La carga de las mochilas provoca trastornos posturales en alumnos de primaria

Bag Burden Causes Posture Disorders in Elementary School Students

Authors

Hendrik Hendrik [1]
Melvi S. Tandi [2]
Andi Halimah [3]
Arpandjam'an Arpandjam'an [4]
Supartina Hakim [5]
Hasbiah Hasbiah [6]

[1] Department of Physiotherapy, Health Polytechnic of Makassar (Indonesia)
[2] Department of Physiotherapy, Health Polytechnic of Makassar (Indonesia)
[3] Department of Physiotherapy, Health Polytechnic of Makassar (Indonesia)
[4] Department of Physiotherapy, Health Polytechnic of Makassar (Indonesia)
[5] Department of Physiotherapy, Health Polytechnic of Makassar (Indonesia)
[6] Department of Physiotherapy, Health Polytechnic of Makassar (Indonesia)

Corresponding author:
Hasbiah Hasbiah
hasbiahfisiopoltekkes@gmail.com

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Abstract

Introduction: In children between 10 and 15 years, postural disorders have been diagnosed. If the disease is not treated, it will worsen with age. This can affect cardiopulmonary function, limit mobility, and cause structural problems. Early detection of postural disorders is crucial to prevent any abnormalities and injuries from worsening.
Objective: the purpose of this study was to analyze the impact of school bag or backpack loads on students with postural disorders at Paccerakkang Inpres Elementary School.
Methodology: This cross-sectional research uses observational research methods. They used observation sheets and data collected by direct measurement. The sample used was 75 primary school students from grades 1 to 3 who met the inclusion criteria of the sample size formula. The samples were gathered using simple random sampling. The study was conducted in 2023 between April and July.
Results: Compared with normal posture, there were more deviant postures. The prevalence of posture problems with the sitting position of elementary school children while studying did not have a significant relationship, according to the chi-square analysis ($p > 0.358$). The relationship between postural abnormalities and bag load was quite large ($p < 0.020$).
Discussion: Children who carry heavy bags are more likely to have posture problems than children who do not. Carrying too much on one side can lead to postural problems, and carrying an inappropriate bag can worsen pre-existing conditions.
Conclusions: Bag load impacts the prevalence of postural abnormalities in elementary school students at Inpres Paccerakkang.

Keywords

bag load; children; ergonomic; scoliosis

Resumen

Introducción: Se han diagnosticado trastornos posturales en niños de entre 10 y 15 años. Si la enfermedad no se trata, empeora con la edad. Esto puede afectar la función cardiopulmonar, limitar la movilidad y causar problemas estructurales. La detección temprana de los trastornos posturales es crucial para prevenir el empeoramiento de anomalías y lesiones.
Objetivo: El propósito de este estudio fue analizar el impacto de la carga de las mochilas escolares en los estudiantes con trastornos posturales de la Escuela Primaria Paccerakkang Inpres.
Metodología: Esta investigación transversal utiliza métodos de investigación observacional. Se utilizaron fichas de observación y datos recopilados mediante medición directa. La muestra fue de 75 estudiantes de primaria de 1.º a 3.º grado que cumplieron con los criterios de inclusión de la fórmula de tamaño de muestra. Las muestras se obtuvieron mediante muestreo aleatorio simple. El estudio se realizó entre abril y julio de 2023.
Resultados: En comparación con la postura normal, se observaron más posturas desviadas. La prevalencia de problemas posturales con la posición sentada en niños de primaria durante el estudio no mostró una relación significativa, según el análisis de chi-cuadrado ($p > 0,358$). La relación entre las anomalías posturales y la carga de la mochila fue bastante significativa ($p < 0,020$).
Discusión: Los niños que cargan mochilas pesadas tienen mayor probabilidad de tener problemas posturales que aquellos que no las cargan. Cargar demasiado en un lado puede provocar problemas posturales, y llevar una mochila inadecuada puede agravar afecciones preexistentes.
Conclusiones: La carga de la mochila influye en la prevalencia de anomalías posturales en estudiantes de primaria en Inpres Paccerakkang.

