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# The effect of Location of the Backpack on Postural Stability in Male Students

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**ABSTRACT**

*There are many of people who carrying the backpack such as recreational hikers, cragsman, and also students carry heavy loads while often walking long distances over uneven terrain. The purpose of this study was to determine the effect of backpack location on postural stability in male students.Fifteen experienced male students participated in this study. Subjects were carried the backpacks with three conditions: without weight in the backpack, with a backpack weighting 10% of their body weight and with 20% of subject's body weight. The angles at the ankle, knee, hip and cervical spine and the position of markers on the ankle, knee, hip, shoulder and temporal bone were measured in different conditions. The results indicated that the mean right hip angle increased during wearing a backpack, this increase was grated with no weight. Differences were not significant between 20% bodyweight and 10%. The hip angle when participants were not wearing a backpack also compared equally to both the 20% and 10% BW hip angles suggesting little change in hip joint angle. This result showed that in which an increase in backpack weight decreased or increased any joint angle measured. Consequently the high position may be more stable and perhaps request less energy.*

**Key words:** Backpack, Postural Stability, Load Carriage

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## INTRODUCTION

In the past decade, backpack has become a common mode of carrying athletes and school related materials. Student and young people adjust their posture to the load during using the backpack. The athlete's spinal has not developed. Maybe they lift and carry weights equal or more than 30% of their body weight [1 and 2]. Students and athletes used kinds of backpacks and carry the materials in different ways. There are limited literatures in short and long term effects of backpack use, so it is clear that the addition researches are needed.

Putting the load on the back has the potential to alter the location of the center of gravity of the body and posture [3 and 4]. Changes in the center of gravity will result in an accompanying change in the relationship of the center of gravity to the base of support; it has the potential to change postural stability [5 and 6]. Athlets and students carrying their materials and supplies in their backpacks encounter stairs in school or buses, walk on uneven surfaces from ice to carpet, may have to lift the loaded bag into a locker and often bend over to pick up fallen objects with the pack on [7, 8 and 9]. Doing these activities with a change the center of gravity or one that may suddenly change as items in the backpack shift may result in slips or falls [10 and 11].

The American Academy of Orthopedic Surgeons [9] and other organizations recommended weight limitation for children should not more than 15% of their body weight; this limitation for adults is 20-25% of body weight. There are so many researchers who suggested that the proper wearing backpack, also provided such as the use of hip

straps, bilateral wear of shoulder straps, weight pattern within the backpack and wearing the backpack on the upper back but these opinions do not include scientific rationales [12, 13, 14, 15, 16 and 17]. It is clear that objective measurements are needed to answer questions about the specific effects of location of backpack on postural stability. It fact, the potential effects of wearing backpack in young people extend to adult back pain through changes posture, body mechanics and altered due to lifting and to potential falls as adolescents or with aging. So identified the factors of wear to decrease these effects would assist in making recommendations regarding limits and features of backpacks. According above explanation the aim of this study is the effect of the location of backpack on postural stability of male student.

## MATERIALS AND METHODS

### Participants

The participants of this study were limited to 12 to 15 years old (Min 13.5 years). The participants at the time of the study are living in Kermanshah province in Iran. We had phone conducted with parents for ensure that the participants 1) carried a backpack to school; 2) was in grade six to nine; and 3) had no any musculoskeletal injuries and medical problems. We descripted the study design and the test conditions to their parents. Testing was scheduled for 15 subjects that met these criteria. Before testing the demographic and anthropometric characteristics of participants were collected. Prior to the testing, subjects were completed several forms. These forms included a history of backpack use questionnaire, a consent form, and a subjective interview questionnaire.

