

A Study On The Effects Of Students' Posture, Comfort And Health In Consequences Of Prolonged Sitting Among Senior Cambridge Students

¹ Dr. Rukshanda Jabeen, ²Dr. Narjis Unar, ³ Dania Shoaib Khan, ⁴ Dr. Shahnawaz Tunio, ⁵ Dr. Noor us Sabah

¹Assistant Professor, Department of Education, Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST), Karachi, Pakistan. (Corresponding Author)

²Institute of Business Management (IoBM), Karachi, Pakistan.

³Mohammad Ali Jinnah University (MAJU), Karachi, Pakistan.

⁴College of Education, Zhengzhou University, Henan, China.

⁵Bahria University of Health Sciences (BUHS), Karachi, Pakistan.

Abstract

The study aims to investigate the consequences of prolonged sitting on the students' posture, their comfort and overall health in a Cambridge school. The study examined the impact of sitting for extended period of time on the posture and comfort levels of students. It also explored potential interventions or solutions that can be implemented to mitigate these effects. The study involved collecting data from students through focused group interviews and analyzed the data to look for the solutions in form of interventions etc. The findings of this research enable the administration and teachers of schools to focus on the school interventions for providing safe and secured school environment. This study also contributed to the development of effective strategies for promoting health, comfort in students with proper posture. It was revealed in the findings that students were aware of the potential adverse effects of prolonged sitting and had a desire for interventions to improve posture and comfort. It is recommended that measures such as regular breaks, physical exercises, and the use of ergonomic furniture could be beneficial in reducing these harmful effects.

Keywords: Ergonomics, Musculoskeletal issues, Physical exercise, Posture, Prolonged sitting.

Introduction:

In recent years the increasing trends of sedentary lifestyle among students due to excessive reliance on technology has badly affected their posture

(Priya & Subramaniam, 2022; Sahu et al., 2021). Heavy backpacks, improper furniture are the most glaring factors which lead to students' postural deviation and persistent pain in the body (Jabeen & Hussain, 2022). Prevalence of

backache and discomfort are the offshoots of prolonged sitting as discussed in the study by Isapka and Omorodion (2019), claimed a strong relationship between prolonged sitting, pain, poor posture and discomfort in school going students. The relationship between prolonged sitting and discomfort, pain, and poor posture in students was also studied by Pervez et al. (2022) specifically focus on students in a classroom setting, and aimed to determine the extent to which prolonged sitting affected their posture and comfort levels. Prolonged sitting affects students' posture and comfort level in a classroom setting, however, potential solutions to reduce the adverse effects of prolonged sitting like adding more movement and physical activity during academic activities, use of ergonomic furniture also help students to overcome these issues in their classroom routine (Caromano et al., 2015).

Prolonged sitting has been found to have negative effects on student posture and comfort especially for those who spend long periods of time sitting in a classroom setting cause discomfort, pain and poor posture (Brink et al., 2015). Samoladas et al. (2018) highlight the issue is becoming increasingly prevalent as technology and sedentary lifestyles have led to more time spent sitting for both children and adults. Jabeen and Hussain (2022) posit that the harmful effects of inappropriate furniture leads to a different health issues pertaining to musculoskeletal disorders, including back pain and several bone deformities among students right from the early age. The study by Doty et al. (2022) found that students who spent a significant amount of time sitting reported more discomfort and pain in their backs, necks, and shoulders. This can lead to chronic pain and a decreased ability to focus and be productive in the classroom. Additionally, prolonged sitting can also lead to poor circulation and muscle weakness during prolonged sitting the muscles in the legs and core are not being used, which can lead to a decrease in muscle tone and strength. Plotnikoff et al. (2015) suggest that it

becomes difficult for students to participate in physical activities, and can also lead to weight gain and obesity.

To deal with the negative effects of prolonged sitting, it is important for students to take regular breaks and engage in physical activity throughout the day (Luciano et al., 2021). Saunders et al. (2022) elucidate that standing desks, stretching exercises, or even walking around the classroom during class diminish students' prolonged sitting. This is why teachers are always suggested to incorporate more movement and physical activity into the classroom to help promote better posture and comfort for students.

