

Description Of Bag Load With Anthropometry Of Elementary School Students

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Abstract. Introduction. Low back pain is one of the most common health problem among school students. Carrying heavy backpack to school is one of the cause of low back pain. **Objectives.** To identify the bag load carried by the students and anthropometry of the students. **Method.** This research is a descriptive observational with a cross-sectional method. Data used is a primer data which is from 268 students by measuring their body weight, height, bag weight and also by interviewing them using interview guidelines. **Results.** The results obtained from 268 elementary school students of Siti Hajar mostly have normal nutritional status. The average bag weight at level I (6.071%), level II (8.510%) and level III (10.812%) where the majority of bag loads compared to elementary school anthropometry were included in the mild category 47.6% at level I, 74.7% at level II and 84.3% at level III eventhough there were some children in the heavy category. 88.8% of children carry their school bags using two shoulders, with a duration of time <30 minutes (61.7%). Respondents who experienced back pain (4.9%) and who did not experience back pain (95.1%). **Conclusions.** The weight of Siti Hajar Elementary School children bag against anthropometry has not exceeded the recommended load limit.

Keywords. Bag load, anthropometry, cross-sectional, interview

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1 Introduction

Low back pain is one of the most common health problems in children and adolescents of school age. One of the causes associated with this complaint is the burden of bags carried by school children. School bags are the most common tool for carrying books and school supplies among school children (Azuan M, 2010). Excessive bag weight can have an effect on the health and posture of school children in the short and long term. Carrying a lot of heavy burden when going to school or using bags that are not right in the long run can cause muscle problems such as back pain in school

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children. A heavy school bag can be an acute, short-term and chronic risk, as well as a long-term health problem (Maureen, 2005).

A bag that is too heavy can cause long-lasting bone damage (Lisanti et al., 2017). Back pain can cause chronic conditions that make the child's posture bent. Elementary school children are at a developmental age, and it is important for them not to carry excessive burdens. Postural development takes place through a series of stages that occur when school-aged children (Cosma G, 2015). A heavy school bag can change a child's posture and also the musculoskeletal system. In addition, external forces such as bag weight can affect normal growth, children's development and also the maintenance of their body alignment, which can pose a major threat to the integrity of posture (Shivananda, 2013).

In Indonesia alone, according to Hendri (2017) data on people with low back pain are not yet known with certainty, but it is estimated that people with low back pain in Indonesia vary between 7.6% to 37% of the population in Indonesia. Balague reported that in a year, the prevalence of low back pain in schoolchildren aged 12-17 years was 26% in Switzerland (Jones, 2004). A recent study of elementary school children from urban areas in India revealed 60.6% of boys and 65.7% of girls reported muscle pain and lower backbone (Balamurugan, 2014). A cross-sectional descriptive study conducted in Uganda East Africa, involving 532 children from six primary schools reported that around 30.8% of children carried school bags that exceeded 10% of body weight. About 88.2% of students reported experiencing bodily pain, especially in the neck, shoulders and upper back. In addition, 35.4% of children report that the causes of musculoskeletal pain experienced are caused by the burden of a school bag being carried (Mwaka ES, 2014). Furthermore, a study in Brazil conducted in 2013 showed that the prevalence of musculoskeletal pain was 51% found in elementary school children (Pereira DS, 2013).

Previous research on elementary school children found that there was a relationship between the weight of a school bag and the angle of trunk inclination if someone carried a bag with a burden of more than 20% of his body mass (Hong, 2003). In some countries, the set limits for recommended bag and literature weights do not exceed the range of 10 to 15% of schoolchildren body weight (Cardon, 2005). According to the World Health Organization, school bags should not exceed 10% of a child's weight. Musculoskeletal complaints in the back area can occur if the weight of a school bag carried by a school child exceeds 10% of body weight.

