

COMPARISONS OF ENERGY EXPENDITURES AMONG CHILDREN DIAGNOSED WITH IDIOPATHIC TOE WALKING AND TYPICAL CHILDREN USING INERTIAL SENSORS

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ABSTRACT

Children diagnosed with Idiopathic Toe Walking (ITW) walk on their toes and are liable for leg pain and fall injuries. It is crucial to understand how toe walking affects energy expenditure in these children compared to typical children of the same age. In this study, we utilized an inertial measurement unit (IMU) attached to the low back to evaluate the number of steps and energy expenditure in the child's natural setting for three days. Twenty participants were instructed to wear a sensor on their low back for three days, and their activities of daily living (ADL) were objectively quantified during weekdays and weekends in their natural settings. We found total energy expenditure was significantly higher among children diagnosed with ITW compared to typical controls ($p < 0.05$). We also found the children diagnosed with ITW took shorter and significantly more steps than age-matched controls ($p < 0.05$). A future investigation into biomechanics and new gait interventions is needed to improve gait efficiency and energy expenditure among children diagnosed with ITW.

Keywords: Idiopathic Toe Walking (ITW), Total Energy Expenditure (TEE), Center-of Mass (COM), Toe walking

INTRODUCTION

Idiopathic Toe Walking (ITW) is a condition with an unknown cause and leads to the individual consistently walking with their heel off the ground. While toe to toe contact is the hallmark of the diagnosis, research has suggested children with ITW experience fatigue [1] and pain [1-5] while completing tasks. The altered gait pattern observed in ITW strongly contrasts with the typical walking behavior of landing the heel on the ground first where the heel-strike leads to a more effective limb muscle length than non-heel-strike walking [6]. Appropriate muscle coordination is vital because discrepancies can lead to imbalance, loss of ankle range of motion, and pain when walking. Some have suggested that ITW may be linked to sensory processing dysfunction, but definitive evidence regarding the relationship between the two has not been found [7].

Furthermore, despite numerous investigations on idiopathic toe walking, there is still no concrete explanation for its underlying cause. It is essential to understand idiopathic toe walking due to its effects on physical abilities and energy expenditures. For instance, one investigation found that children diagnosed with ITW were three times more likely to face severe difficulty with movements of their ankle joints [1]. These physical deficits with ITW could adversely impact these individuals' daily activities and quality of life. Another area of impact is ankle stability since the ankle range of motion strongly correlates with an individual's balance [8]. Ankle stability is vital for routine activities to decrease the risk of falls and injury.