Palabras clave

bolsa de carga; ergonómico; escoliosis; niños

Introduction

Children are still undergoing a period of physical, spiritual, cognitive, and social growth and development. Most spinal postural abnormalities, however, are identified by the time a child reaches the age of ten or fifteen. Children between the ages of elementary and middle school experience this (Hammad et al., 2019; Yang et al., 2020). If this problem is not treated immediately, this condition can worsen and develop into a more serious problem, such as scoliosis, where structural changes can disrupt lung and heart function and limit movement (Molina-Garcia et al., 2020). It's critical to recognize irregularities early to avoid more catastrophic damage(Dillner, 2019).

Using bags or backpacks that are not appropriate for a child's biomechanics is one of the factors contributing to postural disorders in pupils (Layuk et al., 2020). One item that schoolchildren use to complete tasks is a bag. Children of school age frequently utilize bags as a means of transporting books, stationery, and other essentials. The bodily components most commonly impacted by disease or injury are the upper extremities (31.42%), back, including the spine and spinal cord (32.64%), and trunk (47.03%) (Sompan et al., 2024). Backpack carrying can result in both acute and long-term damage (Mohebi et al., 2018b). When schoolchildren wear backpacks heavier than what is advised, they run the danger of developing skeletal abnormalities and back ailments. Ten to fifteen percent of the child's body weight is the optimal weight range for backpacks (Perrone et al., 2018a).

A back muscular imbalance caused by bearing a heavy bag or backpack for extended periods might result in posture issues. A youngster with poor posture may be in pain, which might hinder his activities and ability to learn. Typically, parents and teachers are unaware of this disease until the kid is very young. As a result, the incidence rate in children is increasing, which is a problem for both children and families. Due to the increasing number of cases of postural disorders in students, and they are children who still need to grow, it is necessary to research the inappropriate use of bags or backpacks to prevent postural disorders. The purpose of this study is to examine how school-age children's use of bags or backpacks affects their aberrant posture.

Method

A cross-sectional approach was employed in this investigation and was observational analytical. Analyzing the connections between the variables influencing postural problems in elementary school pupils was the aim of this study.

Participants

Students in classes 1 through 3 at SD Inpres Paccerakkang participated in this study, which was carried out between April and May 2023. Students in classes 1-3 at SD Inpres Pacerakkang made up the study's population, and they were restricted by the following inclusion criteria: 1) bringing a backpack or bag to school, 2) spending a minimum of two hours per day studying while seated, and 3) free from musculoskeletal conditions affecting the spine, pelvis, and legs, resulting in 90 people. The researcher applied the Lemesow formula to calculate the sample size (Lemeshow et al., 1991), thus that 75 individuals made up the sample size. All hypothesis tests were performed at $\alpha < 0.05$, with an absolute precision of 0.05, and a proportion of 1.96. Simple random sampling was used for the sampling process. Before starting the study, all participants were asked about their willingness to be research subjects.

Procedure

After the subject is determined and meets the requirements, measurements are carried out which are continued by 5 evaluators from Physiotherapy students who were previously given a pre-evaluation, so that they have the same perception in the assessment according to the research instrument. Measuring students' height and weight is done by removing all footwear, and then getting on the scales while measuring their height so that data on students' weight and height is obtained. For the weight of the bag, an electric scale is used, where the bag is weighed along with all its contents. In measuring the posture of the student standing upright free from a piece of cloth so that the position of the body, especially the spine, is visible. Then the pendulum is hung from the back of the head (most prominent) to the thigh between the two legs. The pendulum position is recorded against the straight line of the spine whether

there is a change in the structure of the spine or not. Primary data in the form of student posture while studying is obtained through direct observation and photography.

