

A Comparative Study on Ergonomic Evaluation Between Underprivileged and Privileged Secondary School Children

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DOI: <https://doi.org/10.52403/ijhsr.20240907>

ABSTRACT

Background: Ergonomics is the study of people in their working environment. Ergonomic evaluation within the classroom of underprivileged and privileged school children can help detect the need for changes in physical ergonomics so that the habits are well practiced in adulthood and awareness about correct ergonomics could be given in different activity.

Objective: To compare ergonomic evaluation between underprivileged and privileged secondary school children using ergonomic assessment tool and physiocode posture application.

Method: In this study 200 students ,100 privileged and 100 underprivileged school students between age group 12-16 years were included who fulfilled the inclusion and exclusion criteria, ergonomic assessment tool and physiocode posture application were used to score each activity performed by the students.

Result: The statistical analysis showed that the mean ergonomic score was good for privileged school children (7.5/10- good ergonomics) compare to underprivileged school children (6.3/10- bad ergonomics).

Conclusion: This study concludes that privileged school children have better ergonomics compare to underprivileged school children but both the group require intervention and awareness about ergonomics to prevent further musculoskeletal injuries during later stage of life.

Keywords: Ergonomics, Privileged, Underprivileged, Ergonomic assessment tool, Physiocode posture Application.

INTRODUCTION

Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.^[1] Schools are gates of knowledge. Education nowadays poses a lot

of challenge and opportunities to the children.in todays world a point of global concern is musculoskeletal health of school going young age children. Ergonomic evaluation within the classroom can help prevent poor sitting habits from being practiced into adulthood. One must consider that school children are workers within the classrooms, in which correct positing is often overlooked^[2] Workstations at school

are among common factors that contribute to musculoskeletal pain in school aged children. Awkward posturing can entrap peripheral nerves, create localized muscle fatigue and increased susceptibility of muscles of the upper extremity, neck and back to small micro tear and inflammatory changes. The end result of affected muscle and tendons may be pain and impaired function.^[3] The term underprivileged refers to the term “disadvantaged”(uzgiris, 1968; cited in Kundu, 1985). They are disadvantaged section of people who are economically, socially and geographically in an unfavourable situation compared to the rest of the population of the society.^[4] Backpack use among these school children has increased because of several factors, including lack of availability of school lockers, increased homework, big notebooks all of which leads to increase in backpack weight and amount of time spent carrying backpacks.^[5] A mismatch between the children height and the bench height according to the age, insufficient space for legs to spread freely during long hours of lecture, crowding on a single bench, increased arm- desk distance are often observed in most of the underprivileged schools. This level of mismatch between children anthropometric measures and classroom furniture dimensions available to the children revealed that there was a high level of postural overload which affects the performance of classroom activities such as writing, reading and typing; causing pain and discomfort and consequently reducing attention.^[6] Privileged School children are considered as one having high socioeconomic status and going to private schools which have appropriate school facilities like lockers, transportation, properly designed school furniture and well lit and ventilated environment which may reduce the risk of awkward posture while sitting thus reducing stress on musculoskeletal system. High prevalence of musculoskeletal pain is documented, but data on ergonomic comparison between two different socioeconomic school group

children is lacking. Thus, objective of this study is to evaluate and compare the ergonomics among these children using ergonomic assessment tool and posture screen mobile application. The ergonomic assessment tool was developed based on inputs from focus discussions and workshops. The face validity of the tool was obtained from three experts. It was found to be reliable ($r = 0.88$)^[7]. It has five activities to be assessed, each activity was marked as good ergonomics or bad ergonomics. Physiocode posture application demonstrated excellent intra-rater (ICC = 0.92) and inter-rater (ICC = 0.88) reliability is used to detect postures during five activities^[8]. The application calculated posture variables using individuals anatomical points (i.e. ear lobe, acromion process, pelvic iliac spines, greater trochanter, lateral femoral condyle and lateral malleoli) directly over the mobile screen and then the body angles are calculated in compare to the neutral position and will try to find out the presence of risk if any.

