Correlation Between Backpack Weight and Shoulder Pain in Children Aged 6-11 (A Case in Elementary School in Makassar Indonesia)

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Abstract

Using a Backpack is one of the musculoskeletal complaints in children. A backpack with a heavy load can affect posture changes and harm the spine and musculoskeletal problems. The burden carried in a school backpack is a risk factor arising from back pain, which symptoms can last into adulthood. A backpack often results in complaints of the neck, shoulders, lower back, and other potential risk factors. Early detection of complaints in the neck, shoulders, wrists, back, knees, and feet is necessary to maintain musculoskeletal function. The purpose of the study was to determine the relationship between backpack weight and musculoskeletal pain (shoulder pain) in children aged 6 to 11 years old attending an elementary school in Makassar, Indonesia. The study was a descriptive study with an observational approach using a cross-sectional study design. There were 66 elementary students involved as volunteers. This study concluded that the backpack's weight had a statistically significant effect on the amount of shoulder pain experienced by students. The heavier the bag, the more likely pupils will experience shoulder pain. The development of shoulder pain due to backpack use is due to the backpack straps squeezing and tensing the shoulders so that as the bag's weight increases, the tension on the shoulders increases as well.

Keywords: school backpack, musculoskeletal, body posture, backpack load, and risk.

1. Introduction

Physical development or biological growth is an essential aspect for individuals, especially for elementary school-age children, either directly or indirectly. Physical development will directly determine children's movement skills while indirectly will affect the way they see themselves and others (Puspita *et al*., 2018). Physical development and growth occur optimally in elementary school children. The physical growth of school-age children will also have an impact on their adjustment patterns to the environment.

Children aged 0-12 years have the potential for interference during all stages of physical and mental development, depending on their level of physical activity and developmental stage (Mahendrayani, 2014). Watson et al., 2002; and Murphy et al., 2007 discovered that children and adolescents frequently experience skeletal muscle pain.

School bags are one of the causes of musculoskeletal complaints in children (Dockrell et al., 2015). School bags with heavy weights can affect posture changes and are harmful to the spine (de Paula et al., 2015) and musculoskeletal problems (Diana et al., 2011). The burden carried in a school backpack is a risk factor for back pain, which symptoms can last in adulthood (de Paula et al., 2015).

The use of school bags often results in complaints of the neck, shoulders, and lower back and other potential risk factors (Dianat et al., 2011; Dianat *et al.*, 2013; Dockrell et al., 2015; Al-saleem *et al.*, 2016). Early detection of complaints on the neck, shoulders, wrists, back, knees and feet are necessary to maintain musculoskeletal function (Tomaru *et al.*, 2019).

Musculoskeletal pain is a common complaint in children caused by daily activities (Cattalini and Cimaz, 2017). The high prevalence of associated musculoskeletal problems is associated with gender et al., 2011). Identifying musculoskeletal limb complaints in children is difficult, so it is critical to develop prevention and treatment strategies at a young age (Fuglkjr et al., 2017). The prevalence of musculoskeletal complaints is very high among school children, requiring precautions and safe backpack load limits (Dianat, Javadivala, and Allahverdipour, 2011). The use of an unsuitable backpack can affect changes in posture and gait in children (Dumondor, Angliadi, and Sengkey, 2015).

The majority of Makassar City elementary school children use backpacks to hold their school supplies. This study aimed to investigate the association between backpack weight and musculoskeletal pain (shoulder pain) in children aged 6-11 years in Makassar, Indonesia.

