EXAMINING THE INFLUENCE OF BACKPACK WEIGHT ON STRIDE KINEMATICS AMONG CHILDREN WITH AUTISM SPECTRUM DISORDER

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INTRODUCTION
Evidence suggests that children with Autism Spectrum Disorder (ASD) exhibit lower levels of gross motor function and coordination than children with typical development (TD) [1,2]. More recent literature also suggests that the gait pattern of children with ASD differs from children with TD [2,3]. Carrying a backpack filled with added mass on daily basis is routine among school-aged children. Current guidelines state that the load of a backpack within 10-15% of an individuals’ body mass is recommended for children with TD owing to potentially harmful adaptations with greater loads [4]. However, no research has examined gait parameters in children with ASD when wearing a weighted backpack. Thus, the primary purpose of this study was to examine the effects of carrying a loaded backpack on stride length during over-ground walking in children clinically diagnosed with ASD. A secondary purpose was to examine stride length symmetry. It was hypothesized that children with ASD would decrease their stride length as the backpack mass increased to maintain their balance [2,5-7] with bilateral stride length becoming more symmetrical as the load increased.

METHODS
Eight children with clinical diagnoses of ASD volunteered to participate in this study (11.63±4.47 yrs old; 1.45±0.25m; 55.28±26.20kg). After gaining institutionally approved written child assent and parental consent, participants were asked to walk normally at a self-selected speed in each of three different weighted conditions. The experimental conditions were walking while wearing: 1) a backpack with no added mass; 2) 7.5% of their body mass in the backpack; and 3) 15% of their body mass in the backpack. Participants completed 15 trials in each condition while wearing reflective markers placed on medial and lateral malleoli, base of the second toe, and calcaneus, bilaterally. While walking, kinematic data were obtained with a 10-camera motion capture system (200 Hz, Vicon Motion Systems Ltd., Oxford, UK). Calcaneal anterior/posterior position was determined by the coordinate position of the marker placed on the posterior aspect of the calcanei. Stride length was computed by subtracting the position of the calcaneus markers from heel strike to heel strike of the right and left limbs. Group average and standard deviation values were computed for right and left stride lengths. Repeated measures analysis of variance (ANOVA) was used to test for statistically significant (α = 0.05) differences between right and left limbs and among the weighted conditions.

RESULTS AND DISCUSSION
The mean (standard deviation) values for Condition 1 were 1.24±0.23m and 1.26±0.23m (left and right, respectively). Condition 2 values were 1.22±0.24m and 1.22±0.24m, left and right, respectively. Condition 3 values were 1.21±0.24m and 1.21±0.24, left and right, respectively. Repeated measures ANOVA revealed that stride length was not influenced by the interaction of load condition and limb (p=0.677). There also was not a limb main effect (p=0.963). There was however, a condition main effect between the first and third conditions (p=0.016), but there were no differences between conditions 1 and 2 (p=0.075), or conditions 2 and 3 (p=0.650) (Figure 1).

These findings are consistent with contemporary literature [2,3], in that children with ASD exhibit statistically asymmetrical gait patterns. When an added mass is carried during over-ground walking, children with ASD must make adaptations to ensure they do not have an acute gait related issue (slip, trip, or fall). As such, our findings reveal that children with ASD may alter their stride lengths to adapt to the load that has been placed in the backpack.

CONCLUSIONS
This study revealed that added mass, when carried in a backpack, did not functionally influence stride length in children with ASD. Even though analysis revealed a statistically significant difference between the right and left stride lengths in the unloaded condition, we do not believe this difference (0.02m) is a clinically significant difference. Since carrying a backpack is a necessity for school-aged children, understanding the influence of a loaded weight to the body during walking is essential. Although safety guidelines for carrying a backpack with limited weight for the children with ASD has not been established, keeping the backpack weight under 15% of one’s body mass is suggested.

REFERENCES
3. Fournier et al., J Autism Dev Disord, 40(10), 2010