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Schoolbag-Weights and Musculo-Skeletal Complaints in Three Schools In Rural Maharashtra

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ABSTRACT

Introduction: Heavy school-bags and the musculo-skeletal complaints are common concerns across countries, but Indian rural studies are scant. This rural study was undertaken to explore school-bag weights, and association of bag-weights with reported pain/discomfort.

Methods: This is a cross sectional study covering 261 students (m 128, f 131) in 8th and 9th divisions in 3 rural schools in Nashik district. Standard procedures were used for anthropometry and school-bag weights. Reported musculo-skeletal complaints were ascertained with structured questionnaire. Teachers were interviewed. Excel and Epi-Info were used for analysis.

Results: Average schoolbag-weight was 3.7kg.47% schoolbags weighed>10% bodyweight. More girls than boys had heavy bag-packs and musculoskeletal complaints. Heavy school-bags and musculoskeletal complaints showed association with Chi-square; but a t-test showed no association of musculoskeletal complaints with product of bag-weight and walking-duration; while domestic /farm work were confounding variables. Teachers were aware of bag-weight guidelines and health issues but not about the problem in their schools.

Conclusions: Despite awareness, these rural schools had sizeable proportion of heavy bags. Hence counseling of stakeholders and reworking classroom schedules are necessary for safety limits.

Key words: School-bag weights, Back pain, Musculo-skeletal complaints, Bodyweight

INTRODUCTION

Education has progressed from Gurukul to Day Schools and teaching tools from slate to books. Books are increasing in number and becoming bulkier. At the same time extra-curricular activities are gaining importance, adding to the already academically loaded school-bags. Drinking water and lunch boxes add to the existing load. Transport may or may not be available depending on the location of the school (urban/rural).

Systematic reviews as well as media reports have brought out the widespread global problem of increasing schoolbag weights, the link with musculoskeletal pain and other harms, and the safe load limit for schoolbags.[1-12]

The schoolbag loads and safety limits are routinely expressed in terms percentage of bodyweights to adjust for gender and age across school standards. The safety limits for bag-loads vary across countries from 10-15% and there is no universal limit.[5, 13]In India, CBSE circular regulating schoolbag weights does not put a safety limit, [14] whereas Government Resolution (GR) of Maharashtra mentions standard-wise upper limits and 3.4 kg bag-weight and for class 8th.[15]The weighty schoolbag, most often a backpack, may strain muscles and bones of neck, back and shoulders and may dam-

age spine because of ongoing process of ossification. This study was undertaken for two reasons. First, there is now governmental effort to limit schoolbag weights in India and the state of Maharashtra, but its impact is still largely unknown.[14, 15]Secondly as most of the Indian studies mentioned are urban, there is a need to explore rural side of the problem.[1-4]This cross-sectional study explored both these issues. The main objectives of the study are: (a) Estimate weights of schoolbags in rural primary and secondary schools with regard to the safety limit of 10%-bodyweight and the upper limits imposed by the Government of Maharashtra (b) Record any current or reported health complaints (pain or discomfort in back, shoulder or neck) and explore its possible association with heavy schoolbags. (c) Understand efforts of school authorities to minimize school-bag-weight and its adverse health impact.

METHODS

This study was conducted in parts of Igatpuri block of Nashik district having both tribal and non-tribal population. The selected schools were from three villages in the field practice area of a rural Medical College, close to Mumbai-Sinnar-Nagpur highway and 40 km away from the main city. Most of students commute variable distances from homes. No urban high school or convent schools are within 30 km perimeter of this institute and most students attend local schools run by Zillaparishad or grant-in-aid schools run by charitable trusts. All three schools were under Maharashtra State board of Secondary Education. Ethics Committee approval was obtained. Consent of school authorities was taken. Informed consent of the students was also obtained.

Sample Size Calculation: The desired sample size was estimated on Open-Epi version 3, using proportion of musculoskeletal complaints among students to be 60%,[1] and absolute precision of 6%. Total sample size estimated was 253.