Instrument

The researcher only observed two things, namely the way students sat while studying and the weight of the load carried in a bag or backpack. An observation sheet with the responses "yes = 1" or "no = 2" was used to determine whether these two factors contribute to postural problems. If the student's bag or backpack weighs more than 10% of their body weight and they do not meet the ergonomic requirements when seated, the response "yes = 1" is provided. If the student sits in an ergonomic position and the weight of the bag or backpack does not exceed 10% of the student's body weight, the response "no = 2" is provided. The height and weight of the students were measured using scales and microtoice while the height of the table and chair were the same size. The study time of grade 1-3 students has the same study time and the books brought are books studied in a day, both notebooks, printed books, and stationery that have been distributed by the school (according to the education curriculum), so they are considered relatively the same. Measurements are also carried out using a pendulum to determine whether or not there are abnormalities in body posture that manifest as scoliosis, lordosis, and kyphosis. The use of pendulum instruments is considered to have validity and reliability against standard instruments because pendulums are one of the measuring instruments that have been used in several previous research results and are considered still relevant. This instrument is used because it is more practical for field research, and easy to apply without ignoring the results (37. Fraye Watson). All data in the study were evaluated against the survey results and checklists for analysis. Meanwhile, to prevent bias against survey data and checklist data, data cleaning and confirmation were carried out with the data collector.

Data analysis

After the information was collected, the information was digitized. Furthermore, the purification of deviant data was carried out and analyzed using SPSS. Subject characteristic data were analyzed univariately, while to support the research hypothesis, descriptive analysis was applied to categorical data through the use of bivariate and frequency analysis, as shown by the Chi-square test.

This study has obtained a recommendation for eligibility from the Health Research Ethics Commission of the Makassar Ministry of Health Polytechnic has approved the research protocol number 262 / KEPK-PTKMKS / III / 2023.

Results

Descriptive Analysis

Based on student characteristics, the age of the largest sample is 8 years old, which is 40% (n=30), where having normal weight is 53.3% (n=40), and abnormal weight, which is underweight 28% (n=21), and overweight 18.7 (14). For student height in general, they have a height of 111.8 – 122.9 cm, which is 57.4% (n=43), and a height of less than 111.8 cm is 29.3 (n=22), and more than 122.9 cm is 13.3% (n=10). The largest bag weight is in the size of 1.68 kg – 3.94 kg, which is 80% (n=60), bag weight <1.68 is 9.3 (n=7), and bag weight> 3.94 is 10.7 (n=8). As many as 52% (n=39) of the total students sat ergonomically. In the sitting position factor, data was obtained that 48% (n=36) of the total students sat unergonomically. As many as 16% (n=12) of the sample people carried bags or backpacks weighing less than 10 percent of their body weight, while 84% (n=63) of the sample people carried bags or backpacks weighing more than 10 percent of their body weight. In terms of body posture, as many as 56% (n=42) of the sample people had normal body posture, while as many as 44% (n=33) of the sample people had abnormal body posture. The results of the descriptive analysis showed that the age factor did not show a significant difference because the average age of the students was one year apart. Likewise, the weight and height factors of students were generally at normal sizes compared to abnormal sizes. The bag weight factor shows that students generally bring bags to school weighing 1.68 - 3.94 kg, some even exceed 3.94 kg, meaning that the weight of students' bags brought to school generally exceeds 10% of their body weight. Thus, it can be concluded that students generally have bags with a weight that exceeds ergonomic provisions. In terms of sitting position, they tend to sit ergonomically rather than non-ergonomically while studying. Based on the bag load factor, students who carry a load of more than 10% of their body weight are more likely to experience postural disorders compared to those who carry

a load of less than 10% of their body weight. Students are more likely to have normal postures than abnormal postures, based on the bag load factor.

