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Lower Extremity Joint Stiffness During Running in Adolescents with Autism Spectrum Disorder

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LOWER EXTREMITY JOINT STIFFNESS DURING RUNNING IN ADOLESCENTS WITH AUTISM SPECTRUM DISORDER

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Introduction

- Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by a variety of physiological and behavioral characteristics. ASD affects 1 in 44 children in the United States[1]
- Running is the most common form of physical activity for girls and the second most common form for boys aged 12 to 15 years.[2] This is consistent for autistic adolescents, who enjoy solitary activities, such as running, more than team-based sports[3-5]
- Autistic adolescents have reported elevated levels of fear for sustaining injury, being bullied, and fear of exclusion within their physical education classes compared to their non-autistic peers[5]
- Late adolescents undergo rapid skeletal growth leaving individuals more vulnerable to injury risk. Inadequate joint stiffness is one of several factors that may increase injury risk[6]
- The purpose of this study was to examine ankle and knee joint stiffness in autistic adolescents and non-autistic matched controls at self-selected and matched running speeds

Significance

- Investigating loading and joint stiffness of the lower extremity in autistic persons during running may provide points of emphasis for therapeutic and rehabilitation interventions

Methods

- Twenty-two (n=22) autistic adolescents (15 males, aged 14±2 years BMI 22.24±5.76 kg/m^2) and seventeen (n=17) age, sex, and body mass index healthy non-autistic controls (CON) participated
- Participants ran at two matched speeds: self-selected speed (SS) and a standardized speed of 3.0 m/s (3.0)
- Three-dimensional motion capture (Vicon Vantage) and force platform (Bertec) data were recorded. Figure 1 provides an example of the progression from motion capture of a human participant (top) to skeletal model (bottom)
- Joint stiffness (unitless) was calculated as the quotient of the change in joint moment (normalized to body mass*leg length) and the change in joint angle (radians) during the energy absorption phase (Fig 2)
- Stiffness and changes in joint moments were analyzed using 2 (group) x 2 (speed) ANOVA

Table 1. Ensemble joint stiffnesses and change in joint moments (mean±SD)

	Joint Stiffness				Joint Moments			
	ASD SS	ASD 3.0	CON SS	CON 3.0	ASD SS	ASD 3.0	CON SS	CON 3.0
Knee	5.84±0.86	6.44±0.80	6.80±1.05	6.97±1.32	2.47±0.35	2.67±0.38	2.80±0.33	2.90±0.42
Ankle	7.49±1.15	7.33±1.43	8.88±2.35	8.77±2.28	2.28±0.35	2.38±0.38	2.81±0.42	2.82±0.43

Figure 1. Example of data collection, motion capture data in Vicon Nexus then analyzed in Visual 3D

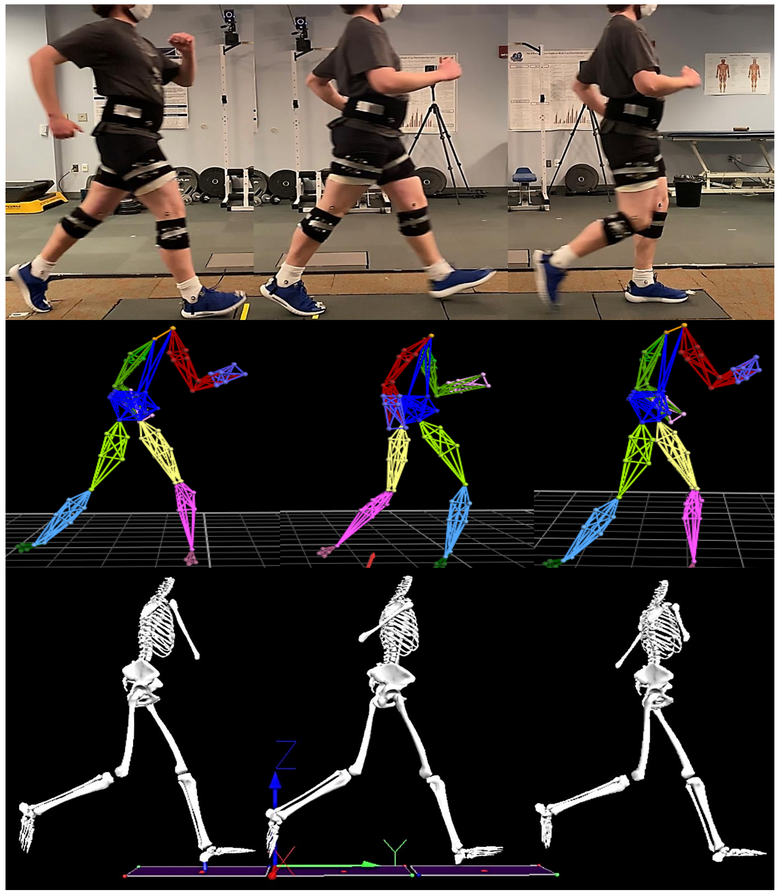
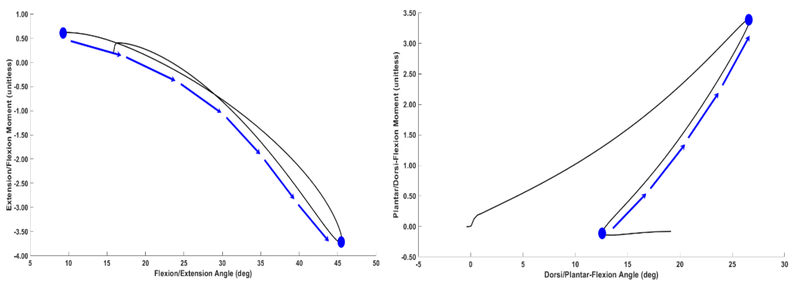


Figure 2. Examples of knee (left) and ankle (right) joint stiffness waveforms



Results

- There were no significant interactions between groups and speeds (p>0.05) for any variable
- Autistic adolescents had reduced knee and ankle joint stiffness (all p<0.020; Table 1)
- Running at the 3.0m/s standardized speed resulted in increased knee joint stiffness compared to self-selected (p=0.010)
- Autistic adolescents had reduced changes in knee and ankle moments (p<0.003; Table 1)
- Running at the 3.0m/s standardized speed increased knee moments over self-selected speed (p=0.004)

Discussion

- Autistic adolescents typically display increased joint stiffness compared to controls.[8] However, our expectation of a similar increase in joint stiffness during running was incorrect.
- Joint stiffness during running has typically been viewed as greater stiffness indicates an increase in injury risk[7]; thus, reduced stiffness could be beneficial
- However, decreased joint stiffness could be indicative of a less efficient running style whereby the elastic recoil is not being optimally utilized by the knee and ankle musculature
- We cannot ignore the implications of prior training on running mechanics. We did not ascertain participants' physical activity; however, we previously tracked physical activity engagement, finding no differences between groups in low and moderate to vigorous physical activity[9]

References

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