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School Bags and Musculoskeletal Pain Among Elementary School Children In Chennai City

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ABSTRACT

Regular use of heavy school bags and inappropriate carrying methods can put children at the risk ofmusculoskeletal problems and changes the body posture. This study set out to determine the prevalence ofmusculoskeletal pain and their relationship with school bags weight. This cross sectional exploratory study wasconducted in different elementary schools in Chennai, South India. A total of 510 elementary school childrencomprising of 297 boys and 213 girls aged between 6 to 12 years participated in the study. Each pupils body weightand school bag weight were measure using standard technique. The ratio of pupil's school weight to body weightwas calculated and used to estimate the percentage weight of school bag in relation to body weight and theparticipants also completed a designed questionnaire to identify prevalence of pain. A high prevalence ofmusculoskeletal pain 60.6% and 65.7% among male and female elementary school children respectively wasreported and the most common area being back and neck. A significantly positive association was found betweenpercentage of school bag weight and presence of musculoskeletal pain among the children (P< 0.05). The studyresults were in line with the prevalence of primary school children of many developing countries and below parwith some African studies owing to different educational demands.

Keywords: Pain, Elementary school children, School supplies,

INTRODUCTION

Appropriate way of carrying school supplies and at the same time carrying recommended school bag weight based on the children BMI and age is an ongoing discussion in children research works of late [1]. Recently it is well noticed that large number of children visit physicians to get treated for their musculoskeletal problems and spinal pain seems to be the most common reasons. Many studies reveal and recommend different school bag weight percentage and carrying methods to avoid bodily stress [2].

The peak rate of growth occurs during childhood, puberty and the growth of the appendicular

skeletal system ceases around 16 years of age for females and 18 years for males. However secondary ossification of vertebrae is not complete until the mid twenties. In these years skeletal tissue transforms from cartilage to bone through the process of ossification occurring in several stages and they are most vulnerable at this time [3, 4]. Therefore, the spine may be susceptible to injury for a greater length of time and establishing standard backpack load should be emphasized during these years.

Children have relatively larger heads and also have higher centre of mass at about T12, compared to L5-S1 in adults resulting in difficulty in maintaining static balance. Carrying posterior loads by young people has been linked with spinal pain, and the amount of postural change produced by load carriage has been used as a measure of the potential to cause tissue damage. Back pain in children appears to be more common than was previously thought. An Indian studies had reported that 10%-30% of healthy children experience back pain, especially low back pain, by their teenage years [5, 6].

Up to now, the effect of carrying heavy bags on children natural growth pattern has not been proven. Studies have reported relationship between heavy school bags and educational failure, lack of motivation, lack of learning, and absenteeism; however no definite results have been obtained [7]. The health effects of carrying heavy backpack loads necessitated the attention given to the determination of the load limit of backpack in the literature. Students sometimes carry as much as 30% to 40% of their bodyweight at least once a week [8]. Many studies present evidence to support backpack load limits for children, but the suggested limits have been based on percentage of the body weight with discrepancies. While some researchers proposed 10 % of body mass [9, 10], another research works proposed 15 % of body mass [11]. Brackley and Stevenson recommended that backpacks weight should be between 10–15% of a child's body mass [12, 13].

Considering the fact that in spite of many studies being carried out on influence of school bag carrying in India, there exist a huge regional differences in data based on regional educational system and type of schools. Hence it is important to develop regional based data of school children in Chennai city and the purpose of this investigation was to explore and exhibit the prevalence of musculoskeletal pain and its association with school bag use in children.

METHOD

The samples of this cross sectional design study were selected through cluster sampling, each school in the Chennai city were considered as cluster and then simple random was done to select clusters. Ethical approval was obtained from Madha college of Physiotherapy research committee, Chennai. The study included children from 7 primary schools between 6 to 12 years of age considering their sensitive body growth. Epi

info software 7 was used for calculating sample size. We used assumed prevalence of 50%, precision of 5%, confidence level of 99% and to this a 50% additional allowance for non- response or refusal to consent on the part of the pupils parents to give a sample size of 576 children and with all consent form dispatched only 510 eligible children and parents consented for the study. The study procedure was explained to school teachers, recruited children and informed consent was obtained from parents or guardian. Official permission was obtained from principal of each school. Children with congenital and structural abnormalities, musculoskeletal problems, neurological problems, and acute or post-acute illness were excluded. The inclusion criteria were parental consent, pupil assent, ability to ambulate independently, and ability to wear a school bag while standing on a weighing scale. Recruitment and measurement were made by 8 trained data collectors in July 2014. The study data were collected through a researcher designed questionnaire.