Many studies have shown that most school children use school bags weighing more than 10% body weight (Lisanti et al, 2017). The study also found a change in the trunk towards the front in children aged 11 to 13 years if carrying a burden of more than 17% of body mass (Pascoe, 1997). Back pain most often occurs at a time of rapid growth (rapid growth) when the age of 11 to 16 years. The stage of bone growth continues until the age of 20 years (Arnsdorff, 2002). But the information about bag load to anthropometry per level of student class still limit information. So this research aimed to know how was the bag load to anthropometry of an elementary school in each grade.

METHODS

This was an observational descriptive research with cross sectional study design because all conditions are observed at the same time. Data collection was conducted from September to November 2019 at one of private Elementary School in Medan, North Sumatera, Indonesia. There were 268 children participated in this research, and we divided subjects into three categories Level I (Class I and II), Level II (Class III and IV) and Level III (Class V and VI) that meet the inclusion and exclusion criteria. The data used are primary data that is directly obtained from the subject by weighing, measuring height, weighing the weight of the bag and conducting interviews about how to carry the bag, the duration of carrying the bag and the pain felt in the back area. The data collected is processed and analyzed using the SPSS computer program.

RESULTS

Characteristics of respondents based on the age of the child, gender and nutritional status from level I to III, can be seen at table 1. From table 1, we shown that the average nutritional status of students were normal.

The average of body weight and bag weight among levels were not difference (table.2)

Table 2 Average body weight and weight of the bag based on grade level

	Mean	SD
Level I		
Body weight	24.49	6.071
Bag weight	2.54	0.898
Level II		
Body weight	29.11	0.898
Bag weight	2.35	0.954
Level III		
Body weight	35.45	10.812
Bag weight	2.26	0.960

Level I = class 1-2, Level II = class 3-4 dan Level III= class 5-6. SD = standard deviasi

Table 1 Characteristics of respondents based on the age of the child, gender and nutritional status of students in level I to III

Respondent Characteristics	Frequency(n)	Percentage(%)
Level I Age		
<6 yeras	40	47.6
>6 years	44	52.4
Total	84	100
Sex		
Boys	40	47.6
Girls	44	52.4
Total		100
Nutritional Status		
Obesity	26	31.0
Overweight	9	10.7
Normal	36	42.9
Malnutrition	13	15.5
Heavy malnutrition	0	0
Total	84	100
Level II		
Age		
<8 years	44	46.3
>8 years	51	53.7
Total	95	100
Sex		
Boys	57	60.0
Girls	38	40.0
Total	95	100
Nutritional Status		
Obesity	27	28.4
Overweight	1	1.1
Normal	51	53.7
Malnutrition	16	6.8
Heavy malnutrition	0	0
Total	95	100
Level III		
Age		
<10 years	50	56.2
>10 years	39	43.8
Total	89	100
Sex		
Boys	52	58.4
Girls	37	41.6
Total	89	100
Nutritional Status		
Obesity	25	28.1
Overweight	3	3.4
Normal	38	42.7
Malnutrition	23	25.8
Heavy malnutrition	0	0
Total	89	100

From table 2, the students's weight increases with age. The higher the weight level of the bag will decrease even though the difference in average bag weight per level is not much different. A students's weight at level 1 is less than a students's weight at level II

and III. The weight of a students's bag at level I is more than the weight of a students's bag at level II and III.

Table 3 Comparison of bag weight and body weight of students

	Mean	SD	Maximum	Minimum
Level I	10.86	4.280	4	21
Level II	8.23	3.743	1	21
Level III	6.65	3.091	2	18

Level I = class 1-2, Level II = class 3-4 dan Level III= class 5-6. SD = standard deviasi

From table 3 above, it is known that the average weight ratio of bags to the weight of students is greatest at level I. The results of this study indicate that students in level I carry their bags >10% of their body weight, but that was not in level II dan III.

Table 4 The average weight ratio of bags to the weight of the school students based on mild, moderate and heavy categories

	Frequency(n)	Percentage (%)
Light	106	69.4
Moderate	63	23.5
Heavy	19	7.1
Total	268	100

Based on table 4.4 it can be seen that the majority of students are included in the mild category. In this study, the mild category was 69.4%, the moderate category was 23.5%, and the heavy category was 7.1%. The results of this study indicate that the majority of the school students carry bags that do not exceed 15% of their body weight.