2. Literature Review

Table 1 summarizes several researches on the musculoskeletal system in children. Several studies have examined the relationship between musculoskeletal load with children's school bags (Adeyemi, Rohani, and Abdul Rani, 2014; de Paula, Silva, and Silva, 2015; Dockrell, Simms, and Blake, 2015). Musculoskeletal problems can affect a child's physical activity (Krul *et al.*, 2009). But it is difficult to get a picture of musculoskeletal complaints, so prevention strategies are needed (Fuglkjær, Dissing, and Hestbæk, 2017). Getting good musculoskeletal examination results must use a high-quality questionnaire (Tomaru *et al.*, 2019). Researchers examined the relationship between schoolbags and musculoskeletal complaints among 529 primary school children, the majority carrying backpacks 93.8% and 89.7% carrying backpacks over their shoulders (Dockrell, Simms and Blake, 2015). In India, as many as 165 children (55.2%) reported experiencing a prevalence of idiopathic musculoskeletal pain (Kumar *et al.*, 2017). Musculoskeletal symptoms are more prevalent in children's lower limbs than in their upper extremities (Fuglkjr, Dissing, and Hestbk, 2017). A total of 615 samples of pre-adolescents aged 7 - 12 years, more than 70%, proving that backpack weight has a significant effect on back pain (Adeyemi, Rohani, and Abdul Rani, 2014).

According to several studies, children's musculoskeletal difficulties can be caused by carrying a hefty school bag (Al-saleem *et al.*, 2016; Zaidi *et al.*, 2016). Most children carry heavy school bags. (Farhood, 2013). The average load carried by school children is 2.9kg, representing 10% of their body weight (Dianat, Javadivala, and Allahverdipour, 2011). Although the amount of burden carried by children within the recommended limit is 10% - 15% of body weight, but the prevalence of musculoskeletal problems is still very high (Dianat *et al.*, 2013). In Karachi, Pakistan, many students carry school bags over 10% - 15% of their body weight, thus risking back problems (Zaidi *et al.*, 2016). In schools in Al-Ahsa, Saudi Arabia, as many as 1,860 out of 2,567 students carry bags heavier than 15% of their body weight (Al-saleem *et al.*, 2016). Ten male students at Kobe University in Japan underwent an experimental test with backpacks weighing 10%, 15%, and 20% of their body weight. The researcher discovered that a backpack weigh 20% of body weight induced significant kinematic changes in the torso, indicating that the backpack's weight should be limited to 15% of body weight (Al-Khabbaz et al. 2010). The weight of a safe backpack must be a weight that almost all students can carry (Ismaila, 2018).

Table 1. Study of musculoskeletal in children

Author	Sample	Methods	Results and Conclusions
Tomaru Y et al., 2019	1.844 students who checked directly and 22.949 questionnaires	Conduct direct examination of students by seven different orthopedic experts and screening questionnaires.	This study shows a comparison between the results of direct examination and questionnaire in musculoskeletal problems. The accuracy and reliability of the questionnaire depending on the quality of the questionnaire
Dockrell S, Simms C and Blake C, 2015	529 school children with 55.8% boys and 44.2% girls	Cross-sectional survey and quasi-experimental pretest-posttest	Most children in Irlanda carry backpacks at 77.5%, with the prevalence of musculoskeletal at 63.4%. Complaints are often felt on the shoulder 27.3% and the back 15%.
Kumar G et all, 2015	1.018 school children aged 5-16 years	Cross-sectional study	The prevalence of idiopathic musculoskeletal pain in schoolchildren aged 5-16 years is significant for daily activities.
McGowan J, Whatman C and Walters S 2019	914 children in New Zealand	Cross-sectional survey study	The group of children aged 10-13 years shows no significant relationship between the initial movement during exercise with a history of injury.
Ranelli S, Straker L and Smith A, 2011	731 children aged 7-17 years who study musical instruments at an Australian government school	Survey and questionnaire	A high prevalence of musculoskeletal problems is an essential issue for children and adolescents who learn musical instruments
Draheim N and Hügle B, 2018	Summarizes some articles about musculoskeletal	Literature review	Musculoskeletal pain that occurs throughout life, which is a recurring condition, can occur in children and adolescents.
Fuglkjær S, Dissing K B and Hestbæk L, 2017	19 general studies and three clinical studies with children aged 0-19 years	MEDLINE and EMBASE are searched electronically	This review shows the prevalence of musculoskeletal complaints in children, adolescents with eye analysis. But the results are considered not feasible because of studying heterogeneity.
de Paula A J F, Silva J C P and Silva J C R P, 2015	916 students aged 10-19 years	Cross-sectional study	The results of the study concluded that the burden of student backpacks is not following biomechanics and ergonomics, especially for younger children and women who are still in the growth phase, so that there is a greater risk of developing spinal cord injuries that impact adulthood
Adeyemi A J, Rohani J M and Abdul Rani M R, 2014	615 children aged 7 - 12 years	Survey and questionnaire	This study proves the significant influence of backpack weight on children with back pain in elementary schools
Ismaila S O, 2018	324 high school students in Ibadan, Nigeria	A strain energy-based model	A safe backpack for high school students is 2.87kg (5.18% of body weight) for men and 2.53 kg (4.91% of body weight) for women.