Table 1. Student Characteristics

Variable	n	%
Age (years)		
7	24	32
8	30	40
9	21	28
Body weight		
Underweight (<16.8 kg)	21	28
Normalweigh (16.8 kg – 39.4 kg)	40	53.3
Overweight (> 39.4 kg)		
Body height (Cm)	14	18.7
Underheight (< 111,8)	22	29.3
Normalheight (111.8 – 122.9)		
Overheight (> 122.9)	43	57.4
Bag weight (kg)	10	13.3
< 1.68	7	9.3
1.68 – 3.94	60	80
> 3.94	8	10.7
Sitting position		
Ergonomic	39	52
Non-Ergonomic	36	48
Bag or backpack load	12	16
<10% of body weight	12	16
> 10% of body weight	63	84
Body posture		
Normal	42	56
Abnormal	33	44

Quantitative Analysis

The correlation between sitting position, body posture, and weight of students' bags is shown in Table 2. To find out whether students' body posture can be affected by the weight of the bag and sitting position, observation data were examined. The table data shows that students who sit ergonomically with normal body posture are 0.32% (n = 24), and abnormal body posture is 0.2% (n = 15). While those who have a non-ergonomic sitting position when studying with normal body posture are 0.24% (n = 18), and abnormal body posture is 0.24% (n = 18). Likewise, the weight of the bag shows that students who carry bags <10% of body weight with normal body posture are 0.31% (n = 23), and abnormal body posture is 0.12% (n = 9). While students who carry bags> 10% of body weight with normal body posture are 0.25% (n = 19), and abnormal body posture is 0.32% (n = 24).

Table 2: The impact of bag load and sitting posture on pupils' body posture

Variable	Body posture		p
	Normal	Abnormal	
Sitting position			
Ergonomic	24	15	
Non-Ergonomic	18	18	0.358
Bag or backpack load			
< 10% of body weight	23	9	
> 10% of body weight	19	24	0.020*

*Significant differences, p< .05.

The results of the chi-square test analysis showed that there was no significant relationship between sitting position and postural disorders (p-value = 0.358), meaning that sitting position is not related to the occurrence of postural disorders in SD Inpres Paccerakkang students in grades 1 to 3. There is a fairly strong correlation between postural disorders and the bag or backpack load factor (p-value =

0.020), meaning that there is a significant relationship between postural disorders and bag weight in SD Inpres Paccerakkang students in grades 1 to 3.

Discussion

This study aims to analyze the effect of the weight of school bags or backpacks on students' postural disorders at SD Inpres Paccerakkang. The results of the research analysis show how elementary school students' posture is affected when using bags or backpacks that weigh more than 10% of their total body weight. Carrying a backpack that is too heavy makes the body bend forward which causes imbalance and poor posture. Biomechanically, there is flexion that is maintained for a long time so that it can cause back pain(Fuentes et al., 2022). This happens because the large weight of the bag causes unbalanced muscle contractions, resulting in changes in the position of the spine (Suri et al., 2020). Unbalanced muscle work due to the weight of the bag makes students feel uncomfortable, so they tend to look for a comfortable position even with the wrong posture, resulting in changes in posture(Ahmad & Barbosa, 2019). Carrying a bag weighing more than 10% of BMI can increase the sacral tilt by up to fifty degrees. Increased sacral tilt will change the length of the legs and cause changes in spinal posture(Suri et al., 2020).

The results showed that children who carried large bags had a higher prevalence of posture problems compared to children who did not. At this age, various variables can contribute to the development of poor posture in children(López Hernández et al., 2020). The uneven distribution of foot pressure forces on the ground is exacerbated by external stressors. In addition, carrying an inappropriate school bag or backpack has been shown to worsen pre-existing diseases(Ahmad & Barbosa, 2019; Schmid et al., 2020). In addition, carrying excessive luggage on one side can cause postural disturbances because the spine on that side is bent(Mohebi et al., 2018). Students who carry overcrowded backpacks or bags are more likely to experience musculoskeletal symptoms than students who wear backpacks or bags with the recommended weight(Perrone et al., 2018). Backpacks that are too heavy can harm the spine and shoulders(Genitrini et al., 2022; Mohebi et al., 2018). Children's musculoskeletal pain is highly correlated with the weight of their backpacks. This pain affects postural changes (Perrone et al., 2018a; Rezapur-Shahkolai et al., 2021). Bags and backpacks cause higher musculoskeletal pain in women than in men(Haroon et al., 2019; Mongkonkansai et al., 2024). It has been shown that when a child carries a bag or backpack that exceeds ten percent of their total weight, their energy consumption, trunk movements, and lung capacity all increase. These elements cause a decrease in the partial pressure of oxygen (PO2), which leads to fatigue and anaerobic respiration(Alami et al., 2020; Mwaka et al., 2014; Yao et al., 2023). Similarly, the anticipatory feedforward motor control mechanism shows that muscle fatigue and discomfort affect movement control after low-level static movements(Nawawi et al., 2024).

