

Gait in Obese Children: Effect of Fitness and Fatigue on Joint Biomechanics

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ABSTRACT:

Purpose: The purpose of this study is to determine how fitness and fatigue influence walking biomechanics in obese children (aged 8-11 years). It was hypothesized that walking biomechanics, as measured by hip and knee moments (stresses), will be inversely related to cardiorespiratory fitness in obese children, in a non-fatigued state. The unique aspect of this project is the examination of cardiorespiratory fitness (an attribute) and cardiorespiratory fatigue (a temporary state), in obese children and the association with physical performance (gait biomechanics).

Methods: Thirty children aged 8-11 years (9.8 \pm 0.9) with BMI above 95th percentile (96.1 \pm 4.1) volunteered for the study. Infra-red emitting markers were applied to the lower limbs, pelvis, and trunk segments to generate biomechanical anatomical models. Gait evaluations were conducted along an 8 m walkway using a 3D motion analysis system (Optotrak, NDI Inc., Ontario) and force plates (Kistler Instruments, Inc., NY). Cardio-respiratory fitness was assessed using an 8-minute submaximal Nemeth treadmill protocol. A PACER protocol was used to fatigue subjects. Walking biomechanics were assessed prior to and immediately following the fatigue activity. Paired t-tests ($p < 0.05$) were performed to determine differences in peak hip and knee moments.

Results: Cardiorespiratory fitness assessed by Nemeth protocol was 35.3 \pm 6.5 (range 24.13 to 49.1) mL/min/kg. During the PACER fatigue protocol subjects completed 17.5 \pm 8.5 (range 4-45) laps. The peak hip and knee adduction moments showed moderate associations with fitness levels ($r = 0.52$ and 0.54 respectively). Hip and knee extensor moments showed weak relationship with fitness level ($r = 0.22$ and 0.18 respectively). Following fatigue there was a significant increase in the knee adduction moments ($p = 0.01$), knee extensor moments ($p = 0.02$) and hip extensor moments ($p = 0.01$). No increase was seen in hip adductor moments (p -value 0.67).

CLINICAL IMPLICATIONS: The results of the study have implications in the clinics, where gait patterns may not be present when obese children are briefly examined during an un-fatigued state. This study provides information on how the level of fitness and fatigue might affect the response during clinical evaluations in obese children.