In short the adverse effects of prolonged sitting are students' bad posture, ill health and lack of focus on the work making them uncomfortable. Students who spend long periods of time sitting in the classroom setting report discomfort, pain, and poor posture (Brink et al., 2015; Doty et al., 2022). Giving short breaks and engaging students in physical activities as a part of daily school routine teach students to refrain from them from the effects of prolonged sitting (Luciano et al., 2021).

The context of the study:

Students in the senior classes of Cambridge board have to sit for long hours to study, it is the demand of their high grades in exam. The sole purpose of conducting this study to investigate the harmful effects of prolonged sitting on students' posture, which lead to their discomfort and poor posture. In senior classes, students often attend back to back classes and sit for longer duration. The concern from senior students' and their parents were shown in the parents' teachers meeting, that students' often complained about body ache and are found lethargic when reach home. Since, this concern was voicing up, it was demanded by teachers also to investigate and look for the root

cause of it so that it can be addressed. It was effecting their grades also. It was then decided by the researcher to interview senior students who are suffering with health issues to learn from their experience of prolonged sitting and its aftereffects on their health. The study has also focused on the consequences of prolonged sitting resulting in bad posture and discomfort also to find the solutions as are there any possible interventions to address these issues? Thus, one Cambridge school was selected as a case study where this issue is addressed at length. The posture and comfort issues amongst students of senior Cambridge level are investigated as a consequences of long sitting hours of students. The result will definitely be helpful in implementing school interventions by the school principals, teachers.

The purpose of the study:

The purpose of this case study in a Cambridge school is to explore the effects of prolonged sitting on student posture and comfort level. The study aims to discover possible interventions in educational setting to avoid sitting in the class for long hours without break. The study also inquires to look for possible solution to combat severe consequences which affect students' bad posture and overall health. This study has also addressed the relationship of prolonged sitting and inappropriate posture and comfort. It has discussed the effective strategies for promotion of healthy and beneficial activities in schools.

The significance of this study:

This study is proved to be valuable in providing a significant addition in the field of ergonomics which deals with the aftermaths of prolonged sitting and use of heavy backpacks. It has been observed that long duration classes compel students to sit for long hours which not only put a bad impact on their health but affect their posture as well (Shakerian et al., 2023). Students undergo different bone deformities, pain, fatigue

and discomfort due to this. Which ultimately effect their scholastic performance and general health. Prolonged sitting has a negative impact on student posture and comfort levels, which can ultimately affect their academic performance and overall well-being (Castelluci et al., 2017).

This study will improve teachers' awareness regarding prolonged sitting in classroom, the impact of inappropriate furniture which enable administration, teachers, students and even parents to understand the gravity of issues. The study will identify potential interventions as a solution to deal with health problems and inform researchers. This empirical study will also be beneficial in diminishing negative effect on students' body posture, musculoskeletal disorders and overall well-being in the school setting. The findings of this study will have considerable importance for the policy makers, teaching practitioners and administration to provide solution to this issue by incorporating educational interventions for the safeguard of students' health and bone deformities right from early ages in the school environment.

Statement of Problem:

Pain, fatigue, postural and muscular issues are the common offshoots of prolonged sitting. Hafez (2019) and Mianehsaz et al. (2022), opine that students who experience discomfort and reduced concentration in studies are the ones who sit for extended periods of time in classrooms. Therefore, it is important to investigate the effects of prolonged sitting on students' body posture, comfort and pinpoint plausible interventions or solutions that can be implemented to diminish these effects (Buchman-Pearle et al., 2023).

The prevalent phenomenon of prolonged sitting has increased over a period of time in the modern era. Students are often found sitting in classrooms for longer periods of time, particularly in school settings. According to a study by Pronk et al. (2016), the average time

spent by students in the classroom is 75% of the total time, of which significant time is spent sitting without performing any physical activity (Lakshmi & Bindu, 2021). Kounter (2019) discusses the consequences of prolonged sitting surfaced in the form of pain, fatigue, musculoskeletal disorders, and bone deformities in students. The aftermath of which may sometimes be so dangerous that it becomes irreversible (Di Nicola, 2021). Students whose academic performance is low are often found dull, lethargic, and inactive, and they do not participate willingly in any physical activity. Glapa et al. (2018) opine that inactive attitude is the outcome of their ill health, which is associated with multiple factors; however, studies have proven the fact that poor body posture leads to pain in the body and fatigue. It is a proven fact that a healthy body possesses a healthy mind, which is reflected in students' school performance (Shutova et al., 2020).

