Muscular Activation Across Loaded Carry Techniques

A Study Review of Bordelon et. al (2021)

Rory O'Brien, MS, CSCS, PES
Guardian Strength and Conditioning

The use of loaded carries has gained an enormous amount of traction in the past decade, not only within the field of strength and conditioning, but in physical therapy as well. This class of exercises, which include farmer's carries, suitcase carries, front rack carries, and overhead carries, trains the stabilizing role of the lumbopelvic-hip complex (LPHC), or core, in a highly functional manner due to the subject walking upright while holding a weight. They can be performed either bilaterally or unilaterally, and place unique demands upon the upper body – specifically the shoulder girdle – that other core exercises do not. On account of these unique characteristics of loaded carry exercises, and due to the relative scarcity of scientific literature on them, Bordelon et al. (2020) investigated the various effects on LPHC and scapular stabilizer muscle activation of different load magnitudes and carry positions.

The authors established the essential role of the LPHC musculature on power transfer through the kinetic chain, including the interconnectedness of the abdominals with the latissimus dorsi and gluteals. Though some discussions of the core musculature end here, they continue on to recognize the often-underlooked role of the scapula in transferring energy from the LPHC to the upper body. On account of the key interaction between the core and scapula, the authors sought to explore not only the effects that loaded carries have on the core musculature, as certain other studies have, but also to measure the activation of scapular stabilizing muscles throughout three different loaded carry variations. To the best of the authors' knowledge the effect of loaded carries on scapular stabilization has not been measured in previous studies. They felt that further research was needed to investigate the effectiveness of different unilateral loaded carry positions on not only core muscle activation but scapular muscle activation as well. They hoped that this would help strength and conditioning specialists to more effectively program loaded carry exercises. The two primary aims of this study were to "a.) quantify the effect of load magnitude on

LPHC and scapular muscle activation, and b.) quantify the effect of different carry positions on bilateral glute medii and external oblique activation during unilateral overhead, front-racked, and suitcase dumbbell carries" (p 115). The authors hypothesized both that muscle activation would increase with load and that contralateral muscle activation would increase for the external obliques and glutei medii across all three carry positions.

In order to carry out this study, the researchers utilized a randomized repeated-measures design, having each subject perform three trials of each load magnitude – light, moderate, and heavy – for each position. The positions utilized were overhead, front-racked, and suitcase carries. Electromyography was utilized to assess muscle activation for the following musculature: upper and lower trapezius, latissimus dorsi, and serratus anterior (for the dominant side), and bilateral activation of the external obliques and glutei medii. Muscle activation was normalized across trials to what is known as maximum voluntary isometric contraction testing values, or MVIC.

The participant group for this study was comprised of eighteen college students, both male and female, who were considered both healthy and resistance trained. (Healthy was defined as not having a musculoskeletal muscle within 6 months of the study and resistance trained was defined as performing resistance training two or more times a week for the preceding 6 months.) Twelve men and six women participated in the study, from whom written consent was obtained prior to participating.

To measure muscle activation, BIO Protech surface electrodes were used on the following muscles: upper and lower trapezius, latissimus dorsi, serratus anterior, dominant and nondominant external obliques, and dominant and nondominant gluteus medii. The same researcher placed each electrode on each participant to ensure that the same placement was used. After a standard upper body warm-up, participants performed three sets of each of the following dumbbell carry variations with their dominant hand: overhead, front rack, and suitcase. The three sets performed were done with light, moderate, and heavy loads. The light load for the overhead carry was 15% of bodyweight. For front racked carry, subjects utilized 25% of bodyweight, and for suitcase carry, 35% of bodyweight. The moderate load for the overhead carry was 20% of bodyweight. For front racked carry, subjects utilized 30% of bodyweight, and for suitcase carry, 40% of bodyweight. The heavy load for the overhead carry was 25% of bodyweight. For front racked carry, subjects utilized 35% of bodyweight, and for suitcase carry, 45% of bodyweight. Subjects were given the same verbal cues to ensure validity across participants.

After data were collected and analyzed for all participants, it was determined by the researchers that the results supported the first hypothesis; namely, that muscle activation would increase as load increased across all three carry variations. The second hypothesis was partially supported, as gluteus medius and external oblique activation on the contralateral side increased in both the overhead and suitcase positions but not in the front racked position. Muscle activation increased in all muscles during overhead carries save the lower trapezius, while the front rack carry elicited significant increases in activation for all muscles. However, in the suitcase carry, only four muscles showed a significant increase in activity, namely, the upper trapezius, latissimus dorsi, and both the nondominant external oblique and gluteus medius.

Limitations of this study were noted by the authors. The first possible limitation is the use of surface electrodes to measure muscle activation, which theoretically could result in the electrodes picking up activity from a nearby muscle. However, due to most of the muscle activity having little dynamic movement, along with the same researcher having placed the electrodes consistently across all subjects, this limitation should not be overly considered. The second possible limitation could be the use of MVIC for trail normalization, yet the authors felt that this method, though its use may be otherwise debated in the scientific community, was appropriate due to the isometric nature of most of the muscle activity measured.

The authors provide a number of helpful practical applications and recommendations for strength and conditioning coaches regarding the use of unilateral loaded carries. Due to the novel portion of the study which pertained to scapular stabilizer activation, they were able to point out that using overhead carries to target these muscles in a highly functional manner, while still training the LPHC musculature, is highly beneficial when athletes need to strengthen these muscles. Overall, unilateral loaded carries are highly beneficial for use in not only sport performance training and tactical strength and conditioning, but for the general population, and can even be used to much effect clinically in physical therapy. This is due to a number of factors. First, activation of not only the abdominal and lower back musculature, but also of the hip abductors (Graber et al., 2021) and scapular stabilizers (Bordelon et al., 2021) is achieved to high degrees in these exercises. Secondly, these exercises are performed in not only an upright, but walking, position, which makes it incredibly functional and able to convert to performance in a number of real-world scenarios.

References

Bordelon, N. M., Wasserberger, K. W., Cassidy, M. M., & Oliver, G. D. (2021). The Effects of Load Magnitude and Carry Position on Lumbopelvic-Hip Complex and Scapular Stabilizer Muscle Activation During Unilateral Dumbbell Carries. *Journal of strength and conditioning research*, *35*(Suppl 1), S114–S119. https://doi.org/10.1519/JSC.0000000000003880

Graber, K. A., Loverro, K. L., Baldwin, M., Nelson-Wong, E., Tanor, J., & Lewis, C. L. (2021). Hip and Trunk Muscle Activity and Mechanics During Walking With and Without Unilateral Weight. *Journal of applied biomechanics*, *37*(4), 351–358. https://doi.org/10.1123/jab.2020-0273