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A Study on the Backpacks of School Children (Aged 10 – 13 Years)

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ABSTRACT: This study aims at exploring the various challenges faced by students while carrying heavy schoolbags, to identify their needs, and to propose a new concept for schoolbag design so as to reduce the difficulty.

An exploratory study was conducted among 120 (58 girls and 62 boys) school going children aged 10-13 years (4th - 8th std) from 20 schools. The main objectives of the study are to study the characteristics and features of the school backpacks carried by the children. The tools for data collection was a self-constructed questionnaire, measuring of the physiological parameters (for 3 consecutive days), and visual analog.

The average age of the sample is 11.3 years, the body weight 32.9 kgs and the average weight of school backpack is 4.9 kgs. It is 1.6 kgs excess to the Children's School Bag Act, 2006 and Maharashtra School Education Department's circular, 2017 which states that the permissible weight of the bag is 10% of the child's body weight. 90% (108) reported that they experienced pain while carrying the bag for more than 10 mins [17 (14.2%)] which also interferes with the working ability of the children. Heavy and uneven loaded backpacks affect the spine and have long term ill effects. Parents and school jointly must keep a check on this aspect affecting the health of the country's future.

KEYWORDS: School backpacks, Students, Ergonomics, Posture, Maharashtra

I. INTRODUCTION

Children are expected to carry loaded bag everyday to and back from school and this may have a negative impact on the health of the growing children. Excessive and uneven loads increase risk of back pain and related discomfort leading to irreversible deformities and in the long term, abnormal curvature of spine

Backpack loads of school students during school days have been suggested to range from 10% to as high as 15% of their body weight and may have a negative impact on their bag.

(<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6267109/> accessed on 12.10.2019). Heavy schools may result in musculoskeletal and psychological problems among primary school children. The study was conducted to assess the weight of school bags in relation to primary school children weight. Children carrying heavy school bags develop Forward Head Posture (FHP) as they are bending forward at the hips to reimburse for the heavy weight on their back. This strains the muscles and in turn thrusts the body to go into an unnatural posture alignment and also causes low back pain(www.practo.com)

Bag features:

Features serve several purposes, one is to make school backpacks more useful and comfortable and secondly to make children's backpack a lot safer as well to add attractiveness of the design.

- Shoulder straps : backpack strap should be well padded and snug to avoid digging or slipping from the shoulder it should be also strong enough to carry books in the school backpack.
- Hip belt: hip belt in a school bag is important for holding the bulk of the bag, a good hip belt transfers weight of the kids from the back to the hips that reduces strain and increases comfort.

- Compartments: a big internal compartment in a school bag is important in loading essentials such as books or a laptop as well as an extra under zipper compartment for more space.
- Back Pads: padded back ensure the child's backpack are safe and comfortable.
- Zippers: it must be tough and proper sized safely covered and not broken. Double zippers that meet in the middle provides a backup
- Durability: good quality material ensures a lasting backpack so pull the seams apart to check for good stitching and tug the straps of the school bag to test for sturdiness
- Compression straps :all the dangling straps perform a valuable function such as bottom and crossover webbing ton keep backpack tight and compact for a balanced load.

A PIL (Public Interest Litigation) was filed on the weight of the school bag by Swati Patil., an activist from Pune, came up for hearing before the division bench of chief justice Pradeep Nandrajog and justice NM Jamdar, the bench sought to know what the issue was as they did not think the weight of school bags was more than what they used to carry when in school. In **July 2015**, after Patil filed a plea in the HC regarding the matter, a government-appointed committee had put a cap on the weight of school bags at 10% of the student's body weight(www.hindustantimes.com).

School students are at a risk of developing musculoskeletal discomfort or possibly long term backpain due to frequent exposure of carrying heavy schoolbags.School children are responsible on carrying their own schoolbag and so it is important for each student to carry their schoolbag in such a way to avoid back pain or musculoskeletal disorders.

Posture is the main concern mainly due to the weight of the backpack carried by the youth. Carrying heavy, oversized backpacks may cause serious spinal deformities among the young children..It is thus a pressing issue that requires immediate attention. 120 school children aged 10 – 13 years were observed for the posture adopted to investigate the discomfort experienced while carrying the heavy backpacks. The specific objectives were to: (i) study the characteristics and features of the school backpacks; and (ii) understand the discomfort experienced while carrying the heavy backpacks. The Visual Analogue Scale (VAS) is a psychometric responsescale which was used to collect the primary data of school going children. It is ameasurement tool for subjective characteristics or attitudes that cannot bedirectly measured. The amount of pain that a child feels ranges across acontinuum from none to an extreme amount of pain which is taken from thechild's perspective to measure the pain and aches while carrying school backpacks.According to the pain measurement scale only4(3%) children has no pain, 11(9%)has mild pain, 53(44%) has moderate pain, 55(46%) has severe pain,23(18%) hasworst pain. Also 44(37%) experienced pain daily, 44(34%) had pain on alternatedays, 32(27%) had pain weekly, 2% had no pain at all.

