The effects of gender and core stability on temporal-spatial gait parameters during short-term adaptation to 20% increase in backpack load carriage

David Hudson[1], John Gilliam[2], Martin Tanaka[3], Arlynn Baker[3]
1 – College of Health and Human Sciences, Western Carolina University, Cullowhee, NC
2 – Department of Physical Therapy, Western Carolina University, Cullowhee, NC
3 – Department of Engineering Technology, Western Carolina University, Cullowhee, NC

Author Contact: dhudson@email.wcu.edu

INTRODUCTION

Carrying a loaded backpack is a common activity across many lifestyles. Changes in kinematics and kinetics have been reported when carrying loads that range from 6.5 – 27.2% of body weight). [1,2] Core strength is generally recognized as an important factor in back health and injury prevention. It has become more common for females to have roles in the military where they must carry a backpack. It is unknown if males and females adapt similarly to weighted backpacks and if core strength is an important factor in the way they adapt.

CLINICAL SIGNIFICANCE

People carrying backpacks are at risk to injuries and core strength is a modifiable functional quality that may help to prevent some injuries.

METHODS

Twelve men and twelve women volunteered for this study (age: 19.8; height: 171cm; mass 73.2kg). Subjects were healthy, college-aged students that routinely carried backpacks. Anthropometric measures included height, weight, leg length (greater trochanter to the floor) and hip width (ASIS to ASIS). Core strength was measured for the frontal plane and sagittal plane. Frontal plane core strength was quantified as time in side-plank position while performing side leg raises, and sagittal plane core strength was quantified using the Sorensen test (time the subject was able to hold the trunk in an extended position). Temporal-spatial measures of gait were recorded while walking at preferred speed during four consecutive lengths of a 20' GaitRite mat (Sparta, NJ). Subjects walked under two conditions: 1- baseline condition (unloaded) and 2 - weighted backpack condition (20% bodyweight). Statistical analysis: Gait velocity (normalized to height), step length (normalized to leg length), percentage of gait cycle in double limb support, base of support (normalized to hip width) and difference scores of these variables between the baseline and weighted conditions were studied. Subjects were grouped by gender and then further divided into weaker and stronger sub-groups for both genders. The weaker and stronger sub-groups were composed of subjects that ranked in the lower and upper 50% of the core strength tests, respectively. Temporal-spatial data collected during the baseline and weighted conditions were compared using paired t-tests to determine if changes occurred between the conditions, independent t-tests were used to determine if the difference scores were different between the weaker and stronger sub-groups of males and females. SPSS version 21.0 was used for statistical comparisons; $p \leq .05$ was set as the threshold for significance.

RESULTS

Table 1. Temporal-spatial changes in baseline to weighted backpack conditions (20% bodyweight)

	All Subjects	sig.
Velocity (% Height)	2.3	> 0.01
SL (% Leg Length)	1.1	0.02
BOS (% Hip Width)	5.3	0.02
DLS (% of gait cycle)	-3	> 0.01

Table 2. Comparison of difference scores in temporal-spatial gait parameters between baseline and weighted backpack conditions. Subjects were grouped by gender and frontal plane core strength

	Weaker Females	Stronger Females	sig.	Weaker Males	Stronger Males	sig.
Velocity (% Height)	4.8	2.3	0.14	-0.83	2.6	0.07
SL (% Leg Length)	2.7	0.58	**0.05**	-1.3	2.4	**> 0.01**
BOS (% Hip Width)	-4.7	-7.6	0.35	-1.4	-1.1	0.4
DLS (% of gait cycle)	-3.9	-3.1	0.06	-2.3	-2.9	0.13

Table 3. Comparison of difference scores in temporal-spatial gait parameters between baseline and weighted backpack conditions. Subjects were grouped by gender and sagittal plane core strength.

	Weaker Females	Stronger Females	sig.	Weaker Males	Stronger Males	sig.
Velocity (% Height)	5.6	1.5	**0.03**	-1.5	3.3	**0.01**
SL (% Leg Length)	3.3	0.01	**> 0.01**	-0.84	1.9	**0.02**
BOS (% Hip Width)	-4.6	-7.8	0.36	-1.3	-1.2	0.45
DLS (% of gait cycle)	-3.8	-3.0	0.06	-1.1	-3.1	**0.03**

DISCUSSION

When walking with the weighted backpack people walked faster with longer steps, used a wider base of support, and spent less time in double limb support. Gender differences in the response to the weight change existed. Overall, weaker women walked faster and weaker men walked more slowly than their stronger counterparts, although only the comparisons in the sagittal plane groups were significant. Females with weaker core stability used longer steps and weaker males used shorter steps compared to their stronger counterparts. These differences could represent a difference in the response to induced instability between males and females. One interpretation is that women tend to use increased velocity to gain stability and thus may be at greater risk in situations where higher velocity is not practical.

REFERENCES

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DISCLOSURE STATEMENT

The authors have no conflicts of interest to disclose.