Health Promotion Perspectives, 2013, 3(1), 36-44
doi: 10.5681/hpp.2013.005
http://journals.tbzmed.ac.ir/HPP

Ergonomic Assessment and Musculoskeletal Health of the Underprivileged School Children in Pune, India

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ARTICLE INFO

Article type:
Original Article

Article history:
Received: Feb 09 2013
Accepted: May 07 2013
e-published: Jun 30 2013

Keywords:
Urban slum children,
Ergonomics,
Posture,
India

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ABSTRACT

Background: Musculoskeletal health in schoolchildren is a global health problem. The objective of the current study was to assess ergonomic behavior and musculoskeletal health in urban poor schoolchildren in Pune, India.
Methods: Sixty-five (29 male students) slum dwelling schoolchildren were assessed for their ergonomics using a validated and reliable tool.
Results: Average age was 13 years. Out of 65 students, 36 reported presence of musculoskeletal pain. In addition, 78.5% had bad ergonomics when lifting books. Sitting posture was poor in 67.7%, while 50.8% demonstrated bad posture while using a computer. As far as the female students were concerned, it was seen that out of 36 students, 55.6% complained of presence of pain. Out of the 20 students who reported pain, 70% had a score lower than 7.5 on ergonomic score assessment (indicative of bad ergonomics). When the male students were considered, out of 29 students, 65.5% reported presence of pain. Out of the 19 students who reported pain, close to 79% demonstrated bad ergonomics.
Conclusion: There is presence of musculoskeletal aches and pains in this underprivileged section of the society, including demonstration of bad ergonomics and postures while performing activities in school. Thus, musculoskeletal health problems exist in urban slum schoolchildren. It is important to identify health problems at an early stage in both boys and girls. Children are the future of the nation and hence, identification of health issues early in life and preventing them from becoming chronic is of utmost importance.

Citation: Rajan P, Koti A. Ergonomic Assessment and Musculoskeletal Health of the Underprivileged School Children in Pune, India. Health Promot Perspect 2013; 3(1): 37-45

Introduction

Musculoskeletal health of young children of school going age is a point of global concern in today's world. "Undernourished and frequently sick children do not learn well at school and often drop out early." (Page 286)[1]. In a recent paper by Zernikow et al., 2249 children were followed for 5 years and it was seen that most of the children suffered from chronic pain[2]. Prevalence of musculoskeletal pain in schoolchildren, as young as 7 years of age, has been reported[3]. A study in Iran particularly looked at the prevalence of musculoskeletal pain among 307 primary school children. It was alarming to find that

86% of the children reported presence of musculoskeletal symptoms at the younger ages between 7 to 12 years[3]. However, it has been seen that knowledge sharing in the form of ergonomic training could prove useful in prevention of musculoskeletal pain related to bad postures[4]. In resource-limited developing nations, the urban slum dwellers form a special population. They are not able to lead a healthy life due to poor living conditions, unhygienic environment and lack of knowledge and access to education and health services[5]. Thus, it is extremely important to cater to the needs of this population of underprivileged families, especially children of school going age and their families.

Children coming from low socio-economic status are more prone to violence, and unhealthy habits like alcoholism[6]. However, over the years, it has also been seen that appropriate rehabilitation techniques like imparting knowledge using play therapy[7] and psychosocial stimulation[8] early in life could help the underprivileged children. Exercises using play therapy used in under privileged African children seemed to reduce violent behavior during adolescence[9]. These children have better emotional control and are less likely to indulge in unacceptable and unhealthy behaviors later on in life[8]. While there are studies on the health outcomes in school going children belonging to the higher socio-economic statuses in India[10,11], published work on the physical and emotional health of the children belonging to lower economic classes in India, especially using different and unique rehabilitation techniques, is seldom. In addition, living in the slums increases the morbidity, making them more prone to developing chronic diseases, having a poor quality of life and increasing the burden on the existing healthcare system[12].