In other findings of this study, there was no impact of sitting position on posture. It is assumed that students sit ergonomically while studying. Ergonomic guidelines are followed in the design of tables and chairs(Bettany-Saltikov et al., 2019; Jung et al., 2021). The chairs and tables of students as subjects have been designed according to the anthropometric measurements of elementary school children who use them so that there is a balance of antagonistic and agonist muscles in the ergonomic sitting position. If the anthropometric data of the sample is ignored, there is a mismatch between the anthropometry and the study bench and table(Pooya Khoshabi, Erfan Nejati, Seyyede Fatemeh Ahmadi, Ali Chegini, Ahmad Makui, 2020). It can even cause increased intra-disc pressure on the vertebral bones(Irfan et al., 2023; Pooya Khoshabi et al., 2020). Sitting that is not ergonomic for a long time can cause postural difficulties, as well as muscle and ligament tension, especially the posterior longitudinal ligament(Tahernejad et al., 2022). Not all sitting situations are non-ergonomic, even outside the classroom. Aspects of contemporary life such as using a computer or mobile phone and watching television can also cause it. Education about the definition of ergonomic sitting position and how to avoid postural disorders is needed. In addition, a comfortable sitting position reduces tension in the back muscles(Kibria et al., 2023; Sutanto et al., 2023).

In addition to the sitting position during study sessions, other factors that can cause postural disturbances include the large shape of the bag, the load on the body, its dimensions, the length of time the load is carried, the physical attributes of the student, and their overall physical condition(Ismaila, 2018).

Clinically, the implications of the weight of school bags or backpacks on postural disorders are the increased risk of injury to the spine, shoulders, and neck. Excessive weight can cause muscle tension, postural imbalance, and even spinal problems such as postural disorders, and low back pain, which commonly affects adolescents in the back area(González-Gálvez et al., 2021). Children's mental and physical health can be affected by these postural problems. With the implications above, this study recommends that to reduce the impact of school bag weight on postural disorders, namely: 1) choosing an ergonomic bag or backpack, that has comfortable padding, and good load distribution, 2) the weight of the bag or backpack should not exceed ten to fifteen percent of the child's body weight, 3) instructing children to use both shoulders when carrying a bag or backpack so that the load is evenly distributed, 4) providing sufficient rest time for children between sessions of carrying a bag or backpack to reduce pressure on the muscles and spine, 5) training children to maintain a healthy posture and avoid sitting or standing in an improper position. This is in line with research findings which state that daily physical activity can provide important benefits for the fitness and health of people with spinal cord injuries(Oviedo et al., 2021).

This study has some limitations related to subjectivity in assessing the presence of postural disorders and needs to be supported by a more precise measuring instrument in the form of three-dimensional angle biomechanical measurements. This may have affected the results. However, the results are relevant. Coincide with other investigations and can conclude future research.

Conclusions

The sitting position is not related to the occurrence of postural disorders, but there is a relationship between postural disorders and bag load in elementary school students in Paccerakkang grades 1 to 3.

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Authors' and translators' details:

Hendrik Hendrik	padanghendrik10@gmail.com	Author
Melvi S. Tandi	melvistandi@gmail.com	Author
Andi Halimah	andihalimah66@gmail.com	Author
Arpandjam'an Arpandjam'an	arpandjaman@gmail.com	Author
Hasbiah Hasbiah	hasbiahfisiopoltekkes@gmail.com	Author
Supartina Hakim	supartinahakim@poltekkes-mks.ac.id	Translator