THE EFFECT OF BACKPACK LOAD ON THE SEVERITY OF NECK PAIN IN STUDENTS' FACULTY OF MEDICINE OF WIDYA MANDALA SURABAYA CATHOLIC UNIVERSITY

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ABSTRACT

Introduction: A heavy backpack results in a forward shift of the neutral centre of mass (CoM) of the body and changes the position of the head and upper and lower cervical vertebrae markedly. The change in cervical alignment caused by a backpack may place a burden on the cervical joints and soft tissues. The comfort of a backpack is a combination of the biomechanical effects on the CoM of the body and the forward-leaning posture. Many studies have reported a correlation between the load of a backpack and back pain. Neck pain is as common as lumbar pain and leads to disability and costly economic effects due to reduced ability to work. **Objective:** The aim of this study is to investigate the influence of backpack weight on the severity of neck pain in medical students at Faculty of Medicine Widya Mandala Catholic University. **Method:** This study is analytical observational research with a cross-sectional design. The sample size forthe study is 72 students from the class of 2020, 2021, and 2022 at FoM WMSCU who use backpacks, selected through Simple Random Sampling. Data is collected through questionnaireresponses and weighing the backpacks and respondents' body weight. The research wasconducted from August to September 2023. The statistical analysis used in this study is Mann-Whitney test. **Result:** The majority of respondents use backpacks that are considered heavy, with 51 individuals (70.83%). Most respondents experience mild neck pain, with 29 individuals (40.28%). The Mann-Whitney analysis yielded a p-value of <0.001. **Conclusion:** There is an influence of backpack weight on the severity of neck pain in medical students at FoM WMSCU.

Keywords: Backpack weight, neck pain level, FoM WMSCU students.

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INTRODUCTION

A heavy backpack also results in a forward shift of the neutral center of mass (CoM) of the body and changes the position of the head and upper and lower cervical vertebrae markedly.[1] The change in cervical alignment caused by a backpack may place a burden on the cervical joints and soft tissues. The comfort of a backpack is a combination of the biomechanical effects on the CoM of the body and the forward-leaning posture.[2–4] Many studies have reported a correlation between the load of a backpack and back pain. Neck pain is as common as lumbar pain and leads to disability and costly economic effects due to reduced ability to work.[5]

The impacts of backpack load on posture focused primarily on changes in postural angles. Drzal-Grabiec et al.[6] examined postural parameters, including habitual posture, with the backpack on the participant's left and right shoulders. The student participants, in this study, exhibited a significant reduction of thoracic kyphosis during load carriage when compared to no load being carried. In particular, the angle of thoracic kyphosis increased between measurements.[6] Similarly, Ramprasad et al.[7], who also examined changes in various postural angles with different backpack weights, found that the craniovertebral (CV) angle changed significantly after 15% BW was reached in backpack loads.

Head on neck (HON) and head and neck (as a single unit) on trunk (HNOT) CV angles were found to significantly change after a load of 10% of BW was reached. However, trunk and lower limb angles, which also altered significantly, changed after only a load of 5% of BW was reached in the backpack.[7]

Six studies[8–13] investigated the impact of backpack loads on parameters of gait. Three of the studies[10,13], compared both unilateral (single shoulder backpack carry) and bilateral (two-shoulder backpack carry) loads, whereas one study[12] looked at a unilateral load only, comparing a loaded side to an unloaded side. In the study by Hong et al.[10], the researchers examined the effects of carrying methods (backpacks and single-strap athletic bags) and loads on phases of gait and ground reaction forces.