Research objectives of the study:

1. To investigate the implications of extended sitting on students' posture and comfort.
2. To inquire into any plausible interventions or remedies that could be used to minimize the detrimental effects of prolonged sitting on students' posture, comfort, and general well-being.

Research questions of the study:

1. Does prolong sitting of students have an impact on their posture and comfort in the classroom?
2. Can any intervention be implemented in the classroom to lessen the effect of prolong sitting affecting their health, posture and comfort?

Literature review of the study:

There has been lot of emphasis on the students' health, posture and overall well-being in the

recent decade. The correlation of students' physical and mental health with their academic performance has been greatly stressed by parents' body (Jabeen & Hussain, 2022). Shamsoddini et al. (2011) emphasize that students posture is directly affected due to their prolonged sitting in classrooms. Thus, by reducing muscular activity and increasing sedentary habits, students affecting their health badly.

Students complain about different skeletal pain and suffer from muscular spasm due to wrong sitting posture and inappropriate furniture. Students' health and poor posture are the consequences of their continuous sedentary behaviour. It is also observed that students who have less physical activity are more prone to postural issues because they spend most of the time sitting on chairs or uncomfortable furniture. There is a higher likelihood of having backache, shoulder and neck pain and face discomfort. Another study by Dampsey et al. (2014) discover that prolonged sitting can also lead to an increase in the risk of diseases like diabetes and cardiac problems. Where students suffer from different chronic diseases, the prolonged sitting also put them in the danger of gaining weight and become obese. The BMI has a standard percentage according to age and height of the children that too gets disturbed because of their sedentary habits leaving them overweight or obese.

Braun et al. (2016) investigate the aftereffects of prolonged sitting and discover that students who most likely face health issues are those who do not engage them in physical activity, repentantly are inactive and scoreless grades in their exam. Students' unwillingness in participating in physical activities lead to their weak performance and absenteeism. COVID-19 has overall changed the scenario for young students who find electronic gadgets are more human friendly than participating in social activities with their physical presence. Their inactive and lethargic behaviour has many stories

to unfold after the advent of COVID-19. Jabeen and Hussain (2022) strongly suggest that school administration, teachers and parents need to incorporate active ergonomic practices to regain students' energy and making them active and agile. Healthy measures are requiring to be adopted by schools' administration and teachers to reduce students' sitting time by planning activity-based teaching strategies and to promote physical exercises during the long duration academic periods (Podrekar et al., 2020).

Theoretical Framework:

There are several theories that can guide the study of prolonged sitting and its effects on posture, comfort, and health of students. However, the ergonomics theory mainly guided this study.

Ergonomics theory, 1857

It is an applied science and human engineering which focuses on improving individual's efficiency and well-being by reducing risk factors and overall system performance. It was first coined by Wojciech Jastrzębowski, later discussed by Scott (2009).

The goal of ergonomics is to design systems and tools that are intuitive and safe to use, while minimizing the risk of injury, fatigue, and errors. Some key principles of ergonomics theory include:

Anthropometry: the study of human body dimensions and measurements, used to design objects and spaces that are well-suited to human proportions.

Biomechanics: the study of the mechanical forces that act on the human body, used to design tools and systems that minimize strain and injury.

Methodology:

The methodology employed in this study is purely qualitative. It's a case study where a Cambridge school is studied as a unit case. Qualitative research design helps to understand

the width and depth of the issue of postural deviation, discomfort and health issues due to prolonged sitting of students in a Cambridge school. Qualitative data were collected through focused group interview to gather students' perceptions about prolonged sitting and its consequences. Students' focused group interviews helped the researcher gauge students' discomfort level in the classroom. The study employed non-probability, purposive sampling technique where 6 students were interviewed through focused group. The focused group interview was tape recorded and converted into verbatim. The reliability and rigor of the study was improved through member check, a process in which verbatim was double check with the participants to confirm their replies. Students were specifically interviewed through a focused group interview in their leisure time with their consent so that they must not miss out on their classes. The duration of this focused group interview lasted for one hour approximately. The participants were given full freedom to express their views at length without limiting them to only one aspect so that they elaborate their responses with full confidentiality and free will.

