 0.159$) (Table 4).

DISCUSSION

As expected, because these university students studied full time (8 hours per day), the largest number of hours sitting is related to their studying. In general, the number of hours sitting over 15 days was higher in the morning than in the afternoon. After the period of study, the activity that kept these students sitting the most was leisure using a computer. By adding the two periods, these students spent 47.99% of the time using a computer for leisure. Several studies point to this trend in the young population to use a computer for an ever greater time, with implications on their musculoskeletal structure. However, the use of a computer seems to be only one of many factors related to these changes, as already pointed out by Healy et al.[26]

There is a tendency to decrease participation in physical activities for young adults, since participation in sedentary activities such as the use of computers, both for school activities and for leisure activities is increasing, and our findings reinforced this assertion. Studies have related this habit to complaints of osteomyoarticular discomfort and pain. This situation is aggravated when the furniture is inappropriate.[27]

The study recorded 572 complaints about discomfort related to the furniture. This is equivalent to 40.72% of the total reports within the total period of the study. In his study on school furniture, Moro[28] showed that 54% of the reported complaints were for the region of the neck and back of the neck. This result warns of the improper positioning of head and neck in prolonged sitting, justifying the high rate of pain/discomfort complaints related to this region found in this study. "Incorrect sitting" presents itself as a compensatory response attempting to improve the discomfort in the body areas affected.

This study found a significant incidence of pain in the region of the head, neck, shoulders, and trapezius muscle, which is compatible with the literature data. This finding may be related to improper positioning, to unsuitable furniture, or even to long periods sitting, encouraging irregular postures.[28]

Another significant result of pain was in the lumbosacral region. Studies correlate lumbar pain with work activities, and it was

Table 1. Total of hours sitting in 15 days and their use considering all the participants (n = 47)

Activity	Morning	Afternoon		
	Total	%	Total	%
Studying	1484.64	29.53	1497.57	34.06
Transportation	581.39	11.57	692.51	15.89
Some form of work	68.82	1.37	61.32	1.47
Eating	515.22	10.25	577.80	13.26
At a computer (studying)	125.81	2.50	341.38	7.83
At a computer (leisure)	1889.21	37.59	453.10	10.40
Leisure	360.26	7.17	747.62	17.15
Total	5025.35		4358.33	

Total of hours sitting/15 days (morning + afternoon) by all students = 9,383.68 hours; Average and standard deviation of total hours sitting in 15 days = 625.6 SD 14.8 hours; Average of total hours sitting per day, per student = 13.4 SD 1.5 hours

Table 2. Percentage of pain in different body areas with the highest incidence

Body area	Mild		Moderate		High		Very high	
	AM	PM	AM	PM	AM	PM	AM	PM
Head	31.37	31.91	25.49	31.91	27.45	17.02	15.68	19.18
Cervical	42.40	33.88	32.00	38.01	22.40	23.14	3.20	4.96
Trapezius	27.40	29.74	34.93	34.87	33.56	30.26	4.11	5.13
Interscapular	28.41	32.20	35.23	35.59	30.68	27.12	5.68	5.08
Thoracolumbar	32.99	26.00	30.93	40.00	29.89	30.00	6.18	4.00
Lumbar	36.22	36.58	39.37	36.58	19.68	22.76	4.72	4.06
Sacral	32.91	30.56	31.65	36.11	27.85	26.85	7.59	6.48
Shoulder								
(right)	34.57	37.36	29.63	29.67	34.57	30.77	1.23	2.20
Shoulder (left)	38.75	42.86	16.25	24.17	40.00	30.77	5.00	2.19

Table 3. Categorization of responses for the final open question

Categories	Total in the category
1 Started to observe own posture	32
2 Used incorrect postures	17
3 Related sitting with pain	17
4 Intervened to improve the sitting posture	9
5 Did not noticed anything different	9
6 Related stress with pain while sitting	7
7 Realized they spent long periods sitting	5
Overall total of reports	96

Table 4. Coefficients of correlations between pain, time, and stress

Spearman test		PAIN	TIME	STRESS
PAIN	Correlation coefficient	1	0.371	0.286
	Significance	-	0.009	0.049
	N	48	48	48
TIME	Correlation coefficient	0.371	1	0.159
	Significance	0.009	.	0.281
	N	48	48	48
STRESS	Correlation coefficient	0.286	0.159	1
	Significance	0.049	0.281	.
	N	48	48	48

**. Correlation is significant at the level 0.01 (2-tailed), and at the level of 0.05 (2-tailed).

observed that the incidence was higher in individuals who work in sitting activities.[28] The data from the present study regarding the rates of complaints related to the lumbar and sacral regions are consistent with those found in the literature. The increased pressure on the discs, thighs, and buttocks, plus inappropriate posture, when kept for long periods of time, are fundamental factors in the emergence of physical problems, fatigue, and symptomatology of discomfort.

Grandjean & Hünting[29] researched 246 workers who performed their activities while sitting and found that low back pain was the discomfort that most affected these women's health, accounting for 57% of the complaints surveyed. In the present study, 40.6% of complaints were related to discomfort associated with furniture, both during school time and at other times.

It was possible to observe that, even without the postural guidance, the use of a diary promoted increased attention to and consideration of the individual's posture. A large part of the participants started to observe their posture with more attention as it is shown in the transcribed speech below: "*I always thought I had bad posture, and that became evident with this study*"... And "*while answering this questionnaire, I started to pay more attention to my posture and the time I remain seated...*". Some students realized they spent too much time sitting: "*During this time I noticed more the amount of time I spent sitting" and "I knew I spent a lot of time sitting, but I got scared with how much*". Other students associated pain with sitting "*I noticed that when I spend more time sitting, I feel more pain especially in the lower back...*" and "*... with the passing of time, I begin to fall on my seat, and afterwards I feel pain.*"

Some students related the stress with pain in prolonged sitting: "*... I change my position trying to circumvent the tiredness, but the pain continues, but it's tolerable, however it stresses me out, I become irritable, distracted*" and "*... the stress often relates to and even mingles with the feeling of pain*." Nine of the participants began to make interventions to improve their sitting posture during the experiment and reported: "*... I have tried to correct my posture since the study*" and "*... when I stand up and walk for a few minutes, the pain in the legs improves, so I started doing this more often ...*"

The importance of using a diary as a tool for critical reflection could be observed, because although it was not the purpose of the study to make the students change their postural

habits, the self-observation made some of them conclude it was necessary to make changes in their routines, and they took actions along those lines, as defended by Scaparo.[30]

CONCLUSION

This study demonstrated that the evaluated students remain sitting for long periods, with relatively more time during the morning, in particular in the activities of studying and leisure on a computer.

The perception of discomfort with the furniture was relevant, suggesting the need for programs of furniture upgrades and for more awareness towards sitting, both by students and teachers. The incentive to the practice of physical activity should also be considered.

The students reported discomfort and/or significant pain complaints that may be related to prolonged time in the sitting position. The places in the body with more complaints of pain were the head, the cervical region, the shoulder, the trapezius muscle, and the lumbosacral spine.

This study demonstrated that the longer the time spent sitting, the greater the incidence of pain complaints. However, it cannot be affirmed that the pain causes or increases the level of stress. No correlation was found between the time sitting and stress.

The diary was a useful tool for data collection and served as an instrument of interference for self-observation and self-care, although this was not the objective of this study. This became evident in the reports for the open question that made it possible to obtain feedback from students about the theme researched and reports of reflection on their postural habits.

The present study contributed to the understanding of how prolonged sitting affects university students and provides indicators for future interventions.

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