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School bag weight and the occurrence of back pain among elementary school children Samuel Layuk, 1,3 Tri Martiana, 2 Bongakaraeng Bongakaraeng 3 1Doctoral Program of Public Health, Faculty of Public Health; 2Department of Occupational Health and Safety, Faculty of Public Health, Universitas Airlangga, Surabaya; 3Polytechnic of Health, Manado, Indonesia Abstract Background: Children in primary schools use school bags to carry study material, although the heavy bags are often associated with musculoskeletal problems, especially back pain.

This practice requires strength, which significantly changes the body posture and walking pattern, subsequently leading to the incidence of back pain as a side effect. The aim of this study, therefore, is to analyze the differences in bag loads between elementary school children in urban and suburban area, and also analyze the relationship with the occurrence of back pain.

Design and methods: This was a cross sectional study, which used stratified random sampling to choose 2 elementary schools each representing the urban and suburban areas. Furthermore, a total sample of 164 students were selected, whose school bag weight were measured for 5 consecutive days, particularly in the morning on respondents arrival at school.

Moreover, the occurrence of back pain was evaluated using a modified Nordic map, and data analysis required the use of independent sample analysis t test and χ^2 test. Results: The results showed the presence of highly significant differences in the school bags weight of respondents in the urban and suburban areas, as well as between schools using the 2013 curriculum and otherwise.

Conclusions: In conclusion, there is a correlation between the weight measured and the occurrence of back pain, hence the 2013 curriculum is recommended to be adopted by all elementary schools. Also, the use of lockers to store items used at school repeatedly by children is also highly encouraged. Introduction School children aged between 7 and 12 years have strong individual physical characteristics, are also active and dependent on parents.

1 This category of people is different from adults, based on the prominent traits of consistent growth, featuring an optimal increase in the number of organs or tools, and development up to the end of adolescence, which is a process related to organ function on maturation. 2 Each stage of child development features a propensity for the occurrence of certain disorders, depending on the development phase and the level of physical activity experienced. Therefore, the presence of a physical disturbance required prompt detection, in order to achieve the intervention goal of correction.

3-5 The conveyance of school materials often requires the use of school bags, which is often the center of attention associated with musculoskeletal problems, especially low back pain. During this height realization period, rapid growth and development is observed in the bones and soft tissues, as the spine structure evolves faster, in comparison with adults.

Furthermore, the presence of external forces, including the weight of a bag affects the growth phase, in relation to the child's posture and pattern of walking, subsequently facilitating the vulnerability to low back pain. 6,7 In adulthood, the complaints of low back pain are prominent in the teenage years, and a history of symptoms is identified in children.

In addition, the use of heavy school bags is assumed to influence the increasing posture and declining balance, which increases the risk of low back pain and other musculoskeletal problems on the long run. 8 The facts link the continuous use of school bags as containers for books and other school tools with the discomfort of children.

Furthermore, it is a common practice for schools to provide extra homework, assignments and extra-curricular activities, which contributes to the amount of material that must be carried in addition to the mandatory curriculum demands. There are currently no regulations governing this burden, with the aim of providing comfort and safety to children, based on the health impact considerations.

According to the Chiropractic Association USA, the load limit for backpack models is 10 - 20% of a child's weight, which is also in line with most guidelines. 9 A backpack is a

container placed on an individuals' back, which is protected by two straps extending vertically over the shoulder, and the developed guide - lines in many countries aim to minimize the bad impression of total weight on a students' back.

10 The results of a research identified the various factors as the cause of the burden, including the demands of curriculum, provision (food and drink), carrying ARTICLE S i g n i f i c a n c e f o r p u b l i c h e a l t h In carrying school materials children often use school bags, and using school bags is often associated with musculoskeletal problems, especially back pain.

External forces such as the weight of the bag will affect the growth and development of the child's posture and pattern of walking which makes the child more vulnerable to develop back pain. In this paper we will discuss the weight of an elementary school student's bag from a school location and the effects of using a different curriculum on the bag's weight. The results of this study are expected to influence school policies to prevent back pain in schoolchildren.

[Journal of Public Health Research 2020; 9:1841] [page 191] [page 192] [Journal of Public Health Research 2020; 9:1841] homework, other tasks (e.g., sports equipment conveyance), poor bag cleaning routine, and selecting an improper model. 11, 12 Backpack syndrome refers to the pains that occur as a result of bag use in the conveyance of school tools and equipment with load weighing 4.5-18 kg or 10-40% of a child's weight.

13 According to the International Association for the Study of Pain (IASP), muscu - loskeletal pain is defined as an unpleasant emotional and sensory subjective sensation obtained from actual or potential tissue dam - age, which describes the current condition of damage. 14 In addi - tion, repeatedly carrying load, especially in a static position causes a disruption in the blood flow carrying oxygen.

This, therefore accumulates into diototous oxygen, potentially leading to anaero - bic metabolism, followed by a buildup of lactic acid in the body, which ultimately initiates skeletal muscle fatigue, felt in the form of muscle pain. 15,16 The purpose of this study, therefore, was to analyze the differ - ences in school bag burden in urban and suburban areas, as well as between schools using the 2013 curriculum and otherwise. Subsequently, a relationship with the complaint of back pain is evaluated.

Design and methods This involves a cross sectional study design, using a popula - tion of all elementary school children in the city of Manado. The elementary school samples were determined through stratified ran - dom sampling, following a division into urban

and suburban center groups. Furthermore, a total of 4 were randomly selected, consisting of 2 urban and 2 suburban center group, respectively using the 2013 curriculum and otherwise.

