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Sleep Disorders and Musculoskeletal Complaints in Undergraduate Students who make Constant use of smartphones

SIMÃO, Lívia Oliveira, SMARZARO, Luiz Paulo Lucas, SANTOS, Hélio Gustavo

Abstract*— *The current study was developed aiming to evaluate sleep habits and musculoskeletal complaints in undergraduate students from São Camilo University Center- ES, who make constant use of smartphones, making it possible to identify the main factors affecting their sleep quality besides the pain levels and sites of the sample analyzed.* ***Objective: *Within all its functions, Ergonomic Physiotherapy evaluates postural changes and sleep disorders in smartphone users evidencing the students from this university as target audience in this study. Through this evaluation it is possible to identify existing sleep disorders and musculoskeletal complaints.* ***Method:*** *The research was carried out with university students during the class hours, employing questionnaires and it counted on 1,603 students from different courses in São Camilo University Center.* ***Conclusion:*** *Through this study, we concluded that in the contemporary world more and more people are making frequent use of smartphones, mainly college students.*

Keywords*— *Sleep; Smartphones; Students.

I. INTRODUCTION

Due to the use of smartphones, users acquire a poor posture, which is really harmful to health. Bad postural habits constitute a collective health problem, affecting students of both sexes as well as in different ages [1]. The individual who makes constant use of smartphones tends to acquire this poor posture, mainly in cervical region. According to Kim [2], the term *Text Neck* refers to the posture of individuals who keep their head tilted, looking at the cellular screen. Specialists state that cases of *Text Neck* are more and more common, which causes headaches because of tension on neck and back of the neck exactly due to the time the individual spends with head tilted in order to visualize the device. Tamura and Bertolini [3] say that a right posture preserves among others organs and bones, the spine, which is the supporting structure of our body, and also responsible for protecting medulla and nerve roots, and for body movements. According to the authors [4,5], the postural alterations lead to several problems in spine caused by several factors. The pain occurs due to an overload; decreased range of motion caused by unbalance in flexibility; muscle weakness and fatigue due to a long period in a poor posture; disorder in synesthetic perception of body alignment for wrong habit and incapacity to correct posture. It should be recalled that, besides causing postural alterations, the constant use of smartphones also causes sleep disorders. The college students are especially subject to changes in their life style and in their pattern in sleep cycle, because most of them deal with technologies like smartphones to help in their studies or even in social life in view of facilities and multiple functions technological advancement provides. One can note a significant increase in number of users, mainly during the last decade. Because of its continuous use in personal and professional lives, smartphones became a man's extension concerning systemic relations of use. Thus, it is noticeable some inadequacies in ergonomic aspect [6,7]. In fact, the problem is this overuse inflicts disorders in sleep-wake cycle, because the emitted light by the device disturbs the sleep. Therefore, the higher education students, being most of them young people, can present sleep deprivation and daytime sleepiness. As a consequence, they suffer from memory problems, problems with their academic performance, behavioral issues, irritability, tension and anxiety. Thus, according to Martini et al [8], this target group needs attention concerning their sleep complaints in order to make it possible to prevent and diagnose these disorders as soon as possible. For Castilho et al [9], besides curricular activities in full time, it is important to note that these students, who are in search of a high professional qualification, add other extracurricular activities on their training, such as: free courses, academic league, internships, scientific initiation and tutoring. This way, they are subject a heavy pressure and stress because of high performance and time required in these studies. So, most of them use smartphones for

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unlimited time, impairing the sleep cycle, making it clear that the light of these devices is harmful to the long time users. Martini et al [8] reports that the sleep-wake cycle is influenced by endogenous and exogenous factors and one of their main synchronizers is the emitted light, in other words, the light/ dark cycle. However, social aspects like familiar routine and working hours affect the sleep duration of these individuals.

