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Types and Load of Backpack Used by Students and Scoliosis Cases in Elementary Students

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Abstract
Health issue concerning with elementary students who were school-aged children were susceptible in suffering posture abnormalities. Several previous studies had shown that there was a posture change that was caused by over load of backpack. The posture also could change due to the way of carrying the backpack which was not ergonomic. Furthermore, this research aimed at knowing the influence of the types and the loads of backpack which was used by elementary students against scoliosis. The design of this research was cross sectional research. The subjects of this research were 4th, 5th, and 6th grade of students who studied at Perumnas IV Elementary School Makassar. The students were examined by using a skitlot for determining the scoliosis. Types of backpack, body weight, and the load of backpack were recorded for data processing. The results showed that there was no significant correlation between types of backpack (p = 0.314) and load of backpack (p = 0.808) and the occurrence of scoliosis.

Keywords: *Backpack types, Backpack loads, Scoliosis, Elementary students*

I. INTRODUCTION

During the process of physical growth and development, the children were vulnerable to injury (Muscari, 2005). Various physical activities, either in group or individual, often caused an injury to the children. Meanwhile, the parents tended to pay more attention to the physical injuries which were seen from the outside. Though, there were also injuries due to repetitive trauma, which actually had more harmful impact. One of the causes of injuries that was often missed from parents' attention was the use of school backpack by the children (Forjuoh, 2003).

Nowadays, backpacks were not only used to carry books, but also used to carry laptops, musical instruments, and others. The American Physical Therapy Association, the Ontario Chiropractic Association, and the American Academy of Orthopedic Surgeons had recommended that backpack loads should not exceed 10% of the body weight. Scoliosis was one of posture abnormalities, which the spine tended to be cursive laterally. Eighty percent of scoliosis cases were idiopathic. Scoliosis could also be caused by neuromuscular disorders, congenital abnormalities, false postures (nonstructural scoliosis), different lengths of both limbs, and other musculoskeletal disorders.

In the United States, since 1984, it had been held a screening school program that was a program for early detection of scoliosis. Although it was controversial, the program was supported by four major American organizations: the American Academy of Orthopedic Surgeons (AAOS), the Scoliosis Research Society (SRS), the Pediatric Orthopedic Society of North America (POSNA), and the American Academy of Pediatrics (AAP). The program continued to run in accordance with the commitment which prevention of severe scoliosis was a top priority (Richards, 2007).

Idiopathic scoliosis screening in Jakarta that was held by Pontoh & Sapardan (1999) found 200 children of 1200 junior high students suspected with scoliosis, with prevalence = 8.46%, with curvature <10 degrees = 6.48%, and the others were with 10-30 degree curvature.Early detection of scoliosis still got less attention in Indonesia, whereas, scoliosis had negative effects, such as decreased confidence, impaired balance, impaired coordination and agility, pain, fatigue, and discomfort in daily activities that interfered learning concentration. However, the physiotherapists began to promote early detection of scoliosis. The role of physiotherapist was not only rehabilitative but also preventive by educating about factors that could cause musculoskeletal abnormalities, such as scoliosis.

II. METHODS

This research was conducted on elementary students who studied at Perumnas IV Elementary School, Tidung, Makassar. The design of this research was cross sectional research. Meanwhile, the population was all elementary students in Tidung, Makassar. The sample was all students who were in class IV, V, and VI and they were selected by purposive sampling technique. Further data were collected, including backpack load, backpack type, body weight, perceived complaints/abnormalities, and measurement of posture abnormality by using physical

examination and scoliometer. The collected data was in categorical type, so it was analyzed descriptively by using frequency and percentage (Nugroho, 2014), and followed by hypothesis test by using Lambda correlation test.

III. RESULTS

Table 1 showed that most of students in Perumans IV elementary school Makassar used backpack (86.31%).

Table 1. Distribution of Backpack Types Used by Students of Perumnas IV Elementary School Makassar

Backpack Types	Frequency	Percentage
Sling bag	1	1.38
Shoulder bag	8	11.11
Backpack	63	86.31
Total	72	100

Table 2 showed that 22.22% of students of Perumans IV elementary school Makassar still carried extra backpack load.

Table 2. Distribution of Backpack Load Used by Students of Perumnas IV Elementary School Makassar

Backpack Load	Frequency	Percentage
Extra	16	22.22
Normal	56	77.78
Total	72	100

Table 3 showed that there was no significant difference in distribution of scoliosis cases based on backpack types used by the students. The result of Lambda correlation test was: p-value> 0.05, thus, it was concluded that there was no significant correlation between backpack types used and scoliosis cases of the students at Perumnas IV Elementary School Makassar.