Ergonomics is the science of work. It is important to study ergonomics because faulty ergonomics has been known to cause musculoskeletal aches and pains[4]. Ergonomic assessment, especially in schoolchildren, is gaining ground as the activities and the postures used to perform those activities could be one of the reasons for prevalence of pain in this young population, which leads to chronic pain in adulthood[3,4]. Underprivileged schoolchildren are more prone to aches and pains, as they live in unhealthy living conditions[12]. Thus, it is of importance to assess the ergonomics of schoolchildren living in the slums.

The authors of the current study interacted with slum dwelling schoolchildren from Vadodara, Gujarat, India in 2012[13]. The information gathered from these interactions led to the development of tools for data collection[13]. In addition, a comparative pilot study between underprivileged schoolchildren from two neighboring cities in India, Vadodara and Pune revealed that the schoolchildren in Pune not only demonstrated bad ergonomics but also had higher prevalence of pain[14]. Hence, it was important to assess the schoolchildren in Pune for their ergonomic behavior and prevalence of musculoskeletal pain.

The objective of the current study was to assess ergonomic behavior and musculoskeletal health in urban poor schoolchildren in Pune, India.

Materials and Methods

The study recruited the underprivileged school-going children (both boys and girls) in Pune that were being rehabilitated by Colorss Foundation-a Non Government Organization. Only those subjects who fulfilled the recruitment criteria (please see below) were included in the study.

Participants

The participants were included in the study based on certain inclusion and exclusion criteria. Those who attended the school for underprivileged children in Pune, India and came under the umbrella of Colorss Foundation were included. Those who were unwilling to be a part of the study were excluded.

The total number of the students at the school that came under the umbrella of Colorss Foundation was 75 students (42 girls and 33 boys), excluding those who were included in the pilot study. Hence, this study aimed to assess the ergonomic behavior of 75 students.

Ethics approval was obtained from the Board at Colorss Foundation. Permission was obtained from the school, which the underprivileged students attended. The assessment sessions at the school were attended by the school staff as well as the staff at Colorss Foundation.

Data collection

The data was collected by two volunteers, who were specially trained to assess ergonomics in slum schoolchildren. The study was conducted at the school for underprivileged children in Pune, India, between Septembers to December 2012. The assessment days were Monday, Tuesday, Thursday and Saturday for one hour each day. A classroom was separately assigned for collecting data. Data collection was done in presence of school staff.

The ergonomic assessment tool was developed based on inputs from the focus group discussions and workshops with underprivileged students[13]. The face validity of the tool was obtained from three experts. The tool was checked for reliability using split half method. It was found to be reliable (r=0.88).

The five activities that were assessed were reading a book, lifting books from the floor, sitting on a chair, carrying a backpack and using a computer. The equipments that were used to assess these activities were school chair, school table, schoolbooks and the participant's backpack. For the activity on book reading, the participant was given a schoolbook and the posture (with emphasis on position of the back, the neck, the shoulders, and the elbows) while reading the book was assessed. When the participant was assessed for lifting books from the floor, the major factor that was considered for good versus bad ergonomics was use of the knees and the back. Use of knee bending more than bending from the back was scored higher (good ergonomics) while assessing this activity. Sitting with a straight back and upright neck was graded better than slouched posture and forward head. When the activity of carrying a backpack was assessed, use of both shoulder straps was graded better than use of one strap. Since the computer lab was not available during assessment days, the participant had to simulate using a computer. This activity was graded based on posture of back, shoulders, neck, elbows and wrist/hand. A slouched posture with forward neck and forward shoulders with unsupported elbows and wrists were considered bad ergonomics and scored lower. The musculoskeletal pain, the information on previous surgeries and current pain medications were self-reported by the participants.

Scoring of ergonomic assessment

The assessment tool had two photographs for each activity one representing good posture (thus good ergonomics) and the other representing bad posture (representing bad ergonomics). The assessor marked the students based on which posture in the photograph resembled the postures used by the participant. In addition, the assessors underwent special training conducted by a community physiotherapist to identify good and bad ergonomic postures in urban slum children.

