Clinical gait analysis in individuals with autism spectrum disorders
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Introduction

 Autism spectrum disorder (ASD) is the most common neurodevelopmental disorder in the school aged youth. In the U.S., 1 in 59 children is diagnosed with ASD [1]. Based on DSM-5, individuals with ASD show deficits in communication, impairment in social interaction and restrictive repetitive behaviors [2].

Individuals with ASD often confront physical challenges. They showed delayed motor skills development, physical inactivity and abnormal gait patterns [3-6]. However, much is unknown about the impact of ASD on walking mechanics.

Leg strength is a key determinant of gait quality. Individuals with ASD may experience deficits in leg strength. However, today, no study conducted to characterize leg strength assessment in children with ASD. It is necessary to qualify the calculated leg strength in children with ASD.

Purpose

• To examine temporal spatial parameters and three-dimensional ground reaction force, kinematic and kinetic gait mechanics exhibited by individuals with ASD in comparison with the age and gender matched control group.
• To examine the leg strength in children and adolescents with ASD in comparison with the age and gender matched control group.

Methods

Participants

<table>
<thead>
<tr>
<th>Control Group</th>
<th>Group with ASD</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>[n=11]</td>
<td>[n=11]</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>Mean</td>
<td></td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>Std. Deviation</td>
<td></td>
</tr>
<tr>
<td>Age [year]</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Body Mass [kg]</td>
<td>58.55</td>
<td>11.40</td>
</tr>
<tr>
<td>Height [m]</td>
<td>1.66</td>
<td>0.10</td>
</tr>
<tr>
<td>BMI [kg/m²]</td>
<td>21.65</td>
<td>2.44</td>
</tr>
<tr>
<td>Normalized knee extensors (N*m/kg)</td>
<td>2.92</td>
<td>0.52</td>
</tr>
<tr>
<td>Cybex Norm Dynamometer (Cybex International)</td>
<td>0.67</td>
<td></td>
</tr>
</tbody>
</table>

• 15-camera motion capture system (VICON Inc) 
• Force-instrumented treadmill (AMTI Inc) 
• Cybex Norm Dynamometer (Cybex International)

Procedures

1. Subject preparation
2. Warm up trials
3. Walking on the treadmill for five minutes
4. Leg strength test

Results

Figure 1. (A) A participant was walking on the treadmill. (B) Leg strength assessment.

Figure 2. Participants with ASD demonstrated (A) a significant shorter stride length compared to the control group (p=0.04), (B) greater stride width variance compared to the controls (p=0.04), (C) greater braking force in the second half of the stance phase (p=0.03), and (D) decreased peak vertical ground reaction force in the second half of the stance phase (p=0.03).

Discussion and Conclusion

• Participants with autism showed significantly weaker knee extensors compared to the control group.
• During walking, participants with ASD demonstrated shorter stride length and greater cadence strategies.
• The greater stride width variance in participants with ASD reflected inconsistent walking patterns which may increase the risk of fall.
• The reduced ankle dorsiflexion angle in participants with ASD at initial heel strike reflects unstable control of the foot position during loading response.
• The increased dorsiflexion moments along with increased power absorption in the ankle during loading response highlighted the physical challenge faced by participants with ASD, which may lead to possible muscle fatigue at ankle level. High variance in stride width and usage of ankle muscle related to increased risk of fall during walking. In conclusion, participants with ASD demonstrated deficits in muscle strength, and different in gait patterns in comparison with the age and gender matched control group.

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References