Dockrell et al. analyzed musculoskeletal discomfort among primary school students and found that the prevalence of baseline musculoskeletal discomfort was high (63.4%) and that schoolbag-related discomfort was reported more frequently in the shoulders (27.3%) than in the back (15%). The dose-response assessment indicated that both statistically and practically significant increases in discomfort were observed following school bag carriage.[14]

Four of the included studies[15–18] investigated the impact of pain felt by the students from carrying their school backpacks. Two studies[15,16] focused on non-specific mechanical back pain, one study[15] looked at the regions of the body that were most affected by school backpack carriage, one study[17] analyzed the influence of backpack weight on back pain and back pathologies, one study[18] analyzed backpack injuries in school students and one study analyzed the patterns of shoulder and abdominal muscle activation during prolonged walking with loads in students.[11]

These studies found that back pain was highly prevalent in the school students, as students reported severity and chronicity of pain was high, with Siambanes et al. finding that 64% of the students reported back pain, 41% felt pain when carrying their backpacks and almost all students reported relief upon taking their backpacks off their backs.[15]

Soares et al. analyzed backpack injuries in Indian school children, finding pressure marks (redness and swelling) over the neck and shoulders, corresponding to locations of the straps of the backpack, stooping posture while carrying the backpack, pain or stiffness in the neck, upper back and shoulders predominantly while carrying the backpack, and an absence of these symptoms during the school holidays. Soares et al. also found the upper back (40%), neck (27%) and shoulder (20%) were the most prevalent body regions in which pain was reported, followed by the forearm and wrist at 7% and lower back at 6%.[18,19]

METHOD

The research type is an analytical observational study with a cross-sectional design involving the active students of the Medical Education Program at the Faculty of Medicine, Widya Mandala Surabaya Catholic University, batches 2020, 2021, and 2022 who meet the inclusion and exclusion criteria. The total selected sample, calculated using the formula, is 72 individuals. Simple Random Sampling was employed as the sampling technique. Data were collected through questionnaire completion and weighing of both the backpacks and the respondents' body weight. The research was conducted from August to September 2023. The collected data were subsequently analyzed using the Mann-Whitney test with SPSS version 27.

RESULT

Table 1. Distribution of Respondent by Gender

Gender	n (%)
Male	34 (47,22%)
Female	38 (52,78%)
Total	**72 (100%)**

Table 1 shows that out of 72 research respondents, the highest frequency is found in female, with 38 individuals (52.78%),

while the frequency of the male gender group is 34 individuals (47.22%).

Table 2. Distribution of Respondent by Age

Age	n (%)
19	9 (12,50%)
20	30 (41,67%)
21	28 (38,89%)
22	4 (5,55%)
23	1 (1,39%)
Total	**72 (100%)**

Table 2 shows that out of 72 research respondents, the highest frequency is in the 20-year-old age group, with 30 individuals (41.67%). The 21-year-old age group follows with a total of 28 individuals (38.89%). Furthermore, the 19-year-old age group consists of 9 individuals (12.50%), the 22-year-old age group has 4 individuals (5.55%), and finally, the 23-year-old age group has 1 individual (1.39%).

Table 3. Distribution of Respondent by Backpack Weight

Backpack Weight	n (%)
Light	51 (70,83%)
Heavy	21 (29,17%)
Total	**72 (100%)**

Table 3 shows that out of 72 respondents, the group with backpacks classified as light (backpack weight <10% of body weight) has the highest number, namely 51 individuals (70.83%). Meanwhile, the group with backpacks classified as heavy (backpack weight >10% of body weight) consists of 21 individuals (29.17%).

Table 4. Distribution of Respondent by Shoulder Pain Severity

Shoulder Pain Severity	n (%)
No Pain	20 (27,78%)
Mild Pain	29 (40.28%)
Moderate Pain	18 (25.00%)
Severe Pain	5 (6.94%)
Total	**72 (100%)**

Table 4 shows that out of 72 research respondents, the group with the highest severity of shoulder pain based on their responses to the NDI (Neck Disability Index) questionnaire is the mild pain/disability group, consisting of 29 individuals (40.28%). In the second position is the pain- free group, with 20 individuals (27.78%). Following that, in the third position is the moderate pain/disability group, with 18 individuals (25.00%). Meanwhile, in the last position with the smallest number, there is the very severe pain/disability group, consisting of 5 individuals (6.94%).

