


# Effects of School-Based Educational Program on Backpack Carrying Behavior in Teenage Students

Journal of Primary Care & Community Health  
Volume 13: 1–5  
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DOI: 10.1177/21501319221086251  
journals.sagepub.com/home/jpc  


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## Abstract

One of the most serious issues is the growing prevalence of backaches among adolescent students as a result of carrying backpacks. The purpose of this study was to examine the impact of an education program (remedial information) on the school backpack carrying habits of adolescent students. The study sample consisted of 138 adolescent students aged 12 to 16 from 4 schools who were randomly assigned to either the experimental (N=69) or control (N=69) groups. The experimental group was subjected to a 6-week education program consisting of 6 sessions, whereas the control group received no educational intervention. During the pre-test and 3 months after the intervention, participants completed a questionnaire. The results (healthy items) were as follows: (1) carry as little as possible, (2) carry a school backpack on both shoulders, and (3) use lockers or something similar. After a 3-month follow-up, healthy items in the experimental group improved, but no significant changes were observed in the control group. When compared to the baseline, the experimental group's healthy backpack usage habits improved significantly at the post-test ( $P = .001$ ). The current study's findings show that school-based education interventions on backpack behaviors improve the school-bag carrying habits of adolescent students.

## Keywords

adolescent, backpack, behavior, education

Dates received: 14 August 2021; revised: 21 February 2022; accepted: 22 February 2022.

Musculoskeletal disorders in adolescents are a worldwide health concern, with evidence suggesting that their prevalence is increasing.<sup>1</sup> People may experience a variety of health problems during adolescence, which is one of the most vulnerable developmental stages, as a result of poor lifestyle choices.<sup>2</sup> Despite the fact that backpacks are one of the leading causes of musculoskeletal injuries, as many professionals from various backgrounds have noted, using them has become a common practice among adolescent students.<sup>3,4</sup> Studies show that most students carry more than 10% of their body weight, which is linked to low back pain (LBP) and other problems.<sup>4-6</sup> When the weight of a backpack exceeds the recommended level (10% of body weight), it causes back and upper-body discomfort.<sup>3</sup> Carrying heavy loads, on the other hand, results in drooping shoulders and kyphosis.<sup>5,7</sup> In Majorca, a study of 16 357 people aged 13 to 15 years discovered that the prevalence of LBP was 50.9% for boys and 69.3% for girls; point prevalence (7 days) was 17.1% for boys and 33% for girls.<sup>8</sup> According to the findings of the Kanani study,<sup>9</sup> school-based treatments are required due to

the significant prevalence of LBP in this region.<sup>10</sup> Health education aims to bridge the gap between what is learned about healthy habits and what is actually practiced.<sup>11</sup> The purpose of this study was to look into the effects of

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school-based educational programs on adolescent students' school backpack carrying habits. It is hoped that the study's findings will provide a good solution for targeted interventions in adolescents, reducing skeletal and muscular injuries.

## Methods

### Design

Ardabil was the area of the investigation. Ardabil is an old city in northern Iran that serves as the provincial capital of Ardabil Province. The target population consisted of adolescent students in high schools aged 12 to 16 years old (among the study participants, 41% were girls and the rest were boys). Individual randomization is typically not possible in school settings due to natural school groups (classes). The samples came from urban areas in their current state, as organized by the school. This is a group-randomized clinical trial, which means that groups were assigned at random rather than individuals.

Individual randomization is usually not possible in intervention studies conducted in schools because the natural school groups (classes) must be maintained in their current configuration. Hence, the current study is a group-randomized controlled trial in which groups rather than individuals are randomized. The 6 classes were divided into 2 groups: experimental (2 classes) and control (2 classes).

The teenagers completed a questionnaire twice (baseline and 3-month follow-up) that included information on the prevalence of low back pain (LBP) and associated side effects, such as the use of school backpacks, which has been linked to an increased risk of LBP in those students.<sup>12-14</sup>

The data on LBP prevalence included lifetime LBP (once a week/2 times a week/3 times a week/almost always) and last week's LBP (yes/no). Age, gender (female or male), weight (kg), and height were all potential risk factors (cm). Healthy backpack behaviors include: loading as little weight as possible (yes/no), carrying the bag on 2 shoulders (yes/no), and using a locker or something similar at school (yes/no).

Each item was coded with a 0 to indicate "no" and a 1 to indicate "yes." The 3 criteria were combined to produce a total rating, which was then used to calculate the safe backpack based on a behavior score (ranging from 0 to 3). Participants were assessed twice: once before the trial and again 3 months later (follow-up). The 6-week education program consisted of 6 sessions (theoretical and operational). Throughout the school day, there were both theoretical and practical sessions. Theoretical sessions covered human pathophysiology, the foundations of LBP and health conditions, health and strength promotion, ergonomic design, musculoskeletal grooming, and a backpack study. Practical sessions include postural analysis and transporting items (including backpacks).

