INTRODUCTION

Autism is a neurodevelopmental disorder characterized by qualitative impairments of language, communication, social interaction in addition to stereotypic behaviors. Autism Spectrum Disorder (ASD) is used to describe children diagnosed with autism as well as those having the same core deficits, but to a lesser severity. This group also includes children diagnosed with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) and Asperger Syndrome. In addition to communicative symptoms, children with ASD display a wide range of other symptoms that impair their development. Motor problems are the most frequently reported non-verbal impairments.

Motor impairments have received little attention in the autism literature, due to the fact that these impairments were considered less important and believed to belong to a co-occurring syndrome. However, recent research suggests that motor impairments may be the earliest indicators of autism and may be observed within the first few months of life (Teitelbaum et al., 1998). Although “clumsiness” is not used to diagnose autism, it is often used to describe children diagnosed with ASD. A clear definition of “clumsiness” in these children remains to be described, however, gait analysis techniques can provide an objective assessment of gait patterns seen in children with ASD.

The purpose of the current investigation was to attempt to describe “clumsiness” observed in young children diagnosed with ASD. Thus, ground reaction forces during stance of young children with ASD were compared to those of typically developing children (TD).

METHODS

Gait trials at self-selected walking speeds were collected for 6 children with ASD (5.5 ± 1.6 years) and 6 TD children (4.3 ± 1.1 years). Ground reaction forces in the vertical (Fz), antero-posterior (Fx) and mediolateral (Fy) directions were collected using a force plate (900Hz). Trials were considered successful if only one complete foot contact occurred on the force plate. Foot contact was determined as the point at which the ground reaction force vector was initially observed and the foot off was determined as the point at which the ground reaction vector diminished to zero. Ground reaction force data were filtered using a 7 point moving average using Microsoft Excel.

Ground reaction forces were normalized to body weight (BW) and % stance phase for all trials. The vertical ground reaction force (Fz) was characterized by Fz1 (maximum force within first 50% of stance phase), Fz2 (maximum within the second 50% of stance phase) and Fz0 (the minimum value between opposite foot off and foot contact). The antero-posterior ground reaction force (Fx) was characterized by Fx1 (maximum posteriorly directed force) and Fx2 (maximum anteriorly directed force). The mediolateral force (Fy) was characterized by Fy1 (maximum lateral force) and Fy2 (maximal medial force). See Figure 1.
RESULTS AND DISCUSSION

Children with ASD had significantly larger Fz₂ values ($t(10) = -2.5, p < 0.05$) and significantly smaller Fy₁ values ($t(10) = 2.3, p < 0.05$). No significant differences were observed for the other measures (Table 1).

Previous research indicates that kinetic measures of gait are consistent (particularly Fz₁, Fz₂, and Fx₂) with Fz₂ being the most reproducible force measure. Increased variability of these measures has been observed in children with cerebral palsy and may be considered an indicator of pathological gait (White et al., 1999) and an inability to modulate increasing gait speed during the first half of stance (Stansfield et al., 2001).

SUMMARY/CONCLUSIONS

Preliminary findings suggest that children with ASD have altered gait kinetics during stance that may contribute to the appearance of “clumsiness”. Force plate data may be a useful tool for quantifying motor impairment in children with ASD. The source of these differences remains unclear. Further gait analysis, including kinematics, is warranted.

REFERENCES


ACKNOWLEDGEMENTS

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Table 1: Means & SD for Ground Reaction Force Measures (*significance $p < 0.05$).

<table>
<thead>
<tr>
<th>Group</th>
<th>Fz₁ (%BW)</th>
<th>Fz₂ (%BW)*</th>
<th>Fz₀ (%BW)</th>
<th>Fx₁ (%BW)</th>
<th>Fx₂ (%BW)</th>
<th>Fy₁ (%BW)*</th>
<th>Fy₂ (%BW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD</td>
<td>1.28 (0.21)</td>
<td>0.88 (0.19)</td>
<td>0.54 (0.13)</td>
<td>-0.22 (0.17)</td>
<td>0.19 (0.05)</td>
<td>0.07 (0.02)</td>
<td>-0.06 (0.02)</td>
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<tr>
<td>ASD</td>
<td>1.21 (0.17)</td>
<td>1.20 (0.26)</td>
<td>0.68 (0.31)</td>
<td>-0.15 (0.08)</td>
<td>0.26 (0.14)</td>
<td>0.03 (0.03)</td>
<td>-0.09 (0.06)</td>
</tr>
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