Study procedure

The subjects were then instructed to remove shoes and stand on the stadiometer and the height in centimetres was noted The weight was first measured when carrying the school bag and then without the school bag and the difference between the two weights was recorded as the weight of the school bag. To avoid school bag weight bias measurement were made only during morning sessions of the school hours. All values were documented on the questionnaire. The weighing scales were recalibrated after each measurement. Care was taken to simplify the questions as much as possible and explanations were given whenever questions arose. Existence and location of pain will be reported according to its presence or absence in each of the options: arms, spine, shoulders, hands, legs, feet and others (in the presence of the latter option, the site is described).

STATISTICAL ANALYSES

The data were exported to SPSS version 20. School bag weight as a percentage of body weight was computed by dividing the weight of the bag by the child's weight. Responses were analyzed using frequency distributions and descriptive statistics. Both linear and logistic regression analysis were performed to analyze the effects of schoolbag usage on musculoskeletal pain, and weights of their bags.

RESULTS

A total of 510 parents consented for their children to be included in the study from 7 primary schools. The sample comprised of 297(58.23%) male and 213 (41.17%) female pupils. The mean age of the pupils was 9.1 years for male and 8.9 years for female. The overall mean body weight for pupils was 29.9 (kg) ± 4.1for male and 30.1(kg) ± 3.5 for female. The pupils carried an average school bag weight of 4.91 (kg) ±1.97 for male and 4.15 (kg) ±1.98 for female, ranging from 0.6 kg to 13.1kg.

Table 1 shows that with weight of school bag when expressed as mean percentage of body

weight both male and female pupils carried 16.31% and 16.22% respectively. This percentage of the school bag over pupil's body weight increased 1.6% with every additional year and standard of class. An overall 297 (54.7%) of pupils were carrying school bag of more than 15% of their body weight and of these 59.9% of the pupils belong to private schools. According to the study findings most of the pupils 395 (77.5%) carried their school supplies as back pack with adjustable straps and a very less percentage of pupils about 15% and 7.5% carried school supplies by shoulder bag and hand bag respectively.

Table 2 shows that presences of musculoskeletal pain or discomfort over the previous 3 weeks were neck (29.2%), shoulder (18.8%), back (39%), elbow (9.4%), hand & wrist (15.1%), thigh (21.2%), knee (17.5%), foot and ankle (5.3%) for male pupils and among female pupils the pain presentation were neck (27.9%), shoulder (12.4%), back (36.3%), elbow (11.4%), hand & wrist (16.8%), thigh (23.5%), knee (15.4%), foot and ankle (6.7%). Alarmingly the prevalence of musculoskeletal pain was 60.6% (180) and 65.7% (140) in male and female respectively.

One hundred and ninety two pupils both male and female reported back pain and a very small proportion 31(5.9%) reported foot and ankle pain. There was a significant association between back pain and percentage of school bag weight (p=0.03) and no significant association was reported between way of school bag carrying and back pain.

DISCUSSION

This study explored the prevalence of musculoskeletal pain in elementary school children between 6 to 12 years of age and its association with their school bag weight in primary schools of Chennai. This study found that 60.6% (180) male pupil and 65.7% (140) female pupils reported musculoskeletal pain and the most affected areas were back and neck. There was a strong association between school bag weight and presence of pain. Lai found that cervical and shoulder postures were influenced by both amount and duration of weight carried by a backpack, suggesting that potential problems may occur from backpack weights greater than 10%. Orloff & Rapp's examination of spinal curvature and load carriage of a 13.8% body weight backpack found significant increases in the thoracic & lumbar spinal curvatures as the children fatigued while carrying the weighted backpack [14]. The forward head position reported here as a compensatory response to carrying a loaded backpack may have far reaching consequences into adulthood as children are subjected to carrying heavy backpacks on a regular basis for educational purposes [15]. A study done by Deere KC et al 2012 on 3376 children reported 45% prevalence of musculoskeletal pain. However, this study was done on adolescent children aged 17 years, which is older than the age group in the current study [16]. Another study done in Uganda