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Table 5 The average students bag weight to body weight based on the nutritional status

Category	Bag weight		
	Mild	Moderate	Heavy
	n (%)	n (%)	n (%)
Obesity	32 (44.4%)	31 (43.1%)	9 (12.5%)
Overweight	7 (38.9%)	8 (44.4%)	3 (16.7%)
Normal	99 (76.2%)	27 (20.7%)	4 (3.1%)
Malnutrition	39 (81.3%)	8 (16.6%)	1 (2.1%)

Based on table 5, it is known that the bag weight exceeds 10% of body weight is mostly found in the students with obesity and over nutrition status.

Table 6 The average bag weight category for the weight of students based on height

Category	Bag weight		
	Mild	Moderate	Heavy
	n (%)	n (%)	n (%)
Normal	177 (66%)	74 (43.1%)	9 (12.5%)
Short	7 (38.9%)	8 (44.4%)	3 (16.7%)
Very Short	99 (76.2%)	27 (20.7%)	4 (3.1%)
Total	39 (81.3%)	8 (16.6%)	1 (2.1%)

Based on table 6, it is known that the height of all Siti Hajar Elementary School children is in accordance with their age and the bag weight of the students mostly found in mild category.

Table 7 Ways of carry bags

	Frequency(n)	Percentage (%)
Two shoulders	238	69.4
One shoulder	63	23.5
Dragging	19	7.1
Total	268	100

Based on table 7, it is known that most children carry bags to school using two shoulders.

Table 8 Duration of carrying bags

	Frequency(n)	Percentage (%)
< 30 min	164	61.7
>30 min	104	37.4
Total	268	100

Based on table 8 above, it can be seen that most children carry their bags in less than 30 minutes

Table 9 Low back pain

Back pain	Frequency(n)	Percentage (%)
Positive	13	4.9
Negative	255	95.1
Total	268	100

Based on table 9, it can be seen that the majority of students do not have experience back pain.

DISCUSSION

In this research, the researcher do interview to students for several questions due to any other stuff that they carried in the bag except books. Through interviews, it was found that students supplied such as textbooks, notebooks, water bottles, stationery, prayer equipment, etc, which were put in school bags. The amount of equipment somehow put in the bag will affect the bag load. From the results of the study, researchers found that the average weight of student's bag starting from level I to level III were 2 kg (table 4.4). When compared to the weight of the bag with the student's weight, most were in the mild category, even though there were 14.3% bag weight with a heavy category at level I, 5.3% at level II and 2.2% at level III. From the results of the test, it can be seen that the increase in body weight due to aging, the weight of the bag of 2 kg does not become heavy for the school students. (table 4.2)

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The students's body weight increases with increasing age because there is an increase in size in the framework of muscles and other organs, while the weight of the bag depends on the contents of the bag. According to Legiran (2008), carrying a bag that is too heavy will cause the spine to bend toward the front exceeding the normal limit or hunchback (kyphosis) because it holds the weight on its back. Kyphosis can occur when the spine in the upper back undergoes deformatic changes. Deformatics can also be caused by various health problems including osteoporosis, disc degeneration, congenital defects and also Marfan or Prader-Willi syndrome.

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In this study, we found that the average of bag weight in most students less than 10% body weight except in level I. This result was different from the Legiran study (2018) which found that quite a lot of school children carry bag weight that exceeds 15% of their body weight. This study is also different from the research conducted by Haselgrove (2008) where Haselgrove found that there were 50% of students carrying 10-15% body weight, 38% carrying loads > 15% body weight and only 12% students carrying <10% burden body weight. Our results different from Legiran, it might be because our research place has cabinet for each students. So, they can put few things that might be continued to bring, leave in their cabinet.