### Study protocol

In this study all participants were tested under the same conditions. Conditions were the location of the backpacks with different weights. The protocols were instructed to the subjects before all testing. Subjects were carried the backpacks with three conditions: without weight in the backpack, with a backpack weighting 10% of their body weight and with 20% of subject's body weight. Use of this percentage was similar to the Hong's protocol [18]. Two locations were high and low locations. High location was as the superior aspect of backpack being placed at C7 and low location was defined as the superior aspect of the placed at the level of inferior angle of the scapula. The angles at the ankle, knee, hip and cervical spine and the position of markers on the ankle, knee, hip, shoulder and temporal bone were measured in different conditions.

### Statistical Analysis

A repeated measure ANOVA was conducted to determine the effect of the different backpack conditions on postural stability. Without any backpack is a baseline value and this condition was considered a covariate. Alpha was set at .05 in this study.

## RESULTS

Posture was measured through the determination of the angles at the ankle, knee, hip and cervical spine and the position of markers on the ankle, knee, hip, shoulder and temporal bone. Data analysis revealed that, with the exception of the right hip joint, joint angles were not significantly different, at different backpack locations and at different backpack weights. The mean right hip angles did change significantly with backpack weight but the difference was so small. The results indicated that the mean right hip angle increased during wearing a backpack, this increase was grated with no weight. Differences were not significant between 20% bodyweight and 10%. The hip angle when participants were not wearing a backpack also compared equally to both the 20% and 10% BW hip angles suggesting little change in hip joint angle. This result showed that in which an increase in backpack weight decreased or increased any joint angle measured (Table 1 and 2).

Results of this study indicated that no consistent pattern of angle variation's factors. The very low changes among angle values during carrying backpack under different conditions minimizes the significance would have a biomechanical change. The results for right hip angles showed that there was a significant change with backpack weight, but this difference was only greater than one degree. The hip angle during unloaded walking also compared equally to both the 20% and 10% their bodyweight hip angles showing small change in this variable during static testing.

**Table 1: Effect of the location of the backpack on the marker position**

| Position of Markers by Backpack Location | | | | |
|---|---|---|---|---|
| **Markers** | Location of Backpack | Mean Position of Marker (m) | | |
| | | Anterior/posterior Mean (SEM) | Medial/Lateral Mean (SEM) | Superior/Inferior Mean (SEM) |
| **Left Temporal** | High on Back (C7) | 0.104(.003)* | 0.126(.001) | 1.431(.004) |
| | Low on Back (Inferior Scapula) | 0.108(.003)* | 0.124(.001) | 1.425(.006) |
| **Right Temporal** | High on Back (C7) | 0.105(.003)* | 0.278(.001) | 1.429(.004) |
| | Low on Back (Inferior Scapula) | 0.11 (.003)* | 0.278(.001) | 1.431(.004) |
| **Left Shoulder** | High on Back (C7) | 0.223(.003) | 0.005(.001) | 1.295(.004) |
| | Low on Back (Inferior Scapula) | 0.227(.003) | 0.006(.001) | 1.301(.003) |
| **Right Shoulder** | High on Back (C7) | 0.22(.003) | 0.393(.001)* | 1.297(.004)* |
| | Low on Back (Inferior Scapula) | 0.223(.003) | 0.39(.001)* | 1.303(.003)* |