A group of 15 experts did a content validity test on the questionnaire, and some of the questions were changed. Expert opinions were also used to determine the legitimacy of the face. According to the Lawshe table,<sup>15</sup> the content validity

index obtained from all of the questions in this section was greater than 0.71, and the content validity ratio obtained from all of the questions in this section was greater than 0.66 (for 10). The reliability of the researcher-created questionnaire was determined using Cronbach's alpha. Cronbach's alpha correlation values were greater than .81 for all questions.

Participation in the study required written permission from participants' schools and parents. The protocol and goals of the study were explained to all participants and their parents in advance. The local Ethical Committee at the University of Tarbiat Modares approved the study protocol. SPSS, version 24.0, SPSS Inc., Chicago, IL, USA, was used for the analyses. For all analyses, the level of significance was set at  $<.001$ .

## Results

### Descriptive Statistics

The questionnaire was completed by 138 students in total. Table 1 shows the characteristics of the survey sample by study group. The individuals' mean age was  $(13.55 \pm 1.26)$ , their weight was 53.86 kg, their height was 1.49 cm, and their BMI was 24.73. According to the study's findings, 48.6% of participants experienced discomfort 4 times in the previous week. The backpack was the most popular type of bag carried by adolescent students (68.3%), with other types of bags carried including shoulder bags, plastic bags, and rucksacks. In the case of backpacks, 47.1% used 2 shoulder straps to carry their bags, while the remaining 52.9% used 1 shoulder strap. Only about a quarter of the participants had access to lockers, which they used throughout the day. The average weight of a schoolbag carried by adolescent students was  $3.11 \pm 1.07$  kg (range 0-12.3 kg). The average bag weight as a percentage of body weight was  $6.20 \pm 2.99$  (range 0%-31.3%) (Table 1). It was  $4.71 \pm 1.40$  for boys and  $7.29 \pm 1.59$  for girls.

In this study, 36.6% of the participants carried backpacks weighing more than 10% of their body weight. The independent *t*-test results showed that participants in both study groups had identical baseline characteristics, with the exception of the experimental group having a higher backpack-to-body weight ratio and the control group having a lower backpack-to-body weight ratio (Table 1). The weight of the bags did not differ between boys and girls ( $P=.63$ ). The findings of this study show that healthy items improved after the program and remained better after 3 months of follow-up in the study group, whereas there were no significant improvements in the control group. In fact, the research group's score for healthy backpack usage behaviors increased significantly when compared to the control group ( $P=.001$ ) (Tables 2 and 3).

## Discussion

The prevalence of LBP among study participants was reported to be 48.6%, which was lower than the results of Diepenmaat et al<sup>16</sup> (60.0%) and Siambanes et al<sup>17</sup> (67.7%).

**Table 1.** Baseline Characteristics of the Research Sample of Each Study Group.

Variable	Total sample (N= 138) (Mean ± SD)	Experimental group (N=69) (Mean ± SD)	Control group (N=69) (Mean ± SD)	P
Age (years)	13.55 (1.26)	13.39 (1.22)	13.72 (1.28)	.12
Weight (kg)	53.86 (12.7)	54.89 (13.32)	52.84 (12.06)	.29
Height (cm)	1.49 (13.86)	1.47 (12.94)	1.51 (14.53)	.67
Body mass index (kg/m <sup>2</sup> )	24.73 (7.42)	25.84 (7.78)	23.62 (6.94)	.24
Bag weight (kg)	3.11 (1.07)	3.07 (1.11)	3.15 (1.03)	.60
The ratio of backpack weight-to-body weight ratio (%)	6.20 (2.99)	6.16 (3.48)	6.25 (2.42)	.004
Score for healthy backpacking habits	4.21 (0.58)	4.28 (0.59)	4.14 (0.57)	.006

Variable	Total sample (N= 138) n (%)	Experimental group (N=69) n (%)	Control group (N=69) n (%)	P
Lifetime LBP (ever)	67 (48.6)	13.39 (1.22)	13.72 (1.28)	.29
Lifetime LBP: occasionally/frequently/almost continuously	33 (51.4)	54.89 (13.32)	52.84 (12.06)	.001
Carry backpack on 2 shoulders	65 (47.1)	34 (49.3)	39 (56.6)	.36
Using lockers or anything equivalent at school	47 (34.1)	21 (30.4)	26 (37.7)	.39

**Table 2.** Characteristics of the Study Groups After 3 Months.

Variable	Total sample (N= 138) (Mean ± SD)	Experimental group (N=69) (Mean ± SD)	Control group (N=69) (Mean ± SD)	P
Bag weight (kg)	2.56 (1.01)	2.08 (0.68)	3.04 (1.06)	.004
Bag weight-to-body weight ratio (%)	6.20 (2.99)	6.16 (3.48)	6.25 (2.42)	.004
Score for healthy backpacking habits	4.21 (0.58)	4.28 (0.59)	4.14 (0.57)	.006