Studies on the weight of the backpack, suggest a weight that is 10% to 15% of the body weight. Mackenzie et al. believe that backpack weight more than 15 to 20 percent of a child's body weight is relevant to back pain. Alwiah et al. understood that carrying heavy backpack with a load weighing from 15-20% of the body weight will result in an increased deviation angle of the upper body.However some researchers believe that even carrying 10% of the body weight may cause injuries.In Iran the statistics show that 57% of the students carry backpacks weighed more than 10% of their body weight. The results show that 24.6 % of students use only one shoulder strap backpacks.

Based on the outcomes of the assessments, changes were conducted in the initial backpack and the final backpack was designed and named the UCD backpack. So with keeping ergonomics features, the measurement of backpack became larger in redesign concept. Results also revealed the low rate of gratitude of the backpack's performance in both girls and boys.So, the backpack must be more simple for use. According to the behavior of students, the inner shelves were eliminated due to complexity and the largest part of new backpack was placed near the back with a zipper on top side.

Thoughtthe recommended weight of the backpack, i.e. 10–15% has been recommended as an acceptable limit for schoolchildren there is still no clear guideline regarding where the backpack centre gravity (CG) should be positioned.Division parts in the UCD (User Centered Design)backpack, distributes the loads better and in addition, it aligns the backpack's center gravity with the body's center gravity. These are important factors in reducing the effective load on shoulders, waist and neck.Results also showed that children have problems finding the shoulders straps in regards to wearing the backpack.So shoulders straps connections were shifted to the top of the backpack inbetween the heavy and semi-heavy section.

In spite of the fact that many research scrutinized the ergonomic features of backpacks, only few focused on the design of backpacks based on ergonomic necessities. In this research it was tried that ergonomic features were practically used in the design of backpack. In conclusion, it could be understood from this research that designing ergonomic backpack for children along with user centered design not only solves the ergonomic issues of current backpacks, but also involves the children in the design procedure. So there can be a proper correlation between the ergonomic stand of the design and other features like appearance and aesthetics. (<https://content.iospress.com/>)

Posture is the bigger concern than most of us think. With growing workload for school children, the issue of the backpack weight increases cumulatively. Carrying heavy and oversized school bags full of heavy books causes serious spinal deformities among children.

Children carrying heavy school bags are developing forward head posture as they are hinging forward at the hips to compensate for the heavy weight on their back. Thus it is a major concern to take corrective measures for this existing issue.

II. METHODOLOGY

An exploratory study was conducted among 120 (58 girls and 62 boys) school going children aged 10-13 years (4th - 8th std) from 20 schools with the objectives to (i) identify the characteristics and features of the school backpacks, and (ii) understand the physical attributes of school going children.

Convenient sampling technique was used with the consent of their parents was employed. A self-constructed and validated questionnaire was used to elicit the information. The questionnaire consisted of three sections:

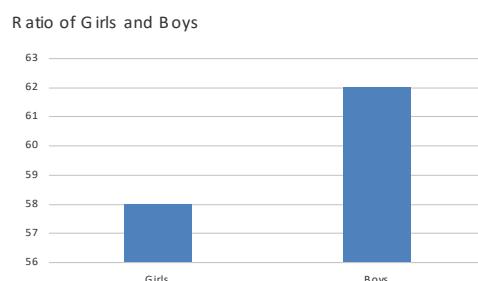
- Part A: collected information on the demographic profile of the children;
- Part B: elicited information of the backpack features, characteristics and its dimensions;
- Part C: CMDQ (Cornell Modified Discomfort Questionnaire to record the bodily pains and aches experienced) and the visual analog scale (a psychometric measuring instrument designed to document the rate of pain occurrence. The pain is rated on the scale from 0 to 10 considering 0 as no pain and 10 as unbearable pain).

The data collected from the sample was coded into the excel sheet and the graphical representation from the pivot table was formulated.

III. RESULTS

The information collected by questionnaire, school visits and interview method was tabulated systematically in MS excel sheet. 120 school children were interviewed with the help of self-constructed questionnaire and random sampling technique by personal interview with children.