For every activity, each student was given a score of 1 for bad ergonomics and a score of 2 if s/he performed the activity with good ergonomics. Thus, each student received a score out of a maximum of 10 and a minimum of 5 (since five activities were assessed). The score range was between 5 and 10, with 7.5 being the middle point of the scoring scale. A score more than 7.5 (scores of 8, 9 and 10) was graded as good ergonomic behavior. A score less than 7.5 (scores 5, 6 and 7) was graded as bad ergonomic behavior.

Statistical analyses

Statistical analyses were done using Microsoft Excel Office 2007. Data is presented as simple percentages.

Results

Out of 75 students, 8 students were busy with their exams during the days when the data was collected. Hence, they were unavailable for ergonomic assessment. In addition, 2 of them were unwell and hence not present at the school on the data collection days. Thus, the ergonomic assessment was done on 65 students. There were 36 girl students and 29 male students who completed the assessments. Majority of the students (approximately 90%) were studying in 8th standard; about 9% were studying in 7th standard. One student was studying in 9th standard (Table 1).

The children came from low socio economic background, with majority of the fathers working as drivers (close to 25%); while most of the mothers worked as house helpers (approximately 57%) (Table 2).

Table 1: Table showing participant characteristics

Characteristic	Male students (n=29)	Female students(n=36)
Age*	12.9±0.9	13±1.1
Standard 7**	1	5
Standard 8**	28	30
Standard 9**	0	1

*Expressed as average (yr) ± standard deviation
** Number of participants

Out of 65 students, 36 (close to 56%) reported presence of musculoskeletal pain and 21 did not report musculoskeletal pain. In addition, 8 did not answer this question (Table 3). However, only 13 students (out of 65) were currently taking pain medications.

A. School boys:

The assessment of male schoolchildren was done using a validated pictorial manual, evaluating five different activities commonly done at school [13]. It was seen that the age ranged from 11 to 15 years.

Table 2: Table showing the occupation status of parents of the participants

Parent	Occupation	Male students (n=29) %	Female students(n=36) %
FATHER	Carpenter	3.5	8.3
	Construction Worker	10.3	8.3
	Driver	34.5	16.7
	Helper	13.9	27.8
	Salesman	6.9	2.8
	Farmer	3.4	0.0
	Painter	10.3	0.0
	Teacher	0.0	2.8
	Watchman	0.0	19.4
	Unemployed	3.4	0.0
	Not mentioned	13.8	13.9
MOTHER	Construction Worker	3.4	11.1
	House help	62.1	52.8
	Helper outside home	6.9	16.7
	Home maker	24.1	16.7
	Farmer	0.0	2.7
	Not mentioned	3.5	0.0

Table 3: Table showing the pain characteristics of the male and female participants

Characteristic	Male students (n=29)	Female students(n=36)
Duration of pain*	1.8±1.6	1.0±1.0
Presence of musculoskeletal pain	65.5%	55.6%
Low back pain	35.3%	36.8%
Knee pain	17.6%	5.3%
Neck pain	17.6%	26.3%
Ankle and foot pain	23.5%	21.1%

*Expressed as average (years) ± standard deviation

Majority of them were studying in standard 8th (almost 97%); one student was studying in standard 7th. It was noted that 66% reported presence of musculoskeletal pain (Table 3). On further interaction, it was noted that 7 children were currently taking pain medications while 2 had undergone musculoskeletal surgery.

B. School girls:

The assessment of female schoolchildren was done using a validated pictorial manual, evaluating five different activities commonly done at school [13]. The age ranged from 11 to 16 years. Majority of them were studying in standard 8th (approximately 83%); 5 students were studying in standard 7th and one student in standard 9th. It was noted that 56 % reported presence of musculoskeletal pain (Table 3) and 6 children were currently taking pain medications while 4 had undergone musculoskeletal surgery.