Inclusion Criteria: The directives regarding schoolbag-weights concern 1st to 8th standard, which is the domain of Right to Education (RTE) regulating primary education. The primary schooling starts at 6 years of age and ends in 8th standard. The secondary schooling starts in 9th standard. The study included 8th standard, which is the upper end of the primary schooling and the RTE ambit. But since ossification of bones is still ongoing, 9thstandard was also included. Thus, in the current study, boys and girls of 8th and 9thstandards, in the age group of about 13 and 14 completed years were included. All students attending on the visit day in selected division were included. The visits were conducted in mid-week to ensure maximum attendance. In one school, absentees in 9thstandard were remarkable (31 absentees out of 109); hence the school was revisited to cover missing students. In other schools and divisions the absentee was less than 10% and hence no repeat visit was done. Together the study included 128 students from 8th and 135 from standard 9th.

Time frame: This study was undertaken in August and September 2016, nearly two months after schools opened in second fortnight of June 2016, to ensure that students were exposed for adequate duration to the their schoolbag weights. The study was done in pre-lunch session.

Enquiry, anthropometry and bag-weights: The investigating team had three members. To avoid possible prior instructions by teachers to students regarding bag-weight reduction, schools were visited without prior intimation. In the systematic review, Dockrell S et al. mentions that some studies blinded the participants and their parents to the timing of the study to avoid bias due to prior information.[5]A survey form was used for enquiry and measurements. Students were explained the study and about forms and the process of measurement. It was ensured that all of them repack and bring the schoolbags just like they bring it from home. Total time of walking on foot from home to school and back was enquired, apart from any vehicular transport time. For doubtful or ambiguous answers, their friends and class-teachers were asked to ascertain the time-distance. Students were asked about daily domestic or farm work, the nature of work in brief and approximate duration.

Body weight was recorded on a digital weighing scale, with usual school clothes on but no footwear and belt. The school-bag, with its full contents, was weighed on a baby-weighing machine. Both weighing scales were checked at the start of weight recordings, against pre-weighed dry sandbags wrapped in plastic. The digital weighing machine (OmronHN-283 serial number 201109-02704F) did not show variation once adjusted for plane with spirit level. The baby weighing machine had to be readjusted for zero level. The height was taken with a stadiometer fixed on wall.

Each student was asked about any current or past 2months' musculoskeletal discomfort in neck-shoulder, back or waist. If the answer was positive, he/she was asked about (a) Reporting of pain/discomfort to either parent (b) Current status of the pain (c) Treatment taken in the period for last two months. The pain/discomfort in neck-shoulder-back was ascertained positive only if he/she answered positively for one or more of these three questions. No school health records were available to verify this or related complaint in this or last year.

The student was also asked later regarding (a) if the schoolbag was felt as heavy or light or just alright and also (b) which day of the week it is heaviest. This helped to check if the day of study is not a light bag day. A random check was done on 10% schoolbags for the weight of academic and other contents-books, notebooks, compass box, bottle etc.

Interviews with teachers: Teachers were interviewed about (a) awareness of schoolbag directives regarding weight (b) efforts to reduce bag-weights (c) health impact of heavy bags (d) did anyone check bag-weights anytime against 10% body-weights? (e) Does the medical team RBSK (Rashtriya Bal Swasthya Karyakram) visited the school and if there were health records kept by the RBSK team (f) did the teachers have any suggestions to lighten the school-bag burdens if any. Results of the study and implications have been shared with schools, for appropriate efforts.

Statistics: Excel was used for entry of data and later EPI Info 7.2software for analysis. Chi square test was used for testing association of pain/discomfort in neck-back-shoulder region and higher bag-weights. The bag-weights and body-weight differences among classes and for gender differences were tested with difference between means. Association of pain and discomfort with product of bag-weight and duration of walking was tested by difference between means.

RESULTS

Students from three rural schools participated. Out of 305 students 236 participated in the study in first visits and 25 of absent students were included subsequently making the total 261 (Standard 8th, girls 62, boys 64 and Standard 9th girls71, boys 64). Some student absentees were reported to be habitual either because of long walking distances or unsupporting families.