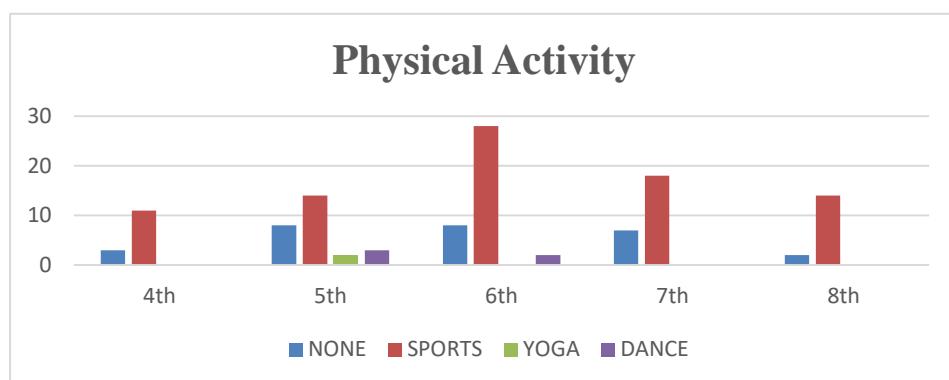
Sample profile: 58(48%) girls and 62(52%) boys were included in the study.



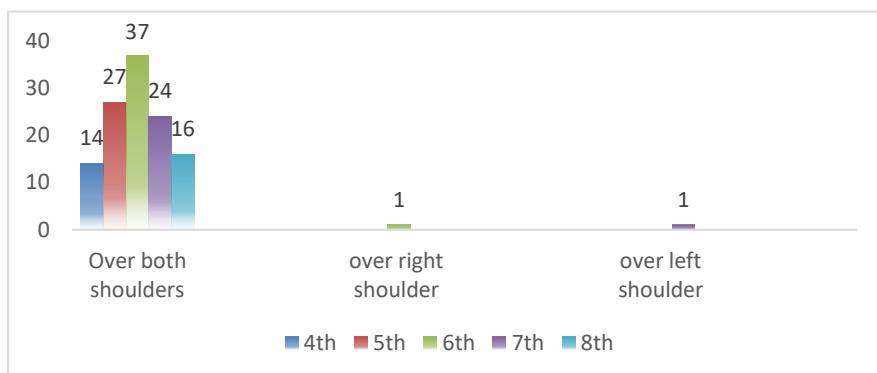
Age and Class

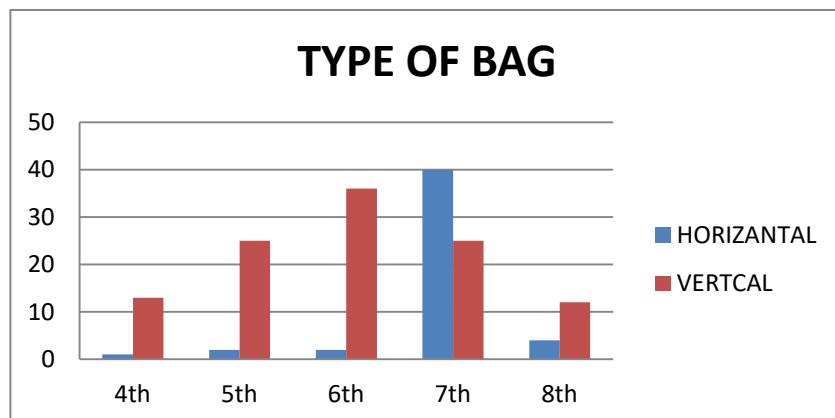
The children who participated in research study included 14(12%) of the children are in 4th std, 27(22%) in 5th std, 39(32.5%) in 6th std, 25 (21%) in 7th std, 15(12.5%) in 8th std.

The data was collected from various schools in the vicinity of Thane,Dombivali and Kalyan.

Physical Activity

The involvement of the school going children according to the research data collected stated that:4th class children 11(9%) were involved in different sports activities,5th class 3(2%) were in dance, 14(12%) were in sports, 2(1%) in yoga, 6th std 2(1%) indance, 28(23%) were involved in sports, 7th standard18(15%) were in sports, 8th standard 14(12%) children were involved in sports activities.