Ergonomic assessment

Five activities were assessed for all students who agreed to be a part of the study. These activities included reading a book, lifting books from floor, sitting on a chair, carrying a two-strapped backpack and using a computer.

1: Posture of the student when s/he reads a book

It was seen that 55.4% of the students demonstrated bad ergonomics. Of these, majority of the students were females (20 out of 36).

2: Posture of the student when s/he lifts books from the floor

While assessing this activity, it was seen that 78.5% of the students did not have good ergonomics (lifting books with back bent posture). For this assessment, females demonstrated bad ergonomics as compared to male students by a small percentage (2%).

3: Posture of the student when s/he is sitting on a chair

On performing the assessment, it was found that 67.7% of the students carried out the activity using bad ergonomics (slouched posture during sitting). As seen with activity 1, even with this activity assessment, female students had worse ergonomics (24 out of 44).

4: Carrying a two strapped backpack (use of both straps or just one)

Students demonstrated better ergonomics with this activity (only 26.2% used only on strap). In this activity as well, female students demonstrated bad ergonomics (64.7%).

5: Posture during use of computer

While 50.8% of the students had bad ergonomics when it came to maintaining a good posture during use of computer, male students seemed to have worse ergonomics as compared to females (17 out of 32).

Ergonomic assessment score

Majority of the students (63.1%) received a score less than 7.5, indicative of bad ergonomics. Of these, 21 (out of 41) were female students. In addition, 63.4% of these students with poor ergonomics reported presence of musculoskeletal pain.

As far as the female students were concerned, it was seen that out of 36 students, 55.6% of the students complained of presence of pain. Out of the 20 students who reported pain, 70% had a score lower than 7.5 on ergonomic score assessment (indicative of bad ergonomics). When the male students were considered, out of 29 students, 65.5% reported presence of pain. Out of the 19 students who reported pain, close to 79% demonstrated bad ergonomics.

Discussion

This study looked at the musculoskeletal health problems related to school activities in the underprivileged students in Pune, India. It was seen that there was high prevalence of musculoskeletal pain in these students and the ergonomics while performing activities at school was poor. It was seen that 56% of the students complained of presence of musculoskeletal pain. Musculoskeletal pain in school children has been reported in earlier studies as well. In a study done on 3376 school children, it was seen that close to 45% reported pain[15]. However, this study was done on adolescent children aged 17 years, which is older than the age group in the current study. In a couple of studies, 18% reported presence of musculoskeletal pain[1,16]. In another study by Roth-Isigkeit et al. on 749 schoolchildren, it was seen that 83% complained of acute onset (less than 3 months) pain[17]. Jayratne et al. reported 36% prevalence of musculoskeletal pain among Sri Lankan schoolchildren[18]. Thus, it can be said that the presence of musculoskeletal pain is prevalent in schoolchildren and this was a similar finding in the current study as well. However, the above studies were conducted on schoolchildren from the privileged section of the society and there has been seldom research on schoolchildren in India, specifically underprivileged school children in India.

The present study found that there was presence of musculoskeletal pain and bad ergonomics in 35% of the students. In the longitudinal study by Jacobs et al, it was seen that ergonomic education over a span of six years resulted in reduction in musculoskeletal pain[4]. In another study, it was seen that ergonomic education could help schoolchildren in reducing the chances of developing musculoskeletal pain[19]. Bad postures were associated with presence of musculoskeletal pain[20]. Due to the cross sectional nature of the current study, it would be difficult to conclude if there is a relationship between bad ergonomics and presence of musculoskeletal pain, although it has been proved in previous studies.