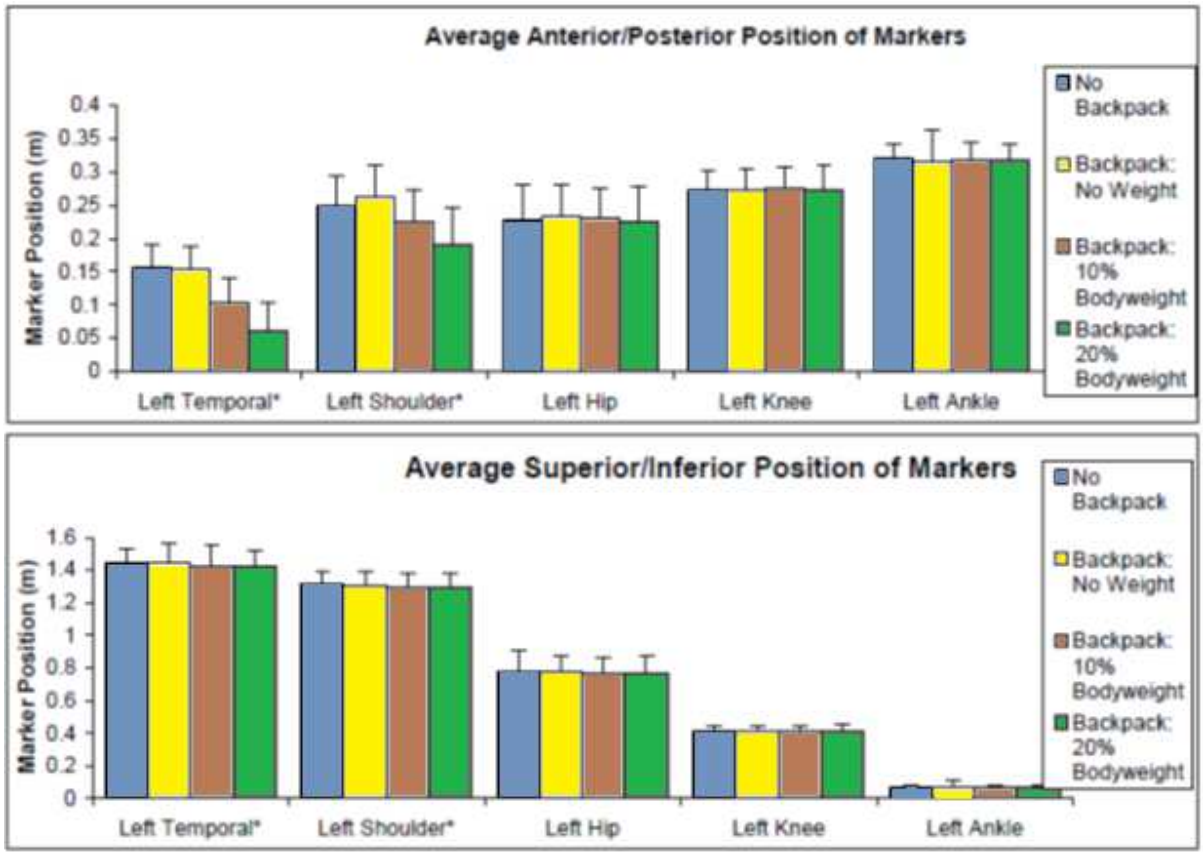


**Figure 1: Position of markers on the left side of the body by backpack weight**

## DISCUSSION AND CONCLUSION

This study indicating a difference in posture during carrying the different placed of load. Load placed in a backpack that is located at different heights of the spine. Previous studies investigated the effect of placed the backpack at waist height, high on the back or in multiple locations [18, 19, 20 and 21]. While comparisons can be made within these investigations, the differences of backpack location make comparisons between studies difficult. In this study two locations were used to determine the postural stability.

Perceived sense of fall, perceived exertion, perceived discomfort, sway length, and sway area were not significantly associated with the location of the backpack. Finding of current study indicated that in the high position, WRTI and SAR variable were less than in the low position significantly. During carrying the backpack in high location, the sway area stays within smaller range of the base of support. In this location body is more stable. In low position the temporal markers were less anterior than the backpack was worn high on the back. The position of shoulder also was medially and inferiorly during the backpack was high on the back. Finding also showed that the location of the backpack had no significant effect on perceived exertion, perceived instability or perceived discomfort.

During putting the backpack in the high position the trunk moved to forward more and also increases the forces at the L5-S1 area. The same results had reported by Bobet and Norman (1984) which indicated that the activity of the trapezius muscle increased significantly [22]. Finding of current study also supported by Stuempfle et al. (2004) study [23]. Consequently the high position may be more stable and perhaps need less energy, and decreased local muscle activity. So finding of this study suggested that backpack usage should be worn the high position.

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