MATERIALS & METHODS

The study was a cross-sectional study. 200 school children (100 underprivileged school children and 100 privileged school children) between age group 12 to 16 years were selected using convenient sampling method. Inclusion criteria: children willing to be part of study, children in the age group between 12-16 years, children studying in class 7th to class 10th. Exclusion criteria: physically disabled children, children pre-diagnosed with Scoliosis, any trauma and fracture within last 6 months, children having psychological and neurological condition such as Cerebral palsy, Autism, Duchenne muscular dystrophy. The study procedure was as follows: 200 school children (100 underprivileged and 100 privileged) were selected based on inclusion and exclusion criteria. A meeting was organized with the parents of children screened for the study where proper explanation regarding the assessment was given and they were made

able to fill and duly sign the consent form and duly signed by parents' socioeconomic status form were also filled during the same time. An assent form was filled and signed by children. Children were assessed using ergonomic assessment tool which have following five activities and angles of posture variables were seen in physiocode posture application during these activities. Following were the five activities:- (1) Book reading: the children were given a school book and the posture while reading the book was assessed (with emphasis on position of the back, neck, shoulder and elbows). (2) Lifting book from the floor: use of knee bending more than back were scored higher while assessing the activity. (3) Sitting on the chair: a straight back and upright neck was graded better than a slouched posture and forward head. (4) Carrying a backpack: children who used both the shoulder straps were graded better than ones using one strap. (5) While using a computer: a slouched posture with forward neck and forward shoulders, an unsupported elbows and wrist were considered as bad ergonomics and scored lower. Scoring of the ergonomic assessment tool:- for each activity, each student was given a score of 1 for bad ergonomics and a score of 2 for good ergonomics, thus each student received a score out of maximum of 10 and minimum of 5. The score range between 5 and 10 with 7.5 being the middle part of the scoring scale. A score more than 7.5 (score

8,9,10) was graded as good ergonomic behaviour and score less than 7.5 were graded as bad ergonomic behaviour. Physiocode posture application took pictures if the subjects from sagittal plane and calculated the postural variables using anatomical landmarks. The body angles were then calculated and an output file with values of postural variables and images that illustrate the digitized points and their locations in relation to the neutral position were made.

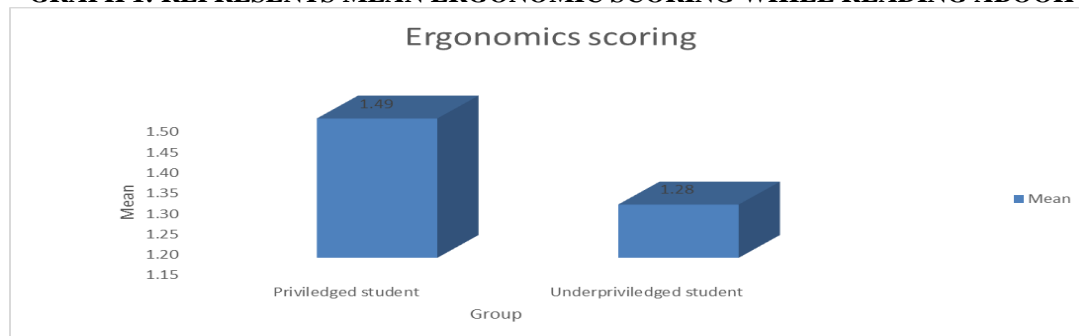
STATISTICAL ANALYSIS

Data was collected in a data sheet and encoded for computer analysis, tables were made using MS word and figures were plotted using MS excel, computerised analysis of the data was done.

RESULT

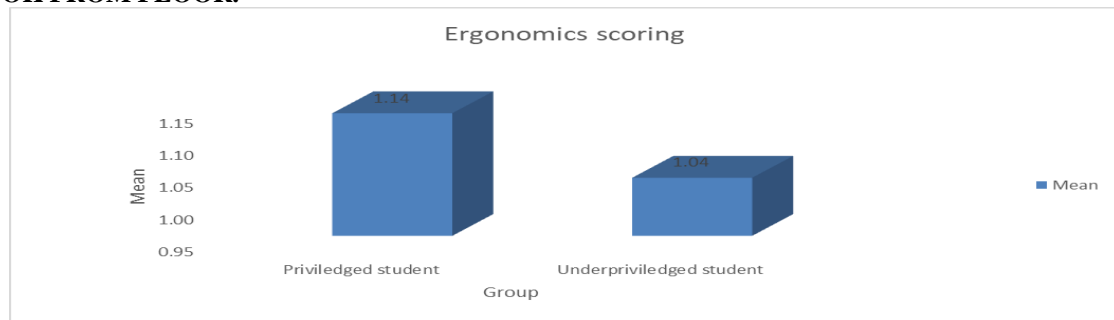
A total of 200 students were included in this study. The mean age of the underprivileged children were 15 years and that of privileged students were 14 years. Both male and female student were included among which in privileged group there were 50 female and 50 male student and among underprivileged group there were 53 female and 47 male student. All five activities were assessed among both the groups. The results showed that mean total ergonomics scoring (out of 10) in privileged student was 7.50 and mean ergonomics scoring in underprivileged student was 6.34.