Table 1. Study of musculoskeletal in children (Continued)

Author	Sample	Methods	Results and Conclusions
Dianat I, Javadivala Z and Allahverdipour H, 2011	307 elementary school children in Tabris, Iran aged 7-12 years	Cross-sectional study	The average weight of a child's school bag is 2.9 kg, around 86% of children report several types of musculoskeletal symptoms.
Dianat I, 2013	307 Iranian primary school children aged 7-12 years who are in grades 1 - 5.	Cross-sectional study	Class 1 students carry an average of 2.5 kg in the weight of their bags, while the higher class carries 3 - 3.2 kg. The study results prove that the current recommended bag weight may not be suitable for elementary school children, so the guidelines must consider other factors.
Dianat I, 2014	586 students aged 12-14 years	Cross-sectional study	The average load of a schoolboy's backpack is 2.8 kg. The main finding in the study was the occurrence of lower back, neck, and shoulder complaints that were relatively high in girls compared to boys.
Al-Saleem S A, 2016	2,567 school children in the Al-Ahsa area, Saudi Arabia	Observational cross-section	The results found that 41.1% of female students and 31.2% of male students carried school bags> 15% of their body weight which meant more than the highest limit according to international guidelines.
Mandic S, 2018	A total of 331 parents, 682 teenagers from New Zealand	Survey and questionnaire	The average weight of a school bag among teenagers is 5.6 kg. 68.3% of parents feel that teenage school bags are too heavy. Then 57.8% of teens feel too heavy to be carried by walking and 65.8% to be taken by bicycle.
Abdon A P V et al., 2018	361 women aged 18-35 years	Cross-sectional study	The results showed 61.7% of women complained of shoulder pain because the weight of their bags was 4.02% heavier than their body weight.
Johnson O E, 2011	381 middle school students in Nigeria	Cross-sectional study	The results of the study revealed that the relationship between backpack weight and pain was not significant. The average total bag weight is 4.48 kg, with BPWT 10.16%, and 65% of them carry backpacks.
Zaidi S M H,2016	Children aged 9-16 years	Cross-sectional study	The results showed that bag weight had a significant risk factor for musculoskeletal pain.
Farhood H F, 2013	242 elementary school students, 116 boys and 126 girls aged 6-12 years	Cross-sectional study	31% of students carry bags with average weight, 28.5% lighter, and 40.1% have heavier loads. The percentage of the weight of a girl's schoolbag is higher than that of a boy.

3. Methods

This type of research is a descriptive study with an observational approach using a cross-sectional study design to determine the relationship between backpack weight and pain in children aged 6-11 years. Sampling was done using

a purposive sampling technique involving only students aged 6-11 years and using a backpack to store their belongings when going to school. Based on these criteria, the number of samples obtained in this study was 66 students, where 56% is women (Figure 1). Samples were taken from students of SDN Bawakaraeng II Makassar. Table 2 provide the age-frequency distribution of the volunteers.

The SPSS 24 software was used to analyze the data and determine the association between backpack weight and student shoulder pain. The Kolmogorov Smirnov test is used to determine whether the data in the study is normally distributed.