on 532 children reported 35.4% prevalence of musculoskeletal pain [17] which is much higher than this study, the reason could be in the above study mean schoolbag weight as a percentage of body weight was 8.5% but, Indian school education system demands the children to carry a heavy school supplies. Carrying a heavy school bag for long periods of time could result in repetitive stress injuries to the growing body. This follows the shifting of the child's centre of gravity in the direction of the load when carrying a backpack [18]. To compensate, the child will typically leans in a direction opposite to the force. For example, to compensate for a heavy backpack worn low over the sacrum, the individual typically moves the head and trunk forward. Another common strategy is lumbar hyperextension accompanied by hand support on the shoulder straps. Such postural deviations can hamper the natural shock absorption abilities of the spine and require greater muscle activity to prevent the individual from falling as a result of the increased forces and moments about the spine. These heavy school bags result in several postural changes at the head and trunk placing soft tissues at a biomechanical disadvantage resulting in fatigue and injury. This study also reported a mean schoolbag weight as a percentage of body weight of 16.31% in male and 16.22% in female which much higher than the recommended limit of 10% of body weight. Researchers have explored whether there is a critical backpack weight-to body ratio that if exceeded affects health. Backpack loads exceeding 10% of body weight have been shown to increase energy consumption, increase trunk forward lean, and result in decreased lung volumes. These factors lead to reduced oxygen partial pressure (PO_2) resulting in anaerobic respiration and eventual fatigue [19]. There are several reasons for heavier backpack loads among school going children, these include: pressure to attain higher academic performance leading to children getting more homework. Hong et al suggested the altered biomechanics required by children to carry increased loads on a daily basis "might be harmful and influence their normal musculoskeletal developmental growth" and recommended a backpack load limit of 10% body weight "since it causes the least disturbance of metabolic processes." Considering the recommended cut off limit of 10% of body, growing educational demands on children and transitional period of spinal growth younger children are likely to be exposed to spinal damage. Future studies should consider the use of quantitative measures of posture, such as photogrammetry which was shown to be a suitable and reliable quantitative method in Santos et al. study, and protocols based on the marking of anatomical points and calculations of angles and postural deviations [20, 21]. 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…." [22].

CONCLUSION

The higher prevalence of musculoskeletal pain among younger children and carrying heavy school supplies with further analyses showing association of school bag weight and spinal pain is a worrying fact. Schools are considered to be an ideal places to conduct activities that favour proper physical and motor development in children, a better understanding of the relation between musculoskeletal pain and its multiple causative factors will allow health care professionals and policy makers to apply the resources that are available for information, prevention and early diagnosis in school setting, as well as refer to specific discipline. There are few strategies suggested by experts like children are provided with lockers in which to keep their school bags and other scholastic materials while at school a number of potential repetitive strain injuries may be averted. Currently, many professional organizations are communicating virtually the same message: choose the right size backpack; pack well and empty out unnecessary items; wear straps on both shoulders; and carry less than 10% of body weight.

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Table no: 01 Subject characteristics of Children

Characteristics	**Male (n=297)**	**Female (n=213)**
Age Range (years)	9.1 (±0.9) 6.5-12	8.9 (±0.9) 6.1-11.8
Weight(kg)	29.9(±4.1)	30.1(±3.5)
Mean weight of school bag (kg) Range (kg) Mean bag weight as % of body weight Range (kg)	4.91 (1.97) 0.6 to 13.1 16.31 (4.1) 2-32.3%	4.15 (1.98) 0.9 to 12.3 16.22(5) 3-31.3%
School bag use Back pack (B) Shoulder bag (R&L) Hand bag	 71% 19%(16&3) 10%	 84% 11% (9&2) 5%

Table no: 02 Pain characteristics of the participants

Type of Pain	Male **(n=297)**	Female **(n=213)**
Pain in at least one part of body	60.6%	65.7%
Neck pain	29.2%	27.9%
Shoulder pain	18.8%	12.4%
Back pain	39%	36.3%
Elbow pain	9.4%	11.4%
Hand and wrist	15.1%	16.8%

pain		
Thigh pain	21.2%	23.5%
Knee pain	17.5%	15.4%
Foot and ankle pain	5.3%	6.7%