Bag weight that exceeds 10% of body weight is classified in the heavy category. Severe categories can cause the risk of back pain. According to the ACA (*American Chiropractic Association*), the weight of a bag carried by a school student should not be more than 10% of their body weight. A relatively larger bag weight will

affect the curvature of the spine. This change in posture can cause back pain and injury by compressing ligaments or spinal muscles or by changing the forces acting on the intervertebral discs (Fernandes, 2008)

The risk of back pain can also be caused by the wrong way to carry a bag and the duration of carrying a heavy bag. In this study, it was found that the majority of students way carried a bag with 2 shoulders (table 4.7) and the duration of carrying the bag was mostly less than 30 minutes (table 4.8) From the 268 students there were 13 children who experienced back pain (table 4.9). Of the 13 students, the majority of those experiencing back pain are from level I and II, with normal nutritional status, the bag weight category is heavy with a duration of time carrying a bag less than 30 minutes (table 4.11). When compared with the study of Hadeel Fadhil Farhood (2013), the prevalence of low back pain was 36.8% of 242 school children in the Hilla City school, Babylon Iraq. This is caused by most children carrying heavy school bags when going to school every day, and there is an increase in burden when reaching higher grades.

The results of this study are consistent with the results conducted by Humaira (2017) stating that as many as 92 school children in SD Negeri No. 064034, Medan, Johor carry bags using two shoulders. From research Gusti Ayu (2016) states that the technique of lifting weights in the way carried must use both shoulders so that the weight carried can be supported equally by both shoulders. If that is the burden carried on the shoulders is not balanced will have an impact on posture. The burden will be reduced if the bag is carried using two shoulders. While the results obtained in this study relating to the duration of carrying a bag are different from the research conducted by Haselgrove (2008), which found that nearly 50% of children carry their school bags for more than 30 minutes in a day. Carrying a heavy school bag for a long period of time can result in recurring injuries and stress on body growth. The students follows the shift in the center of gravity toward the load when carrying a school bag

The Legiran study (2018) of 100 children found that 5-30 minutes long use of bags from home to school every day with an average bag weight of 5.267 kg or 12.3% of body weight, causing shoulder pain 47.8%, pain in the lower back 21.6%, and pain in the neck as much as 18.2%. Excessive weight lifting by the body can cause injury to muscles and bones because of the heavy burden carried can reduce the thickness of the interverbal disc or elements that are between the spine, and this causes back pain. (Legiran, 2010)

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CONCLUSION

The bag load that carried by students still in tolerance category, and most of the student carried their bag with the safety way to their back. But parents and school management must consider to class 1 and class 2 student for things and the way their carried their bag. Because of their age and body weight, bring many thing in their bag in long duration can be risk to back pain.

REFERENCES

1. ACA. 2004. Backpack misuse leads to chronic back pain. Doctors chiropractic say Diakses pada: 27 nopember 2019, diakses dari : <http://www.acatoday.org>
2. American Academy of Orthopaedic Surgeons. 2015. Backpack Safety. Diakses dari <http://orthoinfo.aaos.org/topic.cfm?topic=a00043> Diakses pada, 29 Nopember 2019
3. Anggraeni, A. C. 2012, Asuhan gizi nutritional care process. Yogyakarta: Graha Ilmu, hal. 11.
4. Arnsdorff, M. 2002, Mounting research on backpack use. Published in ICPA Newsletter May-June.
5. Azuan, M., Zailina, H., Shamsul, B. M. T., Asyiqin, N., Azhar, M. N., & Aizat, I. S. 2010, Neck, upper back and lower back pain and associated risk factors among primary school children. *Journal of Applied Sciences*, 10(5),431-433
6. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI. 2010. Riset Kesehatan Dasar (Riskesdas 2010). Kementerian Kesehatan Republik Indonesia, Jakarta
7. Balamurugan, J. 2014, School bags and musculoskeletal pain among elementary school children in Chennai city. *Int J Med Sci Clin Invent*, 1(6), 302-9.
8. Balitbang Kemenkes RI, 2013, Riset Kesehatan Dasar; Riskesdas, Jakarta
9. Bisara, D dan Mardiana. 2010. Kasus Kecelakaan Pada Murid Sekolah Dasar di Kecamatan Mentewe, Kabupaten Tanah Bumbu Kalimantan Selatan Tahun 2010.
10. Byers, S.N. 2008. *Basics of Human Osteology and Odontology. Introduction to Forensic Anthropology. Third Edition. Boston.* p 28-59
11. Cardon, G. M., & Balague, F. 2005, Are children's backpack weight limits enough? A critical review of the relevant literature. *Spine*, 30(9).
12. Dalimartha, S. 2002, Resep tumbuhan obat untuk penderita osteoporosis. Penebar Swadaya, Jakarta.