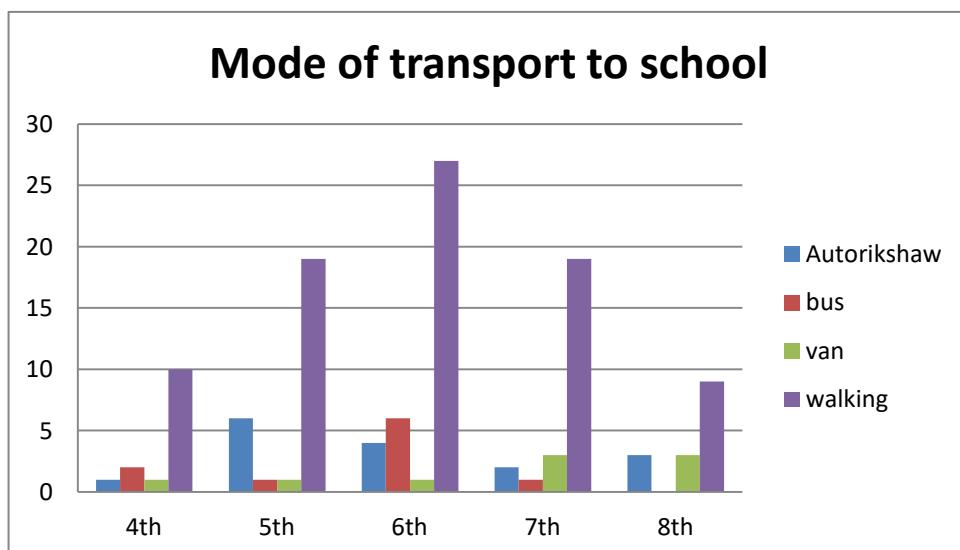
Type of Bag

Class	Horizontal		Vertical	
	f	%	f	%
4 th	1	1	13	11
5 th	2	2	25	21
6 th	2	2	36	30
7 th	0	0	25	21
8 th	4	3	11	9

Table no.1-Type of Bag

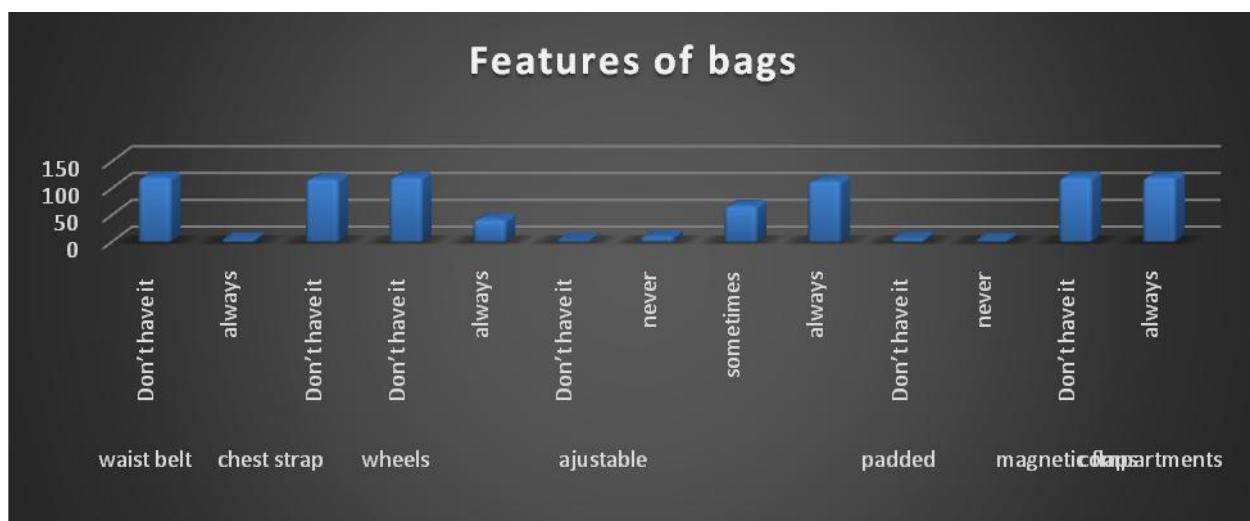
According to the study conducted it is found that most of the children uses vertical bag whereas few of them uses horizontal bag.

Bag Carrying Method: Most of the children carry their bag over both the shoulders, in 4th class-14(12%), 5th class-27(22%), 6th-37(31%), 7th-24(20%), 8th-16(13%)

Mode of transport to School:

Class	Autorikshaw		Bus		Van		Walking	
	f	%	f	%	f	%	f	%
4th	1	1	2	2	1	1	10	8
5th	6	5	1	1	1	1	19	16
6th	4	3	6	5	1	1	27	22
7th	2	2	1	1	3	2	19	16
8th	3	2	0	0	3	2	9	7