REFERENCES

1. Syazwan A, Azhar MM, Anita A, Azizan H, Shaharuddin M, Hanafiah JM, et al. Poor sitting posture and a heavy schoolbag as contributors to musculoskeletal pain in children: an ergonomic school education intervention program.JPainRes2011;4:287-296.
2. Grimmer K, Dansie B, Milanese S, Pirunsan U, Trott P. Adolescent standing postural response to backpack loads: a randomized controlled experimental study. BMC Musculoskelet Disord. 2002; 3: 10.
3. Lanes T, Gauron E, Spratt K, Wernimont T, Found E, Weinstein J. Long term follow up of patients with low back pain treated in a multidisciplinary rehabilitation program. Spine 1995; 20: 801-806.
4. Shumway CA. Control of normal mobility. In: Shumway CA, Woollacott MH, Eds. Motor Control: Theory and Practical Applications.
5. Mayank M, Upendar S, Nishat Q. Effect of backpack loading on cervical and shoulder posture in Indian school children. Indian J Physiotherapy Occupational Therapy 2006; 1: 3-12.
6. Grimmer K, Dansie B, Milanese S, Pirunsan U, Trott P. Adolescent standing postural response to backpack loads: a randomized controlled experimental study. BMC Musculoskelet Disord. 2002; 3: 10.
7. Ko, J and M.Kim, 2013. Reliability and responsiveness of the gross motor function measure-88 in children with cerebral palsy. Phys. Ther., 93; 393-400.
8. Mackenzie, W. G., Sampath, J. S., Kruse, R. W., Sheir-Neiss, G. J., Backpacks in Children, Clinical Orthopaedics and Related Research, vol. 409, pp. 78–84, 2003.
9. Bauer, D. H., Freivalds, A., Backpack load limit recommendation for middle school students based on physiological and psychophysical measurements, Work, vol. 32, pp. 339–350, 2009.
10. Chow, D .H. K., Kwok, M. L. Y., Au-Yang, A. C. K., Holmes, A. D., Cheng, J. C. Y., Yao, F. Y. D., Wong, M. S., The effect of backpack load on the gait of normal adolescent girls, Ergonomics, vol. 48, no. 6, pp. 642– 656, 2005.
11. Hong, Y., Cheung, C., Gait and posture responses to backpack load during level walking in children, Gait & Posture, vol. 17, pp. 28–33, 2003.
12. Brackley, H. M., Stevenson, J. M. Stevenson, Selinger J. C., Effect of backpack load placement on posture and spinal curvature in prepubescent children, Work, vol. 32, pp. 351-360, 2009.

13. Brackley, H. M., Stevenson, J. M., Are Children's Backpack Weight Limits Enough? A critical review of relevant literature, Spine, vol. 29, pp. 2184–2190, 2004.
14. Orloff HA, Rapp CM. The effects of load carriage on spinal curvature and posture. Spine 2004; 29(12):1325-1329.
15. Hong Y, Li JX, Wong AS, Robinson PD. Effects of load carriage on heart rate, blood pressure and energy expenditure in children. Ergonomics 2000; 43(6):717-727.
16. Deere KC, Clinch J, Holliday K, McBeth J, Crawley EM, Sayers A, et al. Obesity is a risk factor for musculoskeletal pain in adolescents: findings from a population-based cohort. Pain 2012; 153:1932-1938.
17. Mwaka et al.: Musculoskeletal pain and school bag use: a cross-sectional study among Ugandan pupils. BMC Research Notes 2014 7:222.
18. Grimmer KA, Williams MT, Gill TK: The associations between adolescent head-on neck posture, backpack weight, and anthropometric features. Spine (Phila Pa 1976) 1999, 24:2262–2267.
19. Hong Y, Brueggemann GP: Changes in gait patterns in 10-year-old boys with increasing loads when walking on a treadmill. Gait Posture 2000, 11:254–259.
20. Pereira DSL, Castro SS, Bertoncello D, Damião R, Walsh IAP. Relationship of musculoskeletal pain with physical and functional variables and with postural changes in school children from 6 to 12 years of age. Braz J Phys Ther. 2013 July-Aug; 17(4):392-400.
21. Santos MM, Silva MPC, Sanada LS, Alves CRJ. Análise postural fotogramétrica de crianças saudáveis de 7 a 10 anos: confiabilidade interexaminadores. Rev Bras Fisioter. 2009; 13(4):350-5. http://dx.doi.org/10.1590/ S1413-35552009005000047.
22. Javadivala, Z., Allahverdipour, H., Dianat, I.and Bazargan, M. Awareness of parents about Characteristics of a healthy school backpack. Health Promot Perspect 2012;2: 166-172.