Results and discussions:

It was revealed in the findings that students were aware of the potential adverse effects of prolonged sitting like improper posture, backache and other musculoskeletal discomfort. It was desired that effective interventions to be implemented to address their health issues and discomfort. Some measures were suggested such as regular breaks, physical exercises, and the also the use of ergonomic furniture was highly demanded to reduce the harmful effects of prolong sitting (Glapa et al., 2018).

Theme – I: Prolonged sitting negatively impact students' posture

Respondent 1 complained as:

“Since we have to spend long hours sitting in the classroom it makes us feel very uncomfortable.”

Respondent 3 supported him by saying

“I realize after sometime that my posture is inappropriate and there is a persistent pain i feel in my body.”

Discussion

In a discussion it was revealed that each one of them was aware that they do not possess a proper posture which is because of sitting in classrooms for longer duration. Bonnet and Barela (2021) show their concern on prolong sitting and report that it has a negative impact on student posture by shaping it inappropriately making them feel uncomfortable.

Theme – 2: Posture and musculoskeletal health

Respondent 2 expressed the discomfort and said,

“I used to have muscular spasm quite often, which afflicts continuous pain in my neck and surrounding muscles and now i can’t sit or stand straight for longer time, I have to bend my shoulder or hunch my back which of course I don’t like, but I don’t have choice as it has become my habit.”

Respondent 5 further added

“I also feel stress on my shoulder and back whenever i try to sit straight on my chair, I want to have a properly designed chair which suits my sitting posture and make me feel free of this muscular stress.”

Discussion

The harmful effects of prolonged sitting are quite evident from students’ inappropriate posture causing back pain, neck pain, and other musculoskeletal issues (Jabeen & Hussain, 2022). Pervez et al. (2019) assert the relationship between inadequate sitting posture and the development of pain and discomfort which is

caused by sitting for long time on inappropriate furniture.

Theme – 3: Physical activity and sedentary behaviour

Respondent 3 showed concern that

“Prolong sitting during study hour complements sedentary behaviour and decreases physical activity which is extremely dangerous for our health.”

Respondent 4 also complained that

“We are not allowed to leave class even if we have continuous periods which is indirectly compelling us to adopt sedentary attitude. We should be allowed to walk around if we get tired of sitting.”

Discussion

This situation is alarming as it will not only make students develop sedentary attitude but increase their anger and stress which has to be timely addressed. DeArouj and Santos, (2023) argue that prolonged sitting leads to a decrease in physical activity which in turn affects posture, comfort which can even lead to anxiety, depression and mental stress and ultimately producing low grades in exam.

Theme – 4: Regular breaks and physical activity promote better posture

Respondent very enthusiastically suggested that

“In my opinion it is highly important for students to take regular breaks and engage in physical activity during school hours.”

Respondent 6 also opined that

“Why can’t we have some stretching exercises while sitting on our chairs, for which we need short breaks in between our lectures.”

Discussion

It has been observed that students were very vocal in getting breaks in between long periods and wanted to engage themselves in a physical activity. Da Silva et al. (2023) reinforce that stretching exercises, or even walking around the classroom during class is highly important for better posture of students. They also state that it is important for schools and teachers to incorporate more movement and physical activity into the classroom to help promote better posture and comfort for students (Jabeen & Hussain, 2022).

Theme – 5: Ergonomics and educational interventions:

Respondent 6 argued that

“It is the responsibility of administration to provide ergonomically designed furniture and classroom to avoid such mishaps”.

Respondents 2, 3 & 6 strongly demanded interventions

“Short physical activity breaks, ergonomically designed classrooms and furniture as well as postural awareness programs for students are the need of an hour”.

Discussion

Al-Hinai et al. (2018) emphasize upon provision of ergonomically design furniture and classrooms positively impact students' health and academic success. The study explored that how classroom design and ergonomics affect students' posture, comfort, and health. explore whether different seating options, such as standing desks or ergonomic chairs, have an impact on students' health outcomes. Buchman- Pearle et al. (2023) stress on the implementation of interventions such as ergonomically design chair, standing desks, postural education and physical activity breaks (Jabeen & Hussain, 2022) leading to improved health outcomes, better posture and improved academic performance.