Variable	Total sample (N= 138) n (%)	Experimental group (N=69) n (%)	Control group (N=69) n (%)	P
Lifetime LBP (ever)	67 (48.6)	13.39 (1.22)	13.72 (1.28)	.29
Lifetime LBP: sometimes/often/almost constantly	33 (51.4)	54.89 (13.32)	52.84 (12.06)	.001
Carry backpack on 2 shoulders	99 (71.7)	58 (84.1)	41 (59.4)	.001
Using lockers or anything equivalent at school	76 (55.1)	50 (72.5)	26 (37.7)	.001

**Table 3.** Characteristics of the Study Groups After 3 Months.

Variable	Experimental group (Mean ± SD)	Control group (Mean ± SD)	P (t-test)
Bag weight (kg)			
Before the intervention	3.18 ± 1.11	3.15 ± 1.03	.41
After the intervention	2.08 ± 0.68	3.04 ± 1.06	.004
Carry backpack on 2 shoulders			
Before the intervention	1.50 ± 0.50	1.14 ± 0.35	.28
After the intervention	1.43 ± 0.49	1.40 ± 0.49	.001
Using lockers or anything equivalent at school			
Before the intervention	1.69 ± 0.46	1.27 ± 0.44	.008
After the intervention	1.62 ± 0.48	1.27 ± 0.44	.001

It appears that this is due to the fact that the statistical population in our study was drawn from the urban population.

36.2% of those polled carried backpacks weighing more than 10% of their body weight. The current study found that

the heavy weight of the school bag was 12.57% of the children's body weight, compared to 10.7% in the United States,<sup>18,19</sup> 9.6% to 9.9% in England.<sup>20</sup> In Greece, the rate is 22.7%, while in Holland,<sup>21</sup> it is 14.7%. This disparity could

be attributed to a gradual increase in the number of school books compared to previous years. Also, students may not be able to figure out which textbooks or materials they should carry based on their daily plans.

Furthermore, only 47.1% of those surveyed carried their backpacks on both shoulders. This contradicts previous research, which found that 71.5% of people carried a backpack with 2 straps on a regular basis.<sup>21-23</sup> This could be due to their proclivity to carry their luggage on 1 shoulder. In a study that compared the use of different backpack models among teenagers, Mackie et al<sup>24</sup> found that acceptance of a backpack model and mode of transportation is more about how the backpack looks and how it fits the person than how well it works.

The findings also revealed that intervention strategies significantly improved the research group's safe backpack usage behavior score ( $P=.0001$ ). This means that the proposed program was effective in reducing the load, taking into account, and potentially preventing the occurrence of low back pain among adolescent students. According to the Brazilian Health Department's School Census, there are 181 504 schools in the country with students of the appropriate age to develop healthy habits and values.<sup>24,25</sup> The Census also showed that this group needs to be educated in a way that is integrated and cohesive so that they can be successful and influential.

Besides, in the experimental group, but not in the control group, the instructional programs had an effect on how long to wear a bag on both shoulders. This conclusion was consistent with the findings of a previous study, which found statistically significant differences in backpack usage behaviors between intervention groups.<sup>24-27</sup>

The researchers encountered some limitations. Firstly, we relied on a self-reported questionnaire, which could be skewed. Secondly, because of the decreased memory bias, lifelong low back pain was only recorded infrequently during the previous week. Furthermore, bias was almost certainly present because some participants changed the weight of their bags after completing consent forms for research participation but before computing backpack weight. This study, on the other hand, makes evidence-based recommendations for future research to improve the health of students.

We examined pain and disability in this study using self-administered questionnaires, which have a tendency to exaggerate the severity of LBP and disability conditions. Therefore, future investigations should employ objective measures. The findings of this study need to be backed up by more research with a larger group of adolescent students.

## Conclusion

We are aware that implementing programs in schools is difficult due to the fact that the school curriculum must cover many other subjects and time is limited. Future adolescent

students should be taught how to carry a backpack safely, and researchers should look into ways to cut back pain in young people, especially those who carry a backpack.

## Acknowledgments

This study was drawn from a research project (No. IR.AUMS.REC. 1398.350) sponsored by the Ardabil University of Medical Sciences. The authors want to thank the students' research committee at the Ardabil University of Medical Sciences for giving them money to do this study.

## Author Contributions

Nazila NeJhaddadgar, Sedigheh Sadat Tavafian, Arash Ziapour, Rohallah Gahvareh, and Ahmad Rreza Jamshidi contributed to the idea or design, acquisition, analysis, or interpretation; critically edited the text; and agreed to be accountable for all areas of work assuring integrity and correctness. Nazila NeJhaddadgar, Sedigheh Sadat Tavafian and Arash Ziapour, and Nafiu Mehedi drafted the manuscript. All of the authors gave final approval.

## Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## Ethical Consideration

All procedures in this research with human subjects were carried out in compliance with the institutional research committee's ethical guidelines, as well as the 1964 Helsinki Declaration and its corresponding amendments or related ethical standards. Ethics approval project approved the under the Code of (IR.AUMS.REC. 1399.064) in Ardabil University of Medical Sciences.

## Consent

To participate in the study, individuals' parents had to provide their informed consent. Tarbiat Modares University gave its consent to the research procedure.

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