Table 3. The Correlation between Backpack Types Used and Scoliosis Cases of Students at Perumnas IV Elementary School Makassar

Backpack Types	Scoliosis Cases		Total	p-value	R
	Yes	No			
Sling Bag	1 (100%)	0	1	0.314	0.034
Shoulder Bag	1 (12.5%)	7 (87.5%)	8		
Backpack	18 (28.57%)	45 (71.43%)	63		
Total	20 (27.78%)	52 (72.12%)	72 (100%)		

Table 4 showed that there was no significant difference of the distribution of scoliosis cases based on backpack loads used by students. The result of Lambda correlation test was: p-value> 0,05, hence, it was concluded that there was no significant correlation between backpack load used and scoliosis cases of students at Perumnas IV elementary school Makassar.

Table 4. The Correlation between Backpack Load Used and Scoliosis Cases of Students at Perumnas IV Elementary School Makassar

Backpack Load	Scoliosis Cases		Total	P-value	R
	Yes	No			
Extra	9 (52.94%)	8 (47.06%)	17 (100%)	0.808	0.027
Normal	11 (20%)	44 (80%)	55 (100%)		
Total	20 (27.78%)	52 (72.12%)	72 (100%)		

IV. DISCUSSION

A. The Correlation between Backpack Types and Scoliosis Cases

Backpack types in this research were shoulder bag, sling bag, and backpacks. The use of backpack was different from the use of either shoulder bag or sling bag. The backpack was carried on both sides of shoulders, thus, allowing the same backpack load distribution on both sides of the body. However, a sling bag and shoulder bag were carried on one side of the shoulder only, as the impact, it resulted in uneven or asymmetrical load distribution.

Moreover, based on the result of the data, we could know that the use of backpack was a top choice for children and students. This statement was proven by the research data that 63 of 72 students used backpack. However, the type of backpack that was preferred by adults, especially women, was handbag or single-strap bag (An, et al., 2009).

However, there were 2 types of scoliosis: structural scoliosis and non-structural scoliosis. The scoliosis that was studied in this research was non-structural scoliosis, which was a scoliosis that was caused by false posture and had undergone adaptation, therefore, it was occurred scoliosis. Although both types of scoliosis had similar symptoms, the structural type was accompanied by a rotation. Both types of scoliosis could be differentiated by simple test that was a test by using Adam forward bending test. This test was conducted by asking the child to bend over while flying his hand. In structural scoliosis, there would be a rib bone protrusion due to the rotation of the rib cage. Meanwhile, in non-structural scoliosis, there was no such protrusion. In addition, the non-structural scoliosis would return to be straight at the time when the test was conducted. During the research, non-structural scoliosis was not found as characterized before.

Although this test could be used to differentiate either structural or non-structural scoliosis, the most accurate test was conducted by radiological examination. In previous research that used scoliosis screening, it still also conducted radiological examination for children who had been tested and detected with positive scoliosis based on forward bending test results. Screening for scoliosis in Greece, the prevalence of scoliosis based on forward bending test was 4185 children, but based on radiological examination, the only true scoliosis was 1436 (curve > 10 degrees).

This study did not find the significant correlation between backpack types used and scoliosis case, however, there were 20 scoliosis suspects of 72 children who were examined. In other words, 1 of 3 children suspected with scoliosis. These results were in accordance with conducted research in Brazil that conducted postural examination in girls who were 7-10 years old. The research divided into 4 age groups (7, 8, 9, and 10 years old). The percentage of scoliosis in each age group was 36%, 45%, 52%, and 48% (Penha, et al., 2005).

Theoretically, backpacks with asymmetric load had a greater chance of the occurrence of scoliosis. Asymmetric load provided a change in all areas of anatomy, including in the frontal area (Negrini, et al., 2007). In the use of asymmetric backpacks, the body would lean towards the contralateral side to provide balance for the body, so the body would be cursive and form a scoliosis posture. If it was let for a long time, then, this condition became irreversible.