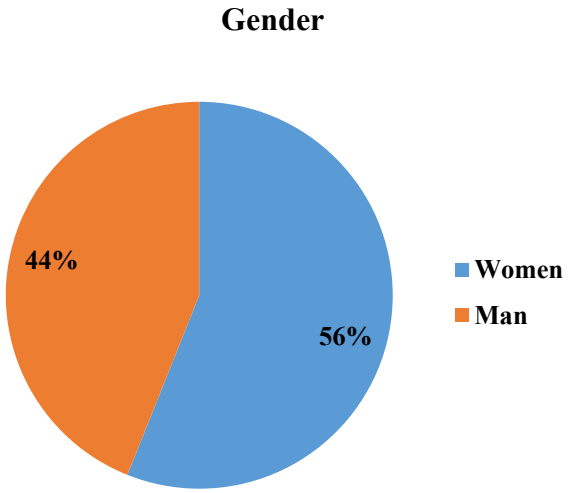

Figure 1. Characteristics of respondents based on gender (n = 66)

Table 2. Age-frequency distribution

Age	Frequency	%
6 years	12	18.18
7 years	11	16.67
8 years	2	3.03
9 years	20	30.30
10 years	14	21.21
11 years	7	10.61
	n = 66	**100**

4. Results and Discussion

Most (68.18%) students aged 6 - 11 years at SD Negeri Bawakaraeng II carry a 3.1 to 3.5 kg backpack. Besides bringing notebooks and textbooks, they generally bring lunchbox and drink water bottles (Table 3).

Table 3. Frequency distribution of backpack weight for children aged 6 - 11 years

Backpack Weight (kg)	n	%
2,5 - 3	19	28.79
3,1 - 3,5	45	68.18
3,6 - 4	2	3.03
Amount	**n = 66**	**100**

Table 4. Frequency distribution of shoulder pain complaints

Backpack Weight (kg)	Pain	Painless	n
2,5 – 3	2	17	19
3,1 - 3,5	24	21	45
3,6 – 4	2	0	2
Amount	**28**	**38**	**66**
Percentage (%)	**42.42**	**57.58**	**100**

The percentage of students who felt complaints of pain in the shoulder was 42.42%, while those who did not feel pain were 57.58%. Most complaints came from students who carried backpacks of 3.1 - 3.5 kg (Table 4). The heavier the backpack, the greater the pressure on the backpack strap against the shoulder Rai dan Agarawal (2013). Other research indicates that the type of strap used to secure a load carried on the shoulder can affect a person's physiological capacity (Bakri, 2012).

Table 5. Frequency distribution of shoulder pain complaints

Chi-Square Tests			
	Value	**df**	**Asymptotic Significance (2-sided)**
Pearson Chi-Square	30.400[a]	9	.000
Likelihood Ratio	36.523	9	.000
Linear-by-Linear Association	23.514	1	.000
N of Valid Cases	66		

a. 15 cells (75.0%) have expected count less than 5. The minimum expected count is .85.

The connection between backpack weight and shoulder pain in children was determined using a bivariate test utilizing the chi-square test. The findings indicated a high correlation between backpack weight and musculoskeletal pain in children aged 6-11 years ($p = 0.000$). The results of this study are in line with several previous studies, including research conducted by Fathoni (2013). Research conducted by Pradnya Ayu Dewantari and Adiputra (2017) also found a significant relationship between backpack weight and complaints of low back pain, shoulder pain, and neck pain of elementary school students. They also found that complaints of shoulder pain are higher than complaints of low back pain and neck pain. Suciati and Pratiwi (2018) underlined that the prevalence of musculoskeletal complaints most often felt by elementary school students was in the shoulder area (32.5%), followed by the neck (29.9%), back (22.7%), and the waist with a percentage of 14.9 %. The size and weight of the books that are carried, the additional weight such as lunch boxes, drinking water bottles, pencil cases, sports equipment, jackets, and laptops are the direct factors affecting the backpack's weight according to Sahib (2016). Meanwhile, indirect factors include the lack of awareness that heavy loads can affect children's health, abilities and physicality, the duration and frequency that they are carried, school assignments, and how to lift and carry bags properly.

6. Conclusion

This study concluded that the backpack's weight had a statistically significant effect on the amount of shoulder pain experienced by students. The heavier the bag, the more likely pupils will experience shoulder pain. The development of shoulder pain due to backpack use is due to the backpack straps squeezing and tensing the shoulders so that as the bag's weight increases, the tension on the shoulders increases as well.

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Biography

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