Conclusion:

Prolonged sitting has negative effects on students' posture, comfort, and health: The study found that prolonged sitting leads to increased musculoskeletal pain, discomfort, and poor posture (Shakerian et al., 2023).

Ergonomic interventions can improve posture, comfort, and health: Ergonomics intervention such as the introduction of ergonomically designed furniture, regular short breaks, healthy physical exercises lead to improved outcomes such as appropriate posture, comfortable environment impacting positively on students' overall health (Castellucci et al., 2017).

Ergonomics awareness campaigns can improve posture, comfort, and health: Awareness regarding ergonomics can also prove to be a healthy sign towards student's better posture, comfort, and health. It can be demonstrated through postural education and implementing ergonomic techniques by demonstrating healthy exercises and reduced academic pressure (Jabeen & Hussain, 2022).

Recommendations:

Schools and university administration: The administration should consider investing in ergonomic chairs, standing desks, or other furniture that is designed to support good posture and reduce musculoskeletal pain and discomfort.

Administrators/ Proprietors: Schools could consider adjusting classroom design to better support good posture, such as ensuring that desks are at the right height and angle to promote good posture.

Policy makers/Educationist: Policy makers and educationist must design policies based on ergonomics principles to be practices in educational setting.

School Principals: The school Principals to train teachers to educate students through postural

education and ergonomics practices techniques to be practiced in school to help students maintain good posture and reduce the risk of pain, discomfort to focus on their class performance.

Teachers: should be encouraged to take short breaks to move around and engage in physical activity during prolonged sitting periods through the use of activity trackers or other incentives.

Students: They need to include regular physical exercises in their daily routine to overcome different muscular pain and to improve their posture.

Future researchers: Further research could be conducted to explore the long-term effects of prolonged sitting on students' health and well-being, as well as the effectiveness of different interventions and strategies.

References

1. Al-Hinai, N., Al-Kindi, M., & Shamsuzzoha, A. (2018). An ergonomic student chair design and engineering for classroom environment. *International Journal of Mechanical Engineering and Robotics Research*, 7(5), 534-543. <https://doi.org/10.18178/ijmerr.7.5.534-543>
2. Bonnet, C. T., & Barela, J. A. (2021). Health issues due to the global prevalence of sedentariness and recommendations towards achieving a healthier behaviour. *Healthcare*, 9(8), 995. <https://doi.org/10.3390/healthcare9080995>
3. Braun, J. M., Gennings, C., Hauser, R., & Webster, T. F. (2016). What can epidemiological studies tell us about the impact of chemical mixtures on human health? *Environmental health perspectives*, 124(1), <https://doi.org/10.1289/ehp.1510569>
4. Brink, Y., Louw, Q., Grimmer, K., & Jordaan, E. (2015). The relationship between sitting posture and seated-related upper quadrant musculoskeletal pain in computing South African adolescents: A prospective study. *Manual therapy*, 20(6), 820-826. <https://doi.org/10.1016/j.math.2015.03.015>
5. Buchman-Pearle, J. M., Gruevski, K. M., Gallagher, K. M., Barrett, J. M., & Callaghan, J. P. (2023). Defining the lumbar and trunk-thigh neutral zone from the passive stiffness curve: application to hybrid sit-stand postures and chair design. *Ergonomics*, 66(3), 338-349. <https://doi.org/10.1080/00140139.2022.2084164>
6. Buchman-Pearle, J. M., Gruevski, K. M., Gallagher, K. M., Barrett, J. M., & Callaghan, J. P. (2023). Defining the lumbar and trunk-thigh neutral zone from the passive stiffness curve: application to hybrid sit-stand postures and chair design. *Ergonomics*, 66(3), 338-349. <https://doi.org/10.1080/00140139.2022.2084164>
7. Caromano, F. A., Amorim, C. A. P. de, Rebelo, C. de F., Contesini, A. M., Fávero, F. M., Frutuoso, J. R. C., Kawai, M. M., & Voos, M. C. (2015). Prolonged sitting and physical discomfort in university students. *Acta Fisiátrica*, 22(4). <https://doi.org/10.5935/0104-7795.20150034>
8. Castellucci, H. I., Arezes, P. M., Molenbroek, J. F. M., de Bruin, R., & Viviani, C. (2017). The influence of school furniture on students' performance and physical responses: results of a systematic review. *Ergonomics*, 60(1), 93-110. <https://doi.org/10.1080/00140139.2016.1170889>
9. da Silva, J. G., da Silva, J. M. N., Bispo, L. G. M., de Souza, D. S. F., Serafim, R. S., Torres, M. G. L., ... & Vieira, E. M. D. A. (2023). Construction of a Musculoskeletal