This study has proposed to evaluate the sleep habits and musculoskeletal complaints of undergraduate students in São Camilo University Center, ES, who use smartphones. Following the methodology, Students of both genders and from different courses and period of study were subject to questionnaires (Identification of the individuals subject to the research, Nordic Questionnaire for musculoskeletal symptoms and Epworth Questionnaire for sleepiness). The site for the questionnaires submission was the University Center (in rooms before prior authorization). The study is characterized as a field study and was carried out in São Camilo University Center, district of Paraíso, in the city of Cachoeiro de Itapemirim, State of Espírito Santo. The research consists in a great number of undergraduates. Today, this University Center has an average of 3.500 undergraduate students, of both genders, attending the following courses: Architecture and Urban Planning, Gastronomy, Administration, Biology, Accounting, Law, Graduation and Bachelor's Degree in Physical Education, Nursing, Environmental Engineering, Civil Engineering, Production Engineering, Pharmacy, Physiotherapy, Nutrition, Information Systems, Mathematics, History, English and Pedagogy. It was selected students between 1st and 10th periods, attending classes in morning, afternoon and night periods. The time for data collecting was from 7 a.m. to 22 p.m. (start and finish times), from Monday to Friday. The researchers interviewed the students in May, June, July, August and September. All of the scholars were invited to participate in the research. After approval of the Ethic in Researches Committee (CAEE) # 665110617.0.000.0062 and the ruling number 2.028.619, the researchers got in touch with the Course Coordinators and professors of each area, asking for authorization in order to administer the Identification of individuals, Nordic and Epworth questionnaires. The students who accepted to participate in the research signed a consent term. The Epworth questionnaire aims to evaluate the sleep quality and the Nordic one aims to evaluate the musculoskeletal aspects. To fill out the questionnaires, the students spent between 10 and 15 minutes, in order to not interfere with the classes and the break. After this, an analysis of data was performed aiming to conclude the study. We always emphasized our goals in the evaluation of pain complaints and the sleep quality of the undergraduates. After carrying out this research, some data about pain, sleepiness, physical activities level, stress perception, work and use of smartphones were discussed.

It is known that most of São Camilo University Center students have a busy life while studying. Many of them work all day long and others live in neighboring towns to Cachoeiro de Itapemirim. This data was collected in the questionnaire of individual identification.

The proposal of this research after achieving this result: consciousness lectures; Inclusion criteria: all the students who are in favor of participating in the research and sign the free and clear consent term (TCLE). Exclusion criterion: non-enrolled students but in the University Campus; Elementary and High school students; post-graduation course students and students who did not sign the TCLE.

For data analysis, descriptive statics was employed (absolute and relative frequencies) for the questionnaire on the population characteristics as well as for Nordic and sleep questionnaires. For all the analyses it was used the SPSS statistic program, version 23.0.

After the sample estimation, a number of 1.594 undergraduates participating in the study were found, taking into consideration the 3.500 students of São Camilo University Center. At the end of the study, 1.603 students were interviewed.

All prevention actions were taken in order to avoid any moral and ethical damages for the participating individuals. It was also taken in account their privacy and confidentiality regarding the collected data. There were not found risks during the research with respect to the students picture themselves ill or with any other problem because of the topic discussed. They were advised they could feel a little uncomfortable in answering the questionnaires. Benefits of the research: learn about the best posture for everyday academic life; learn about the risks of sleep deprivation and its impact on life quality; use the result of the research for healthy habit changes; take new actions to prevent pain development and sleep deprivation.

II. RESULT AND DISCUSSION

Undergraduate Students' Age

The age of the undergraduates who participated in the research varied from 16 to 62 years old. The complaints were most frequent among people between 16 and 20 years old, representing 48.1% and between 21 and 25 years old, representing 36%. The students between 26 and 62 years old represented 16.3%.

The women were 63.8% from the total of interviewees. The prevalence of women in higher education is a worldwide phenomenon, which was found to be a reality

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in the last decades (10). The male participants were represented by 580 individuals.