GRAPH 1: REPRESENTS MEAN ERGONOMIC SCORING WHILE READING ABOOK



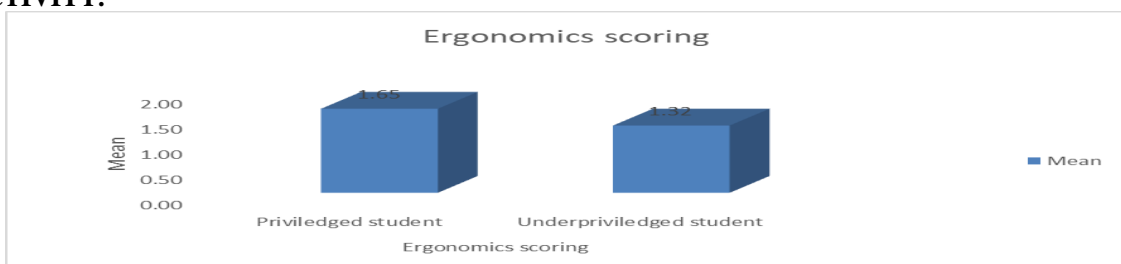
INTREPRETATION: Mean ergonomics scoring in privileged student was 1.49 and mean ergonomics scoring in underprivileged student was 1.28. It was statistically significant ($p=0.002$)

GRAPH 2: REPRESENTS MEAN ERGONOMIC SCORING CHART FOR ACTIVITY OF LIFTING BOOK FROM FLOOR.



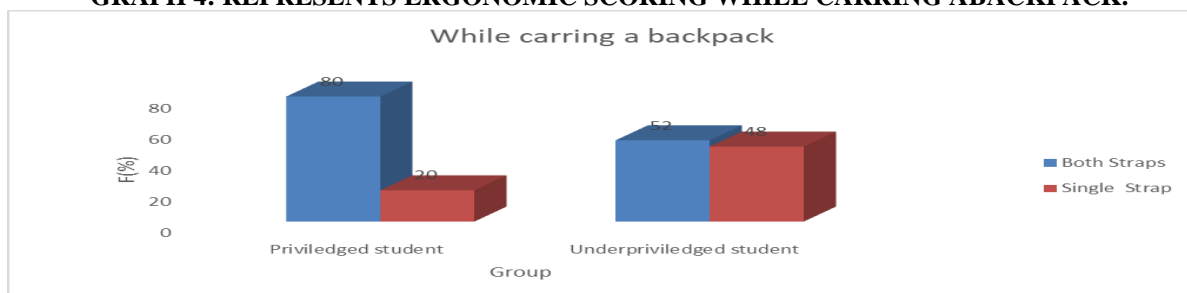
INTERPRETATION: Mean ergonomics scoring in Privileged students was 1.14 and mean ergonomics scoring in Underprivileged students was 1.04. It was statistically significant ($p=0.014$).

GRAPH 3: REPRESENTS MEAN ERGONOMIC SCORING FOR SITTING ON THE CHAIR ACTIVITY.



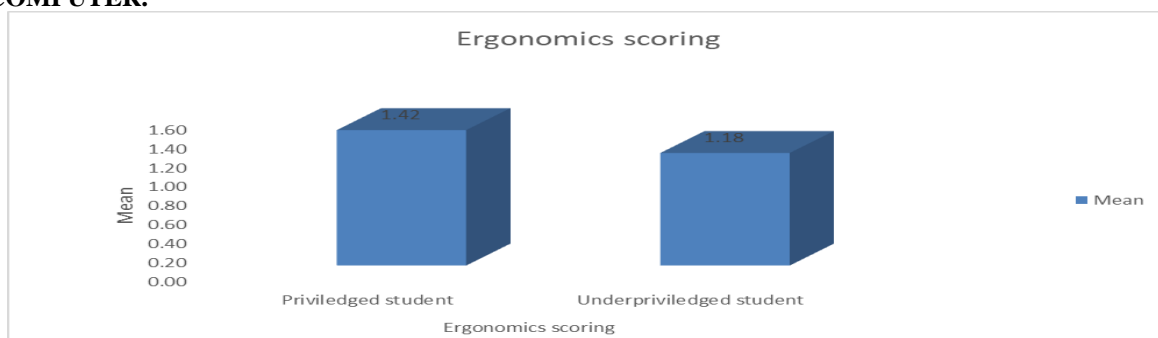
INTERPRETATION: Mean ergonomics scoring in privileged student was 1.65 and mean ergonomics scoring in underprivileged student was 1.32. It was statistically significant ($p<0.001$).