- Discomfort Scale for the Lower Limbs of Workers: An Analysis Using the Multigroup Item Response Theory. *International Journal of Environmental Research and Public Health*, 20(7), 5307.
10. de Araújo, L. V. B., de Sousa Santos, A. Q., de Abreu, E. A. B., de Carvalho Santos, T. T., Lins, L. D., dos Santos, I. S. P., & dos Santos Barbosa, A. (2023). Damage of sedentary lifestyle in adult life because of the lack of practice of activities in physical education discipline in the contemporary world. *European Journal of Development Studies*, 3(1), 52-57. <https://doi.org/10.24018/ejdevelop.2023.3.1.183>
 11. Dempsey, P. C., Owen, N., Biddle, S. J., & Dunstan, D. W. (2014). Managing sedentary behavior to reduce the risk of diabetes and cardiovascular disease. *Current diabetes reports*, 14, 1-11. <https://doi.org/10.1007/s11892-014-0522-0>
 12. Di Nicola, V. (2020). Degenerative osteoarthritis a reversible chronic disease. *Regenerative therapy*, 15, 149-160. <https://doi.org/10.1016/j.reth.2020.07.007>
 13. Doty, T. A., Knox, L. E., Krause, A. X., Berzenski, S. R., Hinkel-Lipsker, J. W., & Drew, S. A. (2022). Keep It Brief: Videoconferencing Frequency and Duration as Predictors of Visual and Body Discomfort. *International Journal of Human-Computer Interaction*, 1-12. <https://doi.org/10.1080/10447318.2022.2132358>
 14. Glapa, A., Grzesiak, J., Laudanska-Krzeminska, I., Chin, M. K., Edginton, C. R., Mok, M. M. C., & Bronikowski, M. (2018). The impact of brain breaks classroom-based physical activities on attitudes toward physical activity in polish school children in third to fifth grade. *International journal of environmental research and public health*, 15(2), 368. <https://doi.org/10.3390/ijerph15020368>
 15. Isapka, A. I., & Omorodion, O. A. (2019). The Mismatch of Students Anthropometric Data with Ergonomic Designs of Learning Workstation is a Risk Factor for Musculoskeletal Disorders. *International Journal Science*, 8(2), 105-111. <https://doi.org/10.18483/ijSci.1913>
 16. Jabeen, R., & Hussain, N. (2022). Teachers' awareness and practices on school ergonomics in Karachi, Pakistan. *Journal of Humanities, Social and Management Sciences (JHSMS)*, 3(1), 366-381. <https://doi.org/10.47264/idea.jhsms/3.1.26>
 17. Kounter, T. (2019). The Prevalence and Consequences of Poor Posture in Children and Adolescents. Senior Honors Theses. 903. <https://digitalcommons.liberty.edu/honors/903>
 18. Lakshmi, V. V., & Bindu, E. S. (2021). Perceived discomfort about classroom chair by college students. *International Journal of Educational Science and Research (IJESR)*, 11(2), 161-166
 19. Luciano, F., Cenacchi, V., Vegro, V., & Pavei, G. (2021). COVID-19 lockdown: Physical activity, sedentary behaviour and sleep in Italian medicine students. *European journal of sport science*, 21(10), 1459-1468. <https://doi.org/10.1080/17461391.2020.1842910>
 20. Mianehsaz, E., Tabatabaei, M., Kashani, M. M., Badi, H. Z., & Rahimi, H. (2022). Evaluating musculoskeletal disorders and their ergonomic risk factors among office workers of a large public hospital in Iran. *International Archives of Health Sciences*, 9(1), 35.
 21. Parvez, M. S., Rahman, A., & Tasnim, N. (2019). Ergonomic mismatch between students anthropometry and university classroom furniture. *Theoretical Issues in*