The loads of bag on one side of body caused emphasis on ipsilateral muscle, thus, it could be occurred postural adaptation. When backpack was carried on one side of the body, the muscle tended to shorten on the contralateral side with the backpack (muscle imbalance), which eventually, it suppressed the structures under the muscle. If it was let for a long time, then, it became irreversible and caused permanent deformity. Besides, the asymmetrical load of backpack on one shoulder enhanced the shifting of the joints and the compressive forces which were caused by muscle contraction. Asymmetric loading also increased energy consumption due to the increase of contralateral paraspinal muscle activity (An, et al., 2009). Asymmetrical paraspinal muscle activity could cause spasm to make a person's posture became scoliosis.

Furthermore, the statement above was supported by conducted study by using EMG which found that the activity of *erector spinae* muscles increased when a person carried a shoulder bag with a load of 15% of body weight. The asymmetric activity of the back muscles was clearly appeared when she/ he carried the shoulder bag, as well as with the *rectus abdominis* muscles (Motmans, 2006). In reality, scoliosis case which was found in backpacks with asymmetric load was occurred on two children only. The other seven children did not have scoliosis. This could be due to the consistency of the backpack. In this research, backpack consistency could not be controlled. It was possible that children who wore shoulder bag and sling bag also wore backpacks, but at the time of this research, they wore the backpack. It was also possible that these children had not worn either shoulder bag or sling bag in a long time.

The number of scoliosis cases could be caused by factors that correlated with the wrong posture that the child did, both at home and at school. Posture changes were often found in either children or adolescents. At this stage of development, posture underwent many adjustments and adaptations due to body changes and psychosocial factors. In essence, if the child maintained the wrong posture, then, there would be muscle imbalance that caused posture changes (Penha, et al., 2005).Kisner, et al., (2007) explained that one of scoliosis case was the difference in limbs length. The effort for balancing the limbs which were not in same length caused body tended to the shorter side

of leg, which meant that it made the body in scoliosis posture. In addition, body asymmetry could also be caused by various activities performed by children, such as sitting on school furniture that was not properly designed, carrying heavy backpacks and using inappropriate shoes (Penha, et al., 2005).

B. The Correlation between Backpack Load and Scoliosis Case

The extra backpack load had been a major cause of back pain in school-aged children in United States. Fifty-five percent of students carried load of > 10% of their body weight. This percentage was the standard recommended by the American Occupational Therapy Association and the Ontario Chiropractic Association (Goodgold, et al., 2002). However, the results of this study indicated that there were 23.61% of students carried extra backpack loads. The backpack load was inconsistent every day, depending on the lesson schedule. Therefore, the least number of students who carried extra load could be caused by the day of the research coincided with the day of less lesson schedule. Erawan (2007) reported that extra backpack loads were associated with scoliosis cases of students in Bung Elementary School Makassar. Nevertheless, this was not the case of this study, although it was clear that children who carried extra load had high risk of scoliosis rather than carried normal loads. Students who did not undergo scoliosis in extra load could be caused by inconsistency of the load. Meanwhile, the consistency of the load was not controlled in this research. It was possible that the child only carried an extra load on that day and the other days did not. In addition, long exposure for carrying extra load should also be considered.

Children still underwent rapid growth and their bones were still immature. In addition, spinal muscles and ligaments were also not fully developed until it reached 16th year of life. Thus, when they were compared with adults, the bones of children were still flexible, hence, it easily bent (Rahman, et al., 2009). Furthermore, it was believed that carrying heavy backpacks continuously would provide additional stress to the developing vertebra. This would lead to children's vulnerability of posture changes. This theory was supported by a conducted study that found the presence of asymmetric lumbar by carrying backpack loads which exceeded 10% (Neushwander, et al., 2007).

There were several causes of scoliosis that could affect children with normal weight, such as the furniture that was not ergonomic in school. A conducted study in Michigan found a mismatch between classroom furniture and student's body dimensions. Most students sat on too high or too low seats with too high tables. This would not only cause improper posture while sitting, but also did not provide full support to body that contacted with the floor and chairs. As a result, there was additional stress on these parts of the body (Parcells, et al., 1999). Despite numerous studies that revealed the impact of load on posture changes, most of those studies were not retrospective studies. Those studies provided load treatment to children and then, it was examined the posture changes. Thus, only acute postural adaptations aroused. So far, only Erawan's studies had found a significant correlation between the changes in scoliosis posture and backpack load.

IV. CONCLUSION

Based on the results of data analysis, it was concluded that scoliosis cases on students who studied at Perumnas IV Elementary School Makassar did not correlate significantly against the backpack types and the backpack load which were used by the students.

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