

Children's Gait Kinematics Footwear Stiffness

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ABSTRACT

At a young age, children are exceptionally plastic and can adapt well to changes in their environment. One particular environmental factor that is often overlooked is children's footwear. Children are subjected to many different types of footwear at a prime age of development. Different types of footwear can have a range of stiffnesses, potentially influencing the way that children walk. **PURPOSE:** The purpose of this study was to investigate what effect varying footwear stiffnesses had on children's gait kinematics. **METHODS:** Eleven healthy children between the ages of 4-6 participated in this study (Age = $4.8 \pm .8$ years, ht = 44.1 ± 3.8 in, wt = 47.1 ± 13.4 lbs). The children walked barefoot and in three separate footwear conditions (moccasin, minimalist, and rigid), on an instrumented treadmill for 3-minutes while motion capture data was captured. Gait kinematics, including range of motion (ROM) and peak joint angle velocities of the ankle, knee, and hip, were computed using Visual3D and custom Matlab software from the motion capture marker trajectories. A repeated measures ANOVA was used to determine any differences between the dependent variables for the conditions with LSD post hoc analysis conducted if necessary. ($p = .05$). **RESULTS:** There was a significant main effect for the knee flexion velocity, knee extension velocity, hip flexion velocity, and for hip extension velocity ($p > .05$). Specifically for knee flexion velocity, the barefoot condition was significantly less than the minimalist and rigid shoe conditions ($p < .05$) but not different from the moccasin. There was a gradual significant decrease by stiffness for the footwear conditions for knee extension velocity, with barefoot exhibiting the greatest velocity and rigid footwear having the least ($p < .05$). Interestingly, there was the exact opposite effect for hip flexion velocity, with a steady increase from barefoot to rigid with the barefoot being significantly less than both the minimalist and rigid shoe conditions ($p < .05$). Hip extension velocity was also significantly less in the barefoot condition compared to the rigid condition ($p < .05$) though no other conditions were significantly different ($p > .05$). **CONCLUSION:** Varying degrees of footwear stiffness had a substantial impact on children's gait kinematics. Specifically, both the minimalist and rigid footwear conditions elicited the greatest differences compared to the barefoot conditions. However, there did not appear to be a difference between the moccasin and barefoot conditions. Future research should be conducted to further understand the potential negative impacts footwear has on the development of gait in children and if perhaps, shoes that truly mimic barefoot gait, such as moccasins, should be more regularly used.