GRAPH 4: REPRESENTS ERGONOMIC SCORING WHILE CARRING A BACKPACK.



INTERPRETATION: No. of students using both straps while carrying a backpack were significantly higher in privileged students (80) as compared underprivileged students (52) ($p<0.001$).

GRAPH 5: -MEAN ERGONOMIC SCORING CHART FOR ACTIVITY OF WHILE USING A COMPUTER.



INTERPRETATION: Mean ergonomics scoring in privileged student was 1.42 and mean ergonomics scoring in underprivileged student was 1.18. It was statistically significant ($p<0.001$).

TABLE 1: REPRESENTS MEAN TOTAL ERGONOMIC SCORE CHART FOR ALL THE ACTIVITIES.

Variables	Group	N	Mean	Std. Deviation	Unpaired t statistic	tp value
Total ergonomics tool scoring (out of 10)	Privileged student	100	7.50	1.02	7.31	<0.001
	Underprivileged student	100	6.34	1.22		

DISCUSSION

The focus of this study was to evaluate ergonomic activities at the level of school among underprivileged and privileged children using ergonomic assessment tool and Physiocode posture application. 200 students were included, 100 privileged and 100 underprivileged school students. Among this 100 privileged students 50 were females & 50 were males and among underprivileged students 53 were females and 47 were males. The mean age of privileged school children were 14 years and that of underprivileged children were 15 years. Ergonomic assessment tool and Physiocode posture app was used to assess ergonomics during school activities. Major finding of bad ergonomic behaviour was seen commonly in underprivileged school children with activities performed at school. While reading a book it showed that the posture of head, shoulder was more protracted among underprivileged school children compare to privileged school children. If the cervical spine is held in protracted position for prolonged duration, it can lead to alterations in head posture ultimately leading to poor posture known as forward head posture (FHP). Forward head and round-shoulder postures can result in shoulder pain and dysfunction because of altered scapular kinematics and muscle activity and consequently, placing increased stress on the shoulder.^[9] Activities like bending from spine was observed most commonly in both the groups during lifting a book from the floor which can produce a change in the geometry of the spine, but moving from standing up to bending down, and then from bending down to standing up (during these movements the lumbar spine goes from being lordotic to kyphotic to lordotic), and when this is combined with lifting or lowering a load it creates a

particular risk for a low back injury.^[10] Carrying a heavy bag asymmetrically on one side of the body causes excessive load on neck, shoulder and back muscles which triggers extreme fatigue and injury.^[11] Side backpack carrying exhibited higher lateral shoulder tilt and trapezius activity. [11]. Pressure sores underneath shoulder straps are also common complaints in Some students. Backpack weight had the greatest influence on shoulder strap tension and shoulder pressure as the increased weight of backpack increase the strap tension, while if the shoulder strap was loose, the tension and pressure under the shoulder strap was decreased.^[12, 13] Considerable physiological changes might result from backpack carriage. There is a positive relationship between the weight of backpack and the changes in the vital signs (such as the respiratory Rate). Significant increase in forward bending and limited movement range of the trunk appears to affect negatively the movement of the thorax and reduce the volume of the abdomen. The abdominal muscles are contracted in order to gain trunk stability and this will prevent abdominal breathing. Thus, the only way that the subject could increase oxygen uptake to support the increased metabolic might be through the use of costal breathing and rapid breathing.^[13, 14]

CONCLUSION

The study concludes that the mean ergonomic score was good among privileged school children compare to underprivileged school children but both the group requires awareness and intervention so as to prevent further musculoskeletal injuries.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: I express my deep sense of gratitude and sincere thanks to our respected sir Dr. Ajay Kumar Yadav and guide Dr. Priyanka Gokhale who has immensely help me with sincere guidance, untiring cooperation, valuable advice and endless inspiration during the course of the study. I also take this opportunity to thank my family members and friends for their help and support.

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Vidhi Jain, Priyanka Gokhale, Ajay Kumar. A comparative study on ergonomic evaluation between underprivileged and privileged secondary school children. *Int J Health Sci Res*. 2024; 14(9):55-60. DOI: <https://doi.org/10.52403/ijhsr.20240907>