Most students had to walk variable distances from their homes; though some had facility of public bus for part of the distance. The mean walking distance was 40 min (S.D. 35). The distribution is skewed and the range was 2 min to 180 min. seven students were using bicycles. In the state of Maharashtra, girls have free school-bus ride but boys have to pay fare for the same bus.

Table 1 indicates that there is no significant difference in the bodyweights of boys and girls in each of 8th and 9th standard (p>0.05), but there is a significant difference in the weights of school-bags of girls and boys (p<0.05) for both standards separately.

Graph 1 shows distribution of bag weights as percentage of body weight among all students. It is seen that 39% students had bags between 10-15% of bodyweights, while 8.43% students had bag weights heavier than 15%. Thus together 47% brought heavier bags.

Table 2 shows that72 girls and 52 boys out (n=124 or 47%) of all 261 students, had bags heavier than 10% of their bodyweights.

Table 1: Body weights and bag-weights of students

Standard & Gender	Bodyweight Mean± SD (kg)	P value	Bag-weight Mean± SD (kg)	P value
8th				
Girls	36.2±7.9	0.44	3.5±0.9	0.04*
Boys	35.21±6.5		3.2±0.8	
9th				
Girls	40.51±6.5	0.15	4.5±1.0	<0.01*
Boys	38.79±7.5		3.6±0.9	

*Statistically significant (p< 0.05)

Table 2: Association between schoolbags more than10% of bodyweight and discomfort/pain

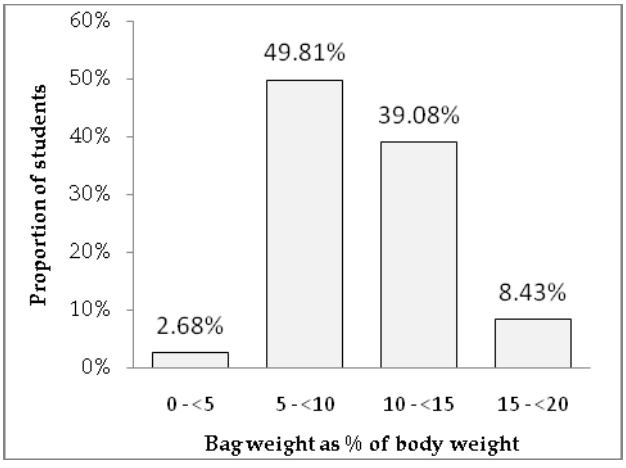
Bag weight category	Pain	No pain	Total	P value
Girls				
> 10% of bodyweight	22	50	72	0.031*
< 10% of bodyweight	9	52	61	
Boys				
> 10% of Bodyweight	3	49	52	0.08
< 10% of bodyweight	12	64	76	

*Statistically significant (p< 0.05)

Table 3: Product of duration of walking and bag-weight for students with or without reported pain (data of students who walk >10 minutes)

Pain/ discomfort	N	Product of Bag weight(kg) hours of walking (Mean± SD)
Present	46	2.8827± 2.079
Absent	215	2.3557±2.4413

Z=1.51, p=0.07 single tailed



Graph1: Distribution of students by bag-weights

Graph 2: Domestic/farm-work and reported musculoskeletal discomfort/Pain

The range of bag-weights as percentage of body-weights was observed to be 3.6% to 18.2%. All the three schools had this problem of heavy bags. All but one student had bag-packs with straps. One student brought books and notebooks in a polythene bag. Most students carried the bags on back when on foot or on bicycle.

Table 2also shows the distribution of students with heavy bags (>10% of their body weights) in relation to musculoskeletal pain/discomfort. The association between heavy bags and musculoskeletal pain was positive in case of girls when tested for statistical significance. The Risk Ratio is 2.07 (CI 1.032-4.16). However the association between heavy bags and musculoskeletal discomfort/pain was not seen in boys. The Relative Risk is 0.365 (CI 0.108 – 1.231).