Another major finding in the study was the bad ergonomic behavior with common activities performed at school. It was seen that except for the activity of carrying a backpack, on an average, approximately 60% of the students demonstrated poor ergonomics. Carrying an appropriately sized backpack does not cause shoulder or low back pain[25]. Although the weight of the backpack was not measured in the current study, the students performed the activity of carrying a backpack with good ergonomics, probably due to the appropriate weight of the backpack. Poor ergonomics among school children has been noted in previous studies as well[18,19-21]. The finding in the current study is in line with the previous studies. Nevertheless, majority of the previous studies have looked at schoolchildren from higher social classes. It would be interesting to look at the comparison in the ergonomic behavior and prevalence of musculoskeletal pain in school students belonging to different socio-economic status.

Gender differences have been noted in symptom reporting by adolescent and preadolescent children, with most previous studies showing more prevalence of musculoskeletal disorders among female students. However, the present study found that female students reported lesser prevalence of pain despite worse ergonomics as compared to male students. A study was recently done on 2558 Spanish schoolchildren by Romero-

Acosta et al.[22]. It was found that Spanish female students tended to report more musculoskeletal symptoms as compared to male students. The study on 1155 Swedish children reported no gender differences for musculoskeletal pain[16]. Male and female students both reported presence of musculoskeletal pain; however, the triggering factors for the same were different environmental factors (like weather, and family conditions) for females and physical exertion for males[17]. There are many factors causing musculoskeletal aches and pains in young school going population. However, this falls outside the purview of the current study.

While some public health researchers have recommended using novel strategies to help raise funds for health programs to benefit slum dwellers[23], some others have suggested developing cost effective solutions[24]. In our study, the data collection was done by volunteers hence no recruitment fee was involved. In addition, the only cost involved was to print copies of the 10-page manual for 65 subjects (less than Rs. 700 or 14 USD). It is especially important to design cost effective strategies in countries that have lesser availability of funds and resources.

This study had certain strengths. The intervention for schoolchildren was done in presence of the school staff, thus increasing the knowledge and motivation of school staff about ergonomics and musculoskeletal health. A cost effective method was employed to identify problems. This was a single blinded study where the volunteers collecting the data were blinded to the expected outcomes of the study. One of the major limitations of the study was that the musculoskeletal pain was self reported and not objectively tested. Future research could be done using objective scales for pain assessment. In addition, the families of the children were not involved in the study since the data collection was done during school hours. The involvement of parents in the prevention of musculoskeletal aches and pain among young schoolchildren could prove effective[25]. Hence, it could be interesting to conduct a similar study on the perspectives of the parents about good ergonomics and healthy life. Since the current study was a cross sectional study, it would be difficult to establish the relationship between presence of musculoskeletal pain and poor ergonomic behavior. Future research needs to be done in order to look at their relationship. The sample size for this study was less since 32 students from this school were already assessed for another study[14] and ten students were not available at the time of data collection. In addition, the children had to be rehabilitated by the NGO, to be included in the study. Due to these reasons, the sample size was less. Nevertheless, this study helped in identification of bad ergonomics in this sample and gave directions for future interventions.

Children play an important role in the population dynamics of a country. "Childhood is important in its own right, but children also represent the future: they are the adults (and the parents) of tomorrow. Because of their vulnerability, children deserve particular care and protection from society, and their right to this protection, enabling them to enjoy life, health, identity, education and other fundamental goods…." (Page 185)[26]. It is important to look into the health problems of the children. "The promotion of child health requires action at the level of the individual, family, school and society and demands cross-disciplinary and intersectoral collaboration". (Page 185)[26].

Conclusions

Musculoskeletal health problems exist in urban slum schoolchildren in Pune, India. These students also demonstrated bad ergonomic behavior with most of the activities at school. It is important to identify health problems at an early stage in schoolchildren, so that chronic health problems in later life could be prevented.

Acknowledgements

Deep gratitude to Colorss Foundation for ensuring smooth progress of the project and getting approval from the school. The study could not be successfully completed without the subjects, who showed willingness to be a part of the study and the volunteers working for Colorss Foundation who helped at every stage of the study. Special mention of Ms. Stuti Prasad and Ms. Rachita Kapoor for their help with data collection.

Competing interests

The authors declare that there is no conflict of interests.

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