INFLUENCE OF A WEIGHTED BACKPACK AND WEIGHTED VEST ON GAIT KINEMATICS IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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INTRODUCTION
Current estimates suggest Autism Spectrum Disorder (ASD) affects 1 in 45 children. Contemporary research indicates children with ASD exhibit dysfunctional movements in comparison to children with typical development. One such movement is the basic form of locomotion: over-ground walking [1,2]. School-age children often carry backpacks filled with books and supplies to school and other activities. Backpacks are thought to worsen posture and increase the risk for future pain in children [3], while weighted vests (WV) are promoted as a therapeutic modality to mitigate negative behaviors in children with ASD [4]. However, no studies have examined changes in walking mechanics while carrying a weighted backpack or wearing a WV. As such, the purpose of this study was to examine lower extremity kinematics in children with ASD while carrying a weighted backpack and while wearing a WV. It was hypothesized that the backpack condition would more greatly alter gait kinematics than the WV relative to an unloaded condition.

METHODS
Eight children with clinical diagnoses of ASD participated in this study (11.63±4.47 yrs old; 1:45±0.25m; 55.28±26.20kg). Reflective markers were placed bilaterally on the lower extremities, trunk, and torso to obtain three-dimensional kinematic data using a 10-camera motion capture system (200 Hz; Vicon Motion Systems Ltd. Oxford, UK). Participants were asked to walk over-ground at a self-selected speed in three experimental conditions, completing 15 trials each, 45 total: 1) over-ground walking with no added mass (unloaded); 2) walking over-ground while wearing a modified weighted vest with 15% body mass, evenly distributed (WV); and 3) walking over-ground while wearing a backpack with 15% body mass (backpack). The WV and backpack conditions were presented in a counterbalanced order after condition 1 to ensure that a previously carried load did not influence the data obtained when unloaded. Data were smoothed with a low pass filter (6 Hz) and normalized to 100% of the gait cycle (101 data points). A point-by-point symmetry analysis [2] paired with the Model Statistic procedure [3] (α = 0.05) was used to test for condition differences at each data point. The number of differences detected per participant was averaged across all participants and presented as a percentage (out of 101) of significant differences.

RESULTS AND DISCUSSION
This analysis revealed that the unloaded condition resulted in the fewest total number of asymmetrical significant differences in knee, and ankle joint position (68.4 ± 19.5, knee; 60.1 ± 19.7, ankle) as expected. The knee and ankle joints exhibited greater asymmetry in the backpack (71.5±26.1, knee; 64.3±19.4, ankle) and WV (74.6±14.7, knee; 64.9±21.5, ankle) conditions. At the hip joint, the unloaded condition generated the highest number of asymmetrical data points (71.0±29.7), while WV generated the least (60.63±31.8). Despite these findings, there were no significant differences, between the percentages of significant differences among conditions (Figure 1). It appears that carrying a backpack or wearing a WV filled with 15% body mass during walking does not positively or negatively influence walking ability in children with ASD.

Although WV can induce positive behavioral changes in children with ASD, these data suggest that WV or backpacks do not influence movement quality with respect to asymmetry. Thus, children wearing backpacks or WV can ambulate without risk of undesirable asymmetry-related events (trips, slips, or falls). The large amount of variability among the participants, as observed in the standard deviation values, is consistent with contemporary literature [1,2] suggesting ASD has many heterogeneous physical manifestations [6].

CONCLUSIONS
Since most school-aged children routinely carry a backpack, and due to the wide usage of WV in clinical interventions, it is important to understand the influence of load carriage (backpacks and WV) on gait mechanics in children with ASD. The findings from this study reveal that neither a backpack nor WV influences lower extremity movement pattern asymmetry during over-ground walking. While this study only examined the lower extremity adaptations to the added mass, it is possible that the movement of the trunk was modified to mitigate lower extremity adaptations to prevent a slip, trip, or fall.

REFERENCES
2. Eggleston et al., Gait & Posture (In review), 2017.