Undergraduate Students' Physical Exercises Practice

Concerning physical exercises practice, 877 students (54.7%) are sedentary, in other words, they do not practice any kind of physical activity; 726 student stated they do physical exercises, thus, representing 45.3% of the participants. The exercises most practiced by the students are: weight lifting (403), jogging (241) and walking (197). Other modalities were also cited. They are: cross fit, fight, gymnastics, functional training and sports (soccer, volleyball and handball, for example). For Souza and Borges, and Santana and Peixoto [11, 12], physical activity is of great importance for health, life quality and welfare and also has a preventive effect against several illnesses and contributes to lessen anxiety, stress, the alterations in mild depression, in humor, self-esteem and contributes to positive attitudes. For students, physical activities help them to have a greater willingness and better mood to carry out the activities, which can influence in a positive way, their academic performance.

Undergraduates' Diet

The study shows 30.1% of the students have only two of the most important meals during all the day. This is a significant result, because it is not enough to keep a healthy body. Only t 6.6% has six daily meals, and 0.1% has seven meals. According to Silva and Busnello [13], it is part of the context to promote health in which it is said that the eating habits initiated during childhood go throughout adult life, but these habits can be affected when the individual enters university. It is justified due to the complex change in routine. The eating habits are complex; the life style orientates feeding in terms of local, schedule, number of companions during meals and financial conditions.

Undergraduates' Stress

The research revealed the undergraduates are stressed. From all the participants, 1178 stated to be stressed, which represents 73.5%. Those who said they are not stressed were 425, representing 26.5% of the sample. Santos [14] asserts the students face new challenges when starting college. Such challenges are different from those in the previous academic life. They are going through a new stage in life, when they have to adapt a new life style, becoming responsible for themselves and for their professional future. When these aspects are not well managed it can be harmful and impact their social as well as personal life, even bringing on physical and psychological complications, such as stress. Stress is considered the disease of this century and its index increases more and more in the world population. The university students represent a group with a higher probability to be affected by stress which interferes with the full training of these future professionals [15]. The most influential factors, according to Silva et al [16], are the tests and projects the students have to carry out, the need to balance work and study, the difficulty in finding time for family and leisure, the little professional perspective, uncertainty, the course and work load, the difficulty in getting the resources and study materials, relationship with classmates, lack of someone to share such difficulties, lack of positive feedback concerning what is carried out, relationship with professors and the difficulty in developing techniques. Yet, the evaluation periods demand a lot from the students which is a physical and emotional overload for them; the tension and need to do the best they can.

Undergraduates' Occupation

A number of 1073, or 66.9%, of undergraduates have to split their time between work and study, while 31.3%, a total of 530, assert they only study and do not have to bear the costs of living. For the authors, the long distance between work and college, mainly in large cities, is an exhausting factor for those who work all day and study at night causing the students to become extremely physical and psychological tired and affects their academic performance. The same happens for those who come from neighboring cities to attend college. In addition to this, there is still the traineeship, which is, most of time, in the morning time, interfering with work performance.

Table 1- Undergraduates' nocturnal Sleep hours

Sleep Time (Hours)	**Absolute Frequency (AF)**	**Relative Frequency** (RF)
4 to 6 hours	790	49.3%
7 to 9 hours	813	50.7%
Total	1603	100%

Source: (The Author, 2017)

In the Table 1 we can note that the most frequent quantity of nocturnal sleep hours presented by the students is that of 6 hours, which corresponds to 29.0% from the participants. Secondly, we have 26.3% for the students who reach 7 hours. Those who sleep 5 hours or less totalize 20.0%. Yet, 107 undergraduates stated they can sleep more than the

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essential per night (8 hours). We also considered that a great deal of these individuals use smartphones before sleeping, justifying many disturbs presented by the users. According to Fonseca et al [18], sleep is a vital phenomenon, as necessary to our preservation as eating. Sleeping has a fundamental biological function for memory consolidation, balance of endocrine functions, thermoregulation, to retain and regain energy and to restore brain energetic metabolism. For Lira and Freitas [19,20], its extensively known the importance of an appropriate sleep standard, which includes duration, resulting in good health and physical and metal conditions, as well as it is also known the effects of a restful sleep deprivation, affecting the individual's quality of life, interfering with his academic and professional performance, among others. It also makes the individual to become prone to illnesses and, consequently, to lower life expectancy. The social environmental factors like appropriate nutrition, sedentary lifestyle, school schedule, directly affect sleep. These factors lead the students to go to bed late and, this way, becoming drowsy.