Table 5. Results of the Analysis of the Effect of Backpack Load on the Severity Level of Neck Pain

Backpack Weight	Neck Pain/Disability Index				Total	Significance
	No Pain	Mild Pain	Moderate Pain	Severe Pain		
Light	20	21	10	0	51	
Heavy	0	8	8	5	21	<0.001
Total	**20**	**29**	**18**	**5**	**72**	

Table 5.5 shows the results of the Mann- Whitney test for this study, with both variables yielding a significance value (p) of <0.001. This value demonstrates that the backpack load significantly influences the severity level of neck pain in FoM WMSCU students. This conclusion aligns with the research hypothesis (Ha), which states "there is an influence of backpack load on the severity level of neck pain in FoM WMSCU students." Meanwhile, the null hypothesis (H0) stating "there is no influence of backpack load on the severity level of neck pain in FoM WMSCU students" does not align with the research findings, leading to the rejection of H0.

DISCUSSION

Based on the research results, the group of respondents with light backpacks tends to have a lower risk of experiencing milder pain. Meanwhile, the research respondent group using heavy backpacks (backpack weight >10% of body weight) tends to experience more severe neck pain.[15]

According to theories from recent studies investigating impacts of contemporary load carriage on students, in order to inform future research and assist in the development of risk management for school backpack loads, which is also the purpose of this research to investigate its impact. In addition to heavy backpack use, there are other factors that can back pain especially neck pain.

With research investigating load carriage practices, noting that the contexts in which loads are carried (including the speed, terrain grade and type and distances) can have a greater impact on the carrier than load weight alone, it is imperative that future research includes variation in these contextual factors as part of investigations into school child load carriage. This may include taking into account walking to and from home, moving from classroom to classroom, movement during recess and lunch breaks and the movement after school (e.g., moving to sporting activities/ venues/ work/ home).[20]

Puckree et al. found that the manner in which a backpack is carried (for example, carried over both shoulders or over one shoulder) significantly affected the number of students who reported pain, and so this should also be considered in future research. In that study, pain also varied with duration of load carriage, another factor that should be considered.[16]

As such, Pal et al. recommends that students should be carefully screened for possible ‘high load-high exposure time’ with a loaded backpack to reduce the risk of foot discomfort or injuries and to allow correct development of the foot structure and functionality during critical stages in a child’s physical development.[6,9] However,

future research is needed to investigate links between load and exposure time, to quantify the level at which risk increases, and to determine whether statistically significant findings do in fact translate to clinical significance.

This information can then be used to inform maximal load or maximal time dosages for backpack load carriage. Alternative carriage of the backpack by changing the positioning occasionally between anterior and posterior positions might help relieve the effects of the backpack on the spine, as identified by Chow et al. who found that spinal curvature and repositioning errors were affected by backpack anterior–posterior positioning and CG levels.[21]

The earlier review by Mackenzie et al. noted that a student's school book bag was reported to weigh more than 15% to 20% of their body weight, was associated with back pain, and when improperly used resulted in changes to the child's posture and gait. The findings of this review were similar, with reported loads ranging up to 20% of body weight, and associations between load carriage and back pain, changes to gait and posture affirmed.[22]

Brackley and Stevenson[23] gave maximum load recommendations for school children of 10–15% of body weight, 14 of the 21 studies in this review reported that a load of 10% of the student's body weight was the appropriate maximum weight to be carried by students to limit the effects of load discomfort, injuries and other adverse impacts.[8–11,21–27]

The impacts those loads may have on the student's body; and the biomechanical, physiological and physical effects that occur to the students as a result of carrying these loads. The wearing of school backpacks does have significant biomechanical, physiological and discomfort impacts on the wearer, especially with loads above 10% of the student's body weight. Such impacts may include changes to posture (e.g., changes to spinal posture, lumbo-sacral angles, and thoracic kyphosis), gait (increases in plantar pressure during foot-ground contact and increased double support), increases in physical discomfort and muscle activity, and increases in breathing rate.[8]

CONCLUSION

There is a significant effect of backpack load on the severity level of neck pain in FoM WMSCU students. In particular, further research of this nature is required to assess the contemporary loads students carry around on a school day in their school backpacks; the impacts those loads may have on the student's body; and the biomechanical, physiological and physical effects that occur to the students as a result of carrying these loads.[8,22,23]

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