- Ergonomics Science, 20(5), 603-631. <https://doi.org/10.1080/1463922X.2019.1617909>
22. Parvez, M. S., Rahman, A., & Tasnim, N. (2019). Ergonomic mismatch between students anthropometry and university classroom furniture. *Theoretical Issues in Ergonomics Science*, 20(5), 603-631. <https://doi.org/10.1080/1463922X.2019.1617909>
23. Plotnikoff, R. C., Costigan, S. A., Williams, R. L., Hutchesson, M. J., Kennedy, S. G., Robards, S. L., ... & Germov, J. (2015). Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, 12(1), 1-10. <https://doi.org/10.1186/s12966-015-0203-7>
24. Podrekar, N., Kastelic, K., & Šarabon, N. (2020). Teachers' perspective on strategies to reduce sedentary behavior in educational institutions. *International Journal of Environmental Research and Public Health*, 17(22), 8407. <http://doi.org/10.3390/ijerph17228407>
25. Priya, D. B., & Subramaniyam, M. (2022). Fatigue due to smartphone use? Investigating research trends and methods for analysing fatigue caused by extensive smartphone usage: A review. *Work*, 72(2), 637-650. <https://doi.org/10.3233/WOR-205351>
26. Pronk, N. P., McLellan, D. L., McGrail, M. P., Olson, S. M., McKinney, Z. J., Katz, J. N., ... & Sorensen, G. (2016). Measurement Tools for Integrated Worker Health Protection and Promotion. *Journal of Occupational and Environmental Medicine*, 58(7), 651-658. <https://www.jstor.org/stable/48501474>
27. Sahu, M., Gnana Sundari, K., & David, A. (2021). Recent ergonomic interventions and evaluations on laptop, smartphones and desktop computer users. In *Advances in Industrial Automation and Smart Manufacturing: Select Proceedings of ICAIASM 2019* (pp. 207-224). Springer Singapore. https://doi.org/10.1007/978-981-15-4739-3_18
28. Samoladas, E., Barmpagianni, C., Papadopoulos, D. V., & Gelalis, I. D. (2018). Lower back and neck pain among dentistry students: a cross-sectional study in dentistry students in Northern Greece. *European Journal of Orthopaedic Surgery & Traumatology*, 28, 1261-1267. <https://doi.org/10.1007/s00590-018-2195-x>
29. Saunders, T. J., Rollo, S., Kuzik, N., Demchenko, I., Bélanger, S., Brisson-Boivin, K., ... & Tremblay, M. S. (2022). International school-related sedentary behaviour recommendations for children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 19(1), 39. <https://doi.org/10.1186/s12966-022-01259-3>
30. Scott, P. A. (Ed.). (2009). *Ergonomics in developing regions: Needs and applications*. CRC Press.
31. Shakerian, M., Esmaili, R., & Rismanchian, M. (2023). Association of ergonomics risk factors among Iranian calico crafts-men and musculoskeletal discomforts: a cross-sectional study. *BMC Musculoskeletal Disorders*, 24(1), 1-12. <https://doi.org/10.1186/s12891-023-06219-x>
32. Shamsoddini, A. R., Hollisaz, M. T., & Hafezi, R. (2010). Backpack weight and musculoskeletal symptoms in secondary school students, Tehran, Iran. *Iranian journal of public health*, 39(4), 120.
33. Shohel Parvez, M., Tasnim, N., Talapatra, S., Ruhani, A., & Hoque, A. M. (2022).

Assessment of musculoskeletal problems among Bangladeshi University students in relation to classroom and library furniture. Journal of The Institution of Engineers (India): Series C, 1-14.
<https://doi.org/10.1007/s40032-021-00792-7>

34. Shutova, T., Vysotskaya, T., Bochkareva, S., & Bodrov, I. (2020). Physical education of students with poor health. Journal of Human Sport and Exercise, 15(2proc), S177-S188.
<https://doi.org/10.14198/jhse.2020.15.Proc.2.08>