INFLUENCE OF BODY WEIGHT ON JOINT LOADING IN STAIR CLIMBING

Gerda Strutzenberger, Anne Richter, Diana Lang and Hermann Schwameder

BioMotion Center, Department of Sport and Sport Science, Karlsruhe Institute of Technology (KIT), Germany

FoSS – Research Center for Physical Education and Sports of Children and Adolescents, Karlsruhe, Germany

KEY WORDS: joint loading, stair climbing, obesity

INTRODUCTION: Exercise is an essential treatment in childhood obesity. Due to the low impact on joint loading exercise recommendations are aerobic exercise such as swimming, cycling and walking (Hassink et al, 2008). Little is known though about the effect of adiposity on the function of the locomotor system (Wearing et al., 2006). Only limited research has been done on obese gait in children (Nantel et al. 2006) and even less is known about other weight bearing tasks such as climbing stairs. Therefore, the aim of this study was to examine the influences of obesity on the load pattern of the lower extremity joints of obese children while ascending and descending stairs.

METHODS: 17 normal weight children (10.4 ± 1.3 yrs, 143 ± 9 cm, 36.7 ± 7.5 kg) and 18 obese children (10.5 ± 1.5 yrs, 148 ± 10 cm, 56.6 ± 8.39 kg) participated in this study. A staircase with 6 steps (17cm x 28 cm per step) was built. Two force plates (AMTI, 1000 Hz) were embedded in the 3rd and 4th step. The kinematic data was collected using 10 infrared cameras (Vicon, 200 Hz). The children performed 3 valid trials walking up- and downstairs with a given speed of 110 steps/min. Dynamic data was normalized to body weight and time-normalized to stance phase. Inverse dynamics were calculated and mean peak values of ankle, knee and hip joint moments were identified. Independent t-tests were used to check for differences between the two groups.

RESULTS: The analysis of this study is still in progress. First results of 9 subjects (5 normal weight, 4 obese) can be reported (Table 1). Due to the low number of subjects no statistical analysis was performed. The transverse plane shows slightly higher peak moments in all joints. Additionally changes of the load pattern in the hip and knee while descending appeared in that plane.

Table 1 Mean peak moments of the hip, knee and ankle in sagittal and transverse plane.

	Hip M_{flex}	Hip M_{add}	Knee M_{flex}	Knee M_{varus}	Ankle $M_{dorsalext}$	Ankle M_{pron}
upstairs: max obese (Nm/BW)	0.81±0.24	0.61±0.15	0.85±0.24	0.50±0.15	1.61±0.32	-0.29±0.12
upstairs: max normal weight (Nm/BW)	0.93±0.21	0.49±0.04	0.97±0.21	0.42±0.04	1.38±0.15	-0.21±0.08
downstairs: max obese (Nm/BW)	0.32±0.24	1.01±0.20	0.96±0.22	0.69±0.18	1.40±0.10	-0.26±0.08
downstairs: max normal weight (Nm/BW)	0.60±0.39	0.98±0.12	0.93±0.30	0.61±0.10	1.67±0.26	-0.21±0.07

DISCUSSION: The differences of joint loading parameters between the two groups are small, but should not be neglected considering the higher body weight of the obese group. Therefore, weight bearing tasks challenge the obese musculoskeletal system, and could overload it when done too excessively. Exercise and sport performed by obese children should hence focus on training in load reduced conditions.

REFERENCES:

Hassink, S.G. et al. (2008). Exercise and the obese child. *Progress in Pediatric Cardiology*, 25, 153-157

Nantel, J.,et al. (2006). Locomotor Strategies in Obese and Non-obese Children. *Obesity*, 14, 1789-1794.

Wearing, S.C., et al. (2006). The biomechanics of restricted movement in adult obesity. *Obesity Reviews*, 7, 13-24.