Table 2- Undergraduates' constant use of smartphones

Smartphone Usage	Absolute Frequency (AF)	Relative Frequency (RF)
No	77	4.8%
Yes	1526	95.2%
Total	1603	100%

Source: (The Author, 2017)

In the Table 2, one can note 1526 (95.2%) of the undergraduates make constant use of their smartphones either for social nets or calls, photos, music, etc. on the other hand, 77 (4.8%) reported they do not use cellphones for a long time during the day, just for the necessary. Yet, others asserted they do not have a cellphone. Due to the technology evolution, the HHD usage has increased worldwide. More and more people acquire smartphones, tablets, notebooks, and the like. Mobiles have a variety of functions helping people in their everyday life. It is possible to instantly communicate with others in different ways: visually, by audio or texting. It does not matter how distant they are from us. Yet, we can conduct business and bank transactions, access information about the worldwide events in real time and others, besides providing us with entertainment.

Table 3- Frequency of smartphones usage by undergraduates (hours/ day)

Usage Frequency (hours/ day)	Absolute Frequency (AF)	Relative Frequency (RF)
Never use	71	4.4%
Less than 3h/ day	224	14.0%
3h to 6h/ day	520	32.4%
6h to 10h/ day	373	23.3%
10h a 15h/ day	415	25.9%
Total	1603	100.0%

Source: (The Author, 2017)

Above, the table shows the duration in hours the undergraduates use smartphones per day. The highest prevalence was between 3h and 6h with 520 users, representing 32.4% of the participants; 788 students asserted they use their HHD between 6h to 10h or 10h to 15h per day, which represents almost half the interviewees, or, 49.2%; 71 students reported they do not use it any moment during the day; and 224 participants, 14.0%, use their smartphones less than 3h/ day. According to Spritzer et al [24], nowadays, for many people it seems impossible to live their lives without facilities it can offer. However, its excessive usage can result in several complaints about physical and emotional alterations. The users can present anxiety, irritability and sadness when distant from their HHD. On the other hand, the wrong way of using smartphones can be triggered by an attempt to alleviate these symptoms. All of this can alienate the users from real life (social life, physical activities), endangering relationships, work and studies.

The Table 4 shows the probability the students would nap during the situations described like reading or watching TV or nap while sitting. Such situations are Epworth Sleepiness Scale's. The score can be "0"- never would nap; "1"- small probability to nap; "2"- medium probability to nap; and "3"- high probability to nap. The "never and small probability to nap" when mostly marked,

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it indicates the individual do not suffer from excessive daytime sleepiness. For Pascotto e Santos [25], when the individual largely marks the "medium or high probability", it indicates the individual suffers from excessive daytime sleepiness. To reach the number of students who suffer from sleep disorders such as daytime sleepiness, we had an average for each situation as shown on the following table.

Table 4

Situations	**Never and small probability to nap**	**Medium and high probability to nap**
sitting and reading	46.6%	53.4%
watching TV	38.0%	62.0%
seated at public place	75.8%	24.2%
riding on passenger´s seat	50.3%	49.7%
sitting after lunch	31.0%	69.0%
Stuck in traffic for Some minutes	83.6%	16.4%
Table 4 Epworth Sleepiness Questionnaire Result		
Total of each situation 100%	54.2%	45.8%

Source: (The Author, 2017)

In the Table 4 we can find all the percentages of the situations presented in the Epworth Sleepiness Questionnaire; for each situation the total was 100%. Three from all situations had a higher score: sitting and reading (53.4%), watching TV (62.0%) and sitting after lunch (69.0%). In these situations, the students marked "medium" or "high" probability to nap during daytime. The other three situations had a higher probability for "never" or "small" with respect to nap during daytime: seated at a public place (75.8%), riding on passenger´s seat (50.3%) and stuck in traffic for some minutes (83.6%).