The relation of reported pain or discomfort with subjective feeling of heaviness of bags was explored. Total 178 students reported about heaviness of bags. The association of perception of heavy bags and actual weight being >10% of bodyweight was found to be positive (Risk ratio 1.67, Chi square 11.87, p=0.0005 S**). Further among the 108 exposed to heavy bags 31 had pain/discomfort. Among the70 unexposed, 9 students had reported pain/discomfort. Thus the subjective feeling of heaviness of bags was positively associated with reported pain/discomfort (Risk Ratio: 2.23, Chi square= 6.12, p=0.013* at df1).

Table 3 shows that there was no significant difference between the product of bag-weight (kg) and hours of walking among those who had and those who did not have pain/discomfort. The distribution of this product variable is skewed. The groups with pain and no pain have been compared for difference between means of the product as independent samples. The difference was not significant statistically. But it is worthwhile to mention that p= 0.07, is marginally less than the level of significance (0.05)

Graph 2shows that most students did some work or other. Over 90% girls do some kind of domestic work like cleaning, washing of clothes and utensils, cooking and some fetching water in both pain and non-pain categories. Some girls also help on farms, but farm-work was linked with boys more. More than 80%boys'also worked in both categories, on farms included irrigation channeling, fodder cutting, giving fertilizers and crate-loading of vegetables for transport and marketing. The farm-work was seasonal, and this season was on at the time of the study. Some students assisted their parents in non-farm manual labour on holidays.

Most students brought drinking water bottles along with books. The bags of 9th standard were heavier; probably due to lunchbox as Mid-day meal is limited to 8thstandard. When 10% subsample was checked for contents of bags, it was found that the average weight of books and notebooks was 2.8 kg, while the average weight of the rest of the bag was 1.5 kg.

Interviews with Teachers

Headmasters/principals from all three schools were interviewed at the end of the student survey with questions listed. The interview revealed that all teachers were aware of the health problems due to heavy schoolbags (damage to spine in tender age) and that Government had issued circulars to eliminate the problem. The Government GR circular was limited to standard 1st to 8th since the RTE (right to education) under *sarvashikshaabhiyan* was limited to 8thstandard. All teachers were aware of this GR but not about the upper limits for bag-weights. All of them had taken active efforts to reduce bag-weights by (a) rearranging timetables (b) asking students to avoid unnecessary baggage (c) asking some students to keep some books and notebooks in the school under the desk, this was especially mentioned in school C. All of them requested to keep the bag-weight information confidential since action could be taken against them in of non-compliance with the circular. All of them had instructed class-teachers to periodically weigh the bags and adjust it to less than 10% of body-weight. All of them felt that the problem of weighty schoolbags is under control and no case would be found. After informing about the weighty schoolbags of some students, particularly in school B, the Headmaster informed us that girls perhaps carried more books and notebooks just to make sure nothing is missed or they have little time to rearrange the bag due to domestic work. RBSK records were not available in any school, except dates of visits in a notebook.

DISCUSSION

This study explored schoolbag weights in relation to bodyweights and any association of the weighty bags with musculoskeletal discomfort/pain experienced by the students in the last two months. The sample of 261students was adequate against the required sample size of 72 for each standard (hence 144). This being essentially a convenience sample, the interpretations are limited to the sample itself. Yet it is reasonable to assume that these schools were no different from other rural schools in the district following the same state board curriculum and examination pattern.

Table 4 summarizes some studies on school-bag weights, including Indian studies. Since all these studies are urban, the schoolbag load may be misunderstood to be an urban problem, probably also a private sector problem.[1-4]However due to covert academic competition with these schools, even the larger sector of government schools and rural schools are bound to be affected by this problem. For any diagnosis of this problem of proportional bag-weights, the profiling of bodyweights is the primary step.