Therefore, all grade 3 and 4 students were subjected to the criteria of backpack utility (Backpack model), and inclusion in the study was based on the willingness to be respondents for 5 consecutive days (Monday to Friday). The total number of subjects comprises of 186 people, where only 164 met the criteria up to the end of study.

The questionnaire developed requested data pertaining to the name of school, name of child, age, class, length time carrying bag daily, how to carry bag, weight, number of bags inside. In addition, the standardized scales were used for the measurement of bag weight, while modified Nordic map was adopted in the assessment of back pain complaints.

Ethics approval was obtained from the Manado Health Polytechnic, while all schools involved in this study received agreement from the School Principal and Homeroom Teacher. Therefore, the collection of data was performed simultaneously on the same days for all 4 teams, with each consisting of 3 people previously involved in trainings on how to fill in questionnaires and use other instruments.

Subsequently, all the participants that met the requirements for measuring bag weight were accessed for 5 consecutive days on arrival at school, while the weight and back pain evaluation was conducted only once. The data obtained were then analyzed descriptively, using chi square test (χ^2) and independent sample t test. Results and discussion Table 1 shows the presence of a higher amount of students in the urban center than to the city edge area.

This phenomenon is congruent with the perception of increased tendency for parents to send children to strategically located schools, especially those of high-quality. An observation of the sex showed similarity between the number male and female, aged 7 and 8 years old, and presently in class 3 than in 2. The population using the new national 2013 Article Table 1. Characteristics of respondents. Categories N=164 % Age 6 years old 11 6.7 7 years old 75 45.7

8 years old 74 45.1 9 years old 4 2.5 Gender Male 81 49.4 Female 83 50.6 Grade 8th 68 41.5 9th 96 58.5 Learning method (curriculum) Government standard 82 50 Modified 82 50 School Location Urban 90 54.9 Suburban 74 45.1 Bag weight Standardized 101 61.6 Not standardized 63 38.4 Back pain No 111 67.7 Yes 53 32.3 Table 2. Differences in school bag loads based on school location and curriculum use.

Item	N	Mean	Std deviation	Std. error	mean	T	Sig. Value	School location	Urban	90	2.6806
		0.89837	0.09470	10.130	<0.001	Suburban	74	1.3530	0.75097	0.08730	Learning method (Curriculum)
		Government standard	82	1.3766	0.76148	0.08409	11.318	<0.001	Modified	82	2.3766
		0.83227	0.09191	curriculum was similar to those adopting the old type. The number of bag loads that did not meet the requirements was 38.4%, while the total respondents with back pain complaints were 32.5%. Table 2 shows an average school bag load of 2.681 kg in the city center, which was 1.353 kg in the suburban areas. Furthermore, statistical test results showed a T values of 10, 130 (P<0.001), indicating the presence of a significant difference between the school bag burden in both study locations, with the urban areas having more baggage.							

Also, Table 2 showed an average load of 1.3766 kg for children using the 2013 curriculum, while 2.7865 kg was recorded for those using the old method, with statistical test results demonstrating a T value of 10, 130, with P<0.001. These study outcomes indicate significant differences amongst groups, with primary schools using the new curriculum having a relatively lower burden, characterized by the use of fewer mandatory books compared to others.

This was due to the fact that more subjects were combined with the aim of achieving competency optimization, which is different from the older curriculum, known to emphasize more on the books for each subject, subsequently increasing the amount of items needed for preparation. Table 3 shows a total of 91 bags that met the requirements, while 63 failed the stipulated criteria.

In addition, the number of school children with complaints was 53, as against the remaining 111. The result of χ^2 test showed a value of 43,168, with P-value<0.001, which indicates the presence of a relationship between the weight of bag load and back pain complaints among elementary school children. Also, the interview conducted identified a higher tendency of complaints amongst those carrying backpacks on one shoulder, and using a single strap.

The results are consistent with the research conducted on school students in South Africa, 17 where a significant difference in relation to the level of pain experienced was established, with the type of bag carried and the fact that a majority properly using two shoulders 9. Moreover, a study carried out in Iran reported on the experience of discomfort in the shoulder 50% of elementary school students, which was related to the weight and the method of conveyance to school.

18 Conclusions In conclusion, there is a correlation between the weight measured and

the occurrence of back pain, hence the 2013 curriculum is recommended to be immediately adopted by all elementary schools. Also, the use of lockers to store items used repeatedly by children is also highly encouraged. References 1. Brustad RJ. Attraction to Physical Activity in Urban Schoolchildren: Parental Socialization and Gender Influences. *RQES* 1996;67:326-23 2.

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The relationship between school bag weight and back pain complaints. School bag weight Back pain ? 2 Sig. Value No Yes Standardized 88 13 43.168 < 0.001 Not standardized 23 40 Correspondence: Tri Martiana. Department of Occupational Health and Safety, Faculty of Public Health, Universitas Airlangga, Jl. Mulyorejo, Surabaya, Jawa Timur 60115, Indonesia. Tel.:

+62315920948 - Fax: +62315924618 E-mail: tri.martiana@fkm.unair.ac.id. Keywords : school bags; back pain; elementary school. Contributions : SL developed the theoretical formalism, performed the analytic calculations and the numerical simulations. TM supervised the project. BB contributed to the final version of the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

Conflict of interest: The authors declare no potential conflict of interest. Funding : The work was supported by the Manado Health Polytechnic grant and Universitas Airlangga Clinical trials : The study did not involve any clinical trials.

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