After all these data, the percentage rates for never and/or small and medium and/ or high probabilities were added up, reaching a final average of 54.2%, or, approximately, 869 students who, according to Epworth Scale, are not subject to nap, to daytime sleepiness and others sleep disorders. For those undergraduates who present some kind of sleep disorders the score was 45.8%, or, 734 students. Excessive daytime sleepiness is characterized by an increased feeling of sleeping and a decrease in alertness, as asserted by Pereira et al [26]. It is worth pointing out that, in Brazil it is common to have graduation courses offering classes in the morning, afternoon or evening. Thus, the studies reveal the nocturnal period students present shorter sleep duration and more sleep and tiredness complaints. According to Obrecht et al [27], this is because many of them work during the day, increasing their responsibilities and reducing the time for personal matters. The same Epworth daytime sleepiness Questionnaires were employed in a recent and similar study carried out by Moraes et al [28] with a group of 157 Medical students and, according to the scale, 36.3% of the students presented excessive daytime sleepiness. Again, it was proved that the rate of students who suffer from this disorder is high.

Table 5- Nordic Questionnaire- Students who, in the last 12 months, presented pains in parts of the body cited below:

Pains in the last 12 months on	**Absolute Frequency (AF)**	**Relative frequency (RF)**
neck	784	49.9%
shoulders	697	43.5%
upper back	861	53.7%
elbow	124	7.7%
wrists/ hands	702	43.8%
lower back	762	47.5%
hip/ thigh	339	21.1%
knees	487	30.4%
ankle/ feet	538	33.5%

Source: (The Author, 2017)

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The table 5 addresses the musculoskeletal pain complaints on the parts of the body distinguished. This table only accounts for the absolute and relative frequency the students complained about pains in the last 12 months. The parts of the body involved when the students make use of their smartphones at home, work or even, at college present a remarkable number of complaints. A number of 784 students (49.9%) reported some kind of discomfort, pain or tingling in the last 12 months, representing almost half the sample of the research which has a number of 1603 participants. In the shoulders, the complaints came from 697 students (43.5%); upper back was the region with a major number of complaints in the last year: 861 (53.7%); wrists and hands accounted for 702 complaints (43.8%) by being very required to hold the HHD and text; lower back had a significant number of complaints, 762 (47.5%). Yet, some parts of the body which are theoretically less required when using smartphones were also in the Nordic Questionnaire presenting the following rates: hip/ thigh 339 (21.1%), knees 487 (30.4%) and ankle/ feet 538 (33.5%) of the complaints. The undergraduates may not have a good posture when using smartphones whether sitting or lying, damaging lower limbs.

All of these physical health problems related to new technologies usage can be prevented by moderate use of the HHD and a good posture [29, 30]. Guterres et al [29], carried out a study with 100 individuals, with mean age of 25, most of them women (54%) and 97% used HHD. Among the interviewees, 48.0% make use of this device up to 5 hours a day; 52.0% between 5 and 10 hours a day or more. The most frequent musculoskeletal complaints reported were: neck (49.4%), wrist and hands (37.9%), shoulders (28.7%) and lower back (18.4%). Remembering that, the participants could mark more than one option.

It is then understood the importance of using smartphones as transformers and influencers in human relations around the world, generating several opportunities to store, collect and share information at a faster pace (Reischl et al. 2018), having smartphone applications. , designed to improve the consumer's experience of its use (Hambrock, 2019). These electronic devices have invaded society and people's lives and are still increasing in popularity (Chuang, 2018).

Although excessive smartphone use in adolescents is often criticized (Aljomaa, et al. 2016; Toh, 2019), it can nevertheless be effectively used for learning and education. Young students demonstrate a deep appreciation for their multifaceted and highly personalized learning experiences on smartphones (Chan, 2013).

III. FINAL CONSIDERATIONS

Through this study, we conclude that, in the contemporary world, more and more people are frequently using the smartphones, mainly college students. So, due to the use of this device in a poor posture for long periods, many musculoskeletal pathologies and sleep disorders have been developed.

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