Table 4: Summary of Some Studies highlighting school-bag weight issues

City	Year	Author	Age group and sample size	Reported Bag-weight as % of bodyweight-boys, girls	Musculoskeletal pain - boys, girls	any other
India-Chennai	2014	Balamurugan J.[1]	6-12 yrs, 510	16.31,16.22	60.6%, 65.7%	54.7 % students carried schoolbag >15% of their bodyweight
India Bangalore	2012	Sharan D et al.[2]	12-16 yrs,22 Selected on pain-injury criteria	All >15% bodyweight	All	-
India Pune	2013	Hundekari J et al[3]	9-14 yrs, 87 students from CBSE school	56% student >10% bodyweight, another 31% student bodyweight	NA	Postural changes noted with higher bag-weight
India Amritsar	2010	KoleyS et al.[4]	6-15 yrs, 300	Heaviest bag-weights in age group 10 about 16% of BW declining to < 10% in youngest 6yrs and eldest 15yrs	NA	Postural impact noted
Systematic Review involving multiple countries	2013	Dockrell S et al.[5]	NA	NA	No evidence of association with bag loads	Safety limit varies from 10 to 15% of bodyweight.
Iran, Tabriz	2010	Dianat I et al.[6]	7-12 yrs, 307	10.1% of BW	86% children reported pain	

Bodyweights of girls in this age group were more than those of boys and this effect was expected and attributed to hormonal changes around menarche. Koley and Kaur also observed that girls were heavier than boys and so does the GR.[4,15]However boys and girls in this study population are shorter and lighter as compared to ICMR height-weight chart for the same ages.[16]It is possible to say that this group seems to be poor on growth due to nutrition and/or physical toil factors. The lower weights and heights make children in this group more vulnerable to harm from bag-loads.

The safe limit for bag loads is variable from 10-15% in various country studies.[5,13]Some Indian studies have used 15% level for analysis and report sizeable proportion of students carrying bags with >15% of their bodyweights, especially Chennai (54.9%) and Bangalore (100%).[1,2] The Pune study suggests 10% as the safe limit for bag-weights.[3]The present study has used the 10% limit for analysis since the GR concurs on this limit.

In this study 47% bag-weights exceeded 10% of bodyweights of students. Even if GR criteria for 8th standard of 3.4 kg as maximum upper limit is used, 71 bags (56%) weigh less than or equal to 3.4kg and 55 are heavier than 3.4kg. [15]Study conducted by Dockrell S. et al in Dublin, shows that 68% of the schoolbags weigh >10% body weight where mean age of students was 13.1 years.[7]In multiple studies it has been observed that schoolbags of all the participants weighed in the range of 10.3.% to 13.2% of their body weight.[8,9,17]. A study conducted in UK observed the median average load to be 9.7% of body weight.[18]

Graph 1 shows that all three schools in the study had the problem of heavy schoolbags. Hence this must be a common problem to other schools. Thus, the study signals that even rural schools suffer from this problem and moreover rural students have to walk longer distances (mean 40 minutes, range 2-180 min)) with these loads. The problem of higher than permissible bag-loads is as common in RTE regulated 8thstandard as it was in the second-

ary school standard of 9th. Both these age groups are also undergoing additional stress of domestic and/or farm work which are confounding factors. These findings are supported by numerous national and international studies which have encountered heavy school-bag-weights. [1, 2, 5, 13]

The finding that feeling of heaviness of bags as reported from recall, was actually associated with heavy bags (>10% of bodyweight) and also with reported discomfort/pain. This validates the questionnaire on recall. Perceived heaviness of the school-bag and its positive association with weighty bags was also observed by Ibrahim and Haselgrove et al.[17,19]However interpretation of perception of schoolbag weight varies in literature. [5]

The problem of weighty bags was seen more with girls than boys in this study. The possible explanation is that girls have less time to rearrange the bag according to timetable or they simply ignore the timetable of the day when filling the bag. Another reason could be more commitment to books and studies. This bag-loading has adverse implication to the health of girls, especially back and neck bones and muscles. Studies show that girls suffer more with same bag-loads due to shorter spine length, and perhaps smaller musculature. Many studies confirm that girls report musculoskeletal problems more than boys.[1,6,7,13,17] Kellis and Emmanouilidou observed that girls carried heavier bags than boys and were twice more likely to experience fatigue symptoms.[8] Ibrahim states that some girls bring more school items than necessary to take to school.[17]Hence much more vigil and care is necessary to limit schoolbag loads and damage in this group among girls.