Table no. 2 –Mode of transport to School

Features of Bag

- Waist belt: from the data collected, all the subjects include 62(52%) boys and 58 (48%) girls,
- No one has waist belt in their bag.
- Chest strap:out of 120 children only 3(2%)have chest strap in their bag and they uses it whereas rest 97(81%) don't have chest strap in their bag.
- Wheels: according to the study conducted, out of 120 children noone has wheels on their bag.
- Adjustable straps: 68(57%) don't have adjustable strap whereas 10(8%) they have but they sometimes use it and42(35%) uses adjustable strap
- Padded Bag: 108(90%) have pad in their bag whereas 12(10%) don't have pad in their bag.
- Magnetic Flaps : out of all 120 childrens , no one has the magnetic flaps in their bag

Class	Waist belt	Chest Strap		Wheels	Adjustable Strap			
		Don't have it	Always		Always	Don't have it	Never	Sometimes
4 th	14		14	14	2	12		
5 th	27	3	24	27	10	17		
6 th	38		38	38	15	19	1	3
7 th	25		25	25	11	9	1	4
8 th	16		16	16	4	9		3

Table no.3- Features of Bag

Class	Padded		Magnetic flaps	Many compartments
	Always	Don't have it	Don't have it	Always
4 th	12	2	14	14
5 th	26	1	27	27
6 th	36	2	38	38
7 th	24	1	25	25
8 th	10	6	16	16

IV. DISCUSSION

Primary students must be asked to complete extra work during the class hours; no homework should be given to them. Less weight of bag will help students to maintain their body posture rather than carrying heavy bag and bending down. The pain which have been seen mostly in the shoulders, neck and backs of the students may not occur if the bag weight is bearable. Also, not only school students must also take care of their health but also they should carry bag according to the timetable. Everyday extra books must be removed from the bag. Do not lean forward or backward when carrying the bag. Maintain a straight back, with the bag just close to your back. Since the weight of the heavy backpacks on children can cause severe deterioration on the lumbar part of the spine, monitoring is essential by either parents or by the help of this system, children themselves, enabling them to decide on making their backpack lighter. Proper orientation and movement of the spine is absolutely essential to brain health

According to the study conducted it is seen that no one has waist belt in the bag also no one has wheels and magnetic flaps and this need to be designed to their bag so as to prevent musculoskeletal discomfort and pain. Also, some don't uses adjustable straps which is not correct they should use their adjustable straps.

V. RECOMMENDATION

Calling attention to the safety concerns associated with carrying heavy backpacks the school administrations and the government plays a major role to undertake strict actions against violating the rules stated by law. Finding the right backpack is the most effective, simple and easy

The essential features that the user must consider before choosing the backpack are:

Engineering control: Weight of the backpack: A lightweight pack, i. e., one that doesn't add a lot of weight to child's load

- Shoulder Straps: There must be two wide, padded shoulder straps. Straps that are too narrow can dig into shoulders.
- Padded Back support: it not only provides increased comfort, but also protects children from being poked by sharp objects or edges (pencils, rulers, notebooks, etc.) inside the pack
- Waist Belt: A good secure belt at the waist helps to distribute the weight more evenly across the body.
- Multiple Compartments: to help distribute the weight throughout the pack
- Wearing/Using the bag: Users must pick up the backpack properly by using both shoulder straps. Bags that are slung over the shoulder or across the chest or that only have one strap aren't as effective at distributing the weight.

Administrative control: Teacher and parent should also take initiatives in providing their children a healthy life by

- Teaching them the correct method of carrying backpack
- Telling them not to bring books which are not necessary and to bring only textbooks and maintain a file or writing in paper so that it will not create that load to the bag.
- Providing a training or lectures on proper method of using backpack at every level.
- Parents should also check whether their child is carrying their books according to the given timetable only or carrying any extra books which are not relevant.

Personal control: A roomy backpack may seem like a good idea, but the more space there is to fill, the more likely child will fill it. Help child determine what is absolutely necessary to carry. Teach child to load the backpack with the

heaviest items first closest to the bottom and the center of the back of the backpack and to make use of multiple compartments to distribute the loads.

VI. CONCLUSION

Today's youth is subjected to carry heavy backpack. Well planned timetable and work schedules by schools and faculty will help reduce the burden of carrying heavy backpacks to a large extent. School should provide proper locker facilities for students to keep some of their books in the school, worksheets instead of workbooks, etc are some of the simple easily implementable solutions. The MHRD Ministry of Human Resource Department recently said the schoolchildren of Classes I and II would not get any homework anymore from their schools and there would be prescribed weight limits for school bags of every class and should not only pass the law but should need to take strict actions and surveillance has to be done. School should take special care of the weight carried by every student. The school backpack weight must not be more than 10% of the student's body weight

Author Statements:

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Informed Consent: A written informed consent was taken from all 120 participants.

Conflict of Interest: The authors declare that they have no conflict of interest.

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