12. Dewi.A.P.A.G, Widyastuti.P.A.I, 2016, Gambaran Perubahan Postur Tubuh pada Siswa Sekolah Menengah Pertama (SMP) Akibat Penggunaan Tas Punggung Berat, Dosen Keperawatan Medikal Bedah Sekolah Tinggi Ilmu Kesehatan (STIKES), Bali.
13. Ehrlich G.E. Low back pain. Bulletin of the World Health Organization.
14. Evelin C. Pearce, 1999, Anatomi dan Fisiologi Untuk Paramedis, PT Gramedia Pustaka Utama, Jakarta.
15. Fauzan M.T. 2013, Hubungan Antara Faktor Pekerjaan Dengan Kejadian Low Back Pain Pada pekerja Servis Industri bengkel Mobil di Makassar Tahun 2013.
16. Haselgrove C, Straker L, Smith A, O'Sullivan P, Perry M, Sloan N,2008, Perceived school bag load, duration of carriage, and method of transport to school are associated with spinal pain in adolescents: School of Physiotherapy, Curtin University of Technology, Perth, Australia.
17. Hendri, E. F., & Dewi, A. P. 2014, Hubungan penggunaan backpack dengan kejadian low back pain pada mahasiswa Universitas Riau. Jurnal Online Mahasiswa (JOM) Bidang Ilmu Keperawatan, 1(2), 1-9.
18. Hong, Y., & Cheung, C. K. 2003, Gait and posture responses to backpack load during level walking in children. *Gait & posture*, 17(1), 28-33.
19. Humaira, Afriza, 2017, Gambaran Nyeri Punggung pada Anak pengguna tas punggung di SD Negeri No. 064034, Medan Johor, Fakultas Keperawatan , Universitas Sumatera Utara
20. Indriati, E. 2010, Antropometri untuk kedokteran, keperawatan, gizi, dan olahraga. Yogyakarta: PT Citra Aji Parama..
21. Irianto K. 2004, Struktur Dan Fungsi Tubuh Manusia untuk Paramedis, Yrama Widya, Bandung.
22. Kharismawati.R,2010,Hubungan tingkat asupan energi, protein, lemak, karbohidrat dan serat dengan status obesitas pada siswa SD Semarang,Universitas Diponegoro.
23. Lai, J. P. H., & Jones, A. Y. M. 2001, The effect of shoulder-girdle loading by a school bag on lung volumes in Chinese primary school children. *Early human development*, 62(1), 79-86.
24. Lane N. E. 2001, Osteoporosis, PT Raja Grafindo Persada, Jakarta.
25. Lee PB, JC Kim ,CJ Lee, 2006, Efficacy of Pulsed Electromagnetic therapy on Chronic Lower Back Pain, a Randomized Double Blind Plasebo Controlled Study. *Journal of International Medical Research* 34 No 2 p.160-167.