The product of bag-weight with distance carried should be a more important determinant than bag-weight alone for musculo-skeletal problems. The current study indicates no significant association of product of bag-weight and duration carried with musculoskeletal problems experienced. Although the difference in the product of bag-weight (kg) and duration of walking (hrs) in the categories of presence and absence of pain/discomfort is statistically not significant, the z value (1.51) and probability (p=0.07) is on the margin of significance level. Hasselgrove et al. in a longitudinal study observed that almost 50 % of the participants reported carrying their school-bags for more than 30 minutes daily. The high duration / passive transport category reported higher rates of back and neck pain categories. [19] Systematic review conducted by Rai and Agrawal, revealed that both backpack weight and time carried influenced cervical and shoulder posture.[13]

The presence of neck-back-shoulder musculoskeletal pain was ascertained by a simple question and then with confirmatory question as discussed. This method has limitations of recall but the study finds a positive association between heavy bag-weights (>10% of bodyweights) and musculoskeletal pain in the student pool (261) as defined by the questionnaire. Similar findings have been observed in many studies. [6,9,17] This was evident in girls separately but not boys. However this association was not to be seen when product of walking time and bag-load was tested against pain-no pain. This suggests that walking time could be a major confounding factor. Haselgrove et al observed that physical activity in the form of walking or riding to school may offset the potentially provocative effects of prolonged bag carriage, but this relationship needs further investigation. [19]

A study in UK it was observed that children having part time job had a 60% increase in odds of reporting low back pain.[18] However, the factor of domestic or farm work had no impact on musculoskeletal pain in this study, probably because very few students are free from work. Whether musculoskeletal pain is influenced by routine domestic work can be investigated in a suitable case-control study design. The stress on shoulder, back and neck are also linked to several factors like habitual hard work, gender differentials in body weight and hence nutrition, time and distances to reach the school, facility of transport, bag design, habit of using straps, forward bend, lifting style, number of times the bag is lifted in the day, bench-design and so on. Urban and rural students have different work habits and nutrition levels.

All students carry a water bottle, adding a kilogram of weight to the schoolbag. Water supply in rural schools is neither regular nor safe. No school in this study has an RO filter or piped water from a filter plant. Therefore the water bottle is here to stay. A random check on 10% schoolbags suggested that major part of the bag-weight was academic contents namely books, notebooks, compass box etc. Therefore weight reduction needs to be done in both parts--academic and other objects like water-bottle or schoolbag design itself. No school had a locker facility for bags or books. Hence all students carried their bags from the homes

The teachers were aware about the issue of weighty bags, but were unaware that their schools still had this problem. Probably they do not have the time to weigh bags and advise the students often.

LIMITATIONS

Some literature indicates that low back pain could be psychosomatic in nature.[5, 13, 18,19]This aspect was not studied in research. Urban schools were not included in this study due to lack of consent from

concerned principals. This preempts any comparative analysis between urban rural schools. The survey was limited to age 13 and 14 years. Cross sectional studies cannot really analyze cause-effect relations. A pain-discomfort scale could not be employed and only qualitative enquiry was used.

CONCLUSION

Schoolbag weights, despite guidelines from school authorities, tend to be heavier that the prescribed limit (<10% of body weight) for 47% of the students. The reported pain/discomfort shows a statistically significant association with heavy bags in case of girls but not boys. However the confounding factors walking duration, used as product with bag-weight negates such association with reported pain/discomfort.

The GR sent by the education department to all schools is quite comprehensive and detailed. It states about harmful effects of bag-loads, the need to educate parents, teachers and students, and defined ways to reduce bag-loads, specifically mentioning (a) Re-scheduling of subject teaching from 6-7 to 4-5 each day so that book-load is reduced. (b) Following the safe upper limit set by the GR for each standard.

It is necessary to do more concerted efforts on this problem through student counseling, parent-teacher meets and timetable reforms to limit subjects taught each day. Providing students with safe drinking water with an RO filter can be another measure that could bring most bag-weights below 10% bodyweight. This will also ensure good investment in health. Some students suggested that half the books and notebooks can be kept under the desk and rest carried home. Stringent following of the GR guidelines will be instrumental in reducing the school-bag-weights and consequently the problems associated with it.

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