26. Legiran, Suciati.T, Pratiwi.R Hubungan antara penggunaan tas sekolah dan keluhan muskuloskeletal pada siswa sekolah Fakultas Kedokteran, Universitas Sriwijaya, Palembang.
27. Lisanti, L., Martini, M., & Widjasena, B. 2017, Hubungan Penggunaan Tas Punggung dengan Keluhan Muskuloskeletal pada Siswa MI Nashrul Fajar Meteseh Kecamatan Tembalang Kota Semarang. *Jurnal Kesehatan Masyarakat (e-Journal)*, 5(4), 409-417.
28. Maizura, F. 2015, Faktor–Faktor yang Berhubungan dengan Keluhan Nyeri Punggung Bawah (NPB) pada Pekerja di PT. Bakrie Metal Industries tahun 2015..
29. Markenson JA. 2004, An In-Depth Overview of Osteoarthritis for Physician.9, no.2,pp. 41-50.
30. McEvoy, Maureen P., McEvoy & Grimmer, K. 2005, Reliability of upright posture measurements in primary school children.
31. Mwaka, E. S., Munabi, I. G., Buwembo, W., Kukkiriza, J., & Ochieng, J. 2014, Musculoskeletal pain and school bag use: a cross-sectional study among Ugandan pupils. *BMC research notes*, 7(1), 222.
32. Netter, Frank H. 2014, Atlas Of Human Anatomy 25th Edition. EGC, Jakarta.
33. Pascoe, D. D., Pascoe, D. E., Wang, Y. T., Shim, D. M., & Kim, C. K. 1997, Influence of carrying book bags on gait cycle and posture of youths. *Ergonomics*, 40(6), 631-640.
34. Pulat, B. Mustafa. 1992, Fundamentals of Industrial Ergonomic. AT & T Network System. Oklahoma.
35. Purnamasari, H., Gunarso, U., & Rujito, L. 2010, Overweight sebagai faktor resiko low back pain pada pasien Poli Saraf RSUD Prof. Dr. Margono Soekarjo Purwokerto. *Mandala of Health*, 4(1), 26-32.
36. Roger,W. 2002, Anatomi dan Fisiologi, Buku Kedokteran EGC, Jakarta.
37. Rusbandi Sarpini, 2017, Anatomi Dan Fisiologi Tubuh Manusia, IN MEDIA, Bogor.
38. Saladin,Kenneth S. 2011, Human Anatomy, Third Edition, McGraw-Hill, New York.
39. Sherwood, Lauralee. 2012, Fisiologi Manusia dari sel ke sistem, Buku Kedokteran EGC, Jakarta.
40. Shivananda, S. V., Yakub, S., & Babu, M. 2013, Analysis of cervical and shoulder posture in school children using backpack experimental study. *International Journal of Physiotherapy and Research*, 1(1), 36-41.

41. Snell R.S. 1997, Anatomi Klinik Untuk Mahasiswa Kedokteran .Bagian 1.Edisi 3.Alih Bahasa Adji Dharma. EGC, Jakarta,pp.1-55.
42. Soetjningsih,DSAK. 1995, Tumbuh Kembang Anak, Buku Kedokteran EGC, Jakarta.
43. Suharyanto, 2001, skripsi Kaitan sosial ekonomi keluarga dan konsumsi energi protein dengan status gizi anak sekolah di Desa Sumber Agung, Banjarejo,Kabupaten Blora
44. Sukfitrianty Syahrir, 2011 Gambaran Status Sosial Ekonomi dan Status Gizi Anak SD NO. 234 Inpres Takalar Kota Kabupaten Takalar Tahun 2011, Fakultas Ilmu Kesehatan , Universitas Islam Negeri Alaudin Makassar
45. Sugianto, S., Rasmana, S. T., & Wibowo, M. C. (2013). Perbaikan Kualitas Citra Sinar X Tulang Belakang Penderita Skoliosis Dengan Menggunakan Gaussian Cropping. Journal JCONES, 2(1).
46. Suma'mur, P. K. 2009, Higiene perusahaan dan kesehatankerja (HIPERKES). Jakarta: Sagung Seto, 116-32.
47. Supariasa. 2001, Penilaian Status Gizi. Buku Kedokteran EGC, Jakarta.
48. Syaifuddin,H. 2002, Fungsi Sistem Tubuh Manusia, Widya Medika, Jakarta.
49. Tarwoto Ns, 2009, Anatomi dan Fisiologi, CV Trans Info Media,Jakarta.