NATA RESEARCH & EDUCATION FOUNDATION

Grant Information Summary:

Shock Attenuation for Children Running on a Treadmill and Overground

Practical Significance Statement

The amount of impact shock that children attenuated during running was dependent on velocity and whether or not the children were running on a treadmill or overground. Furthermore, the amount of impact shock attenuated was different then expected when compared to adult data. This research is a step towards understanding strategies that can be implemented to reduce the risk of running overuse injuries due to impact forces for children.

Study Background

Children have many opportunities to participate in sports that involve running and it is well documented that runners are susceptible to overuse injuries. The impact between the foot and ground is likely a factor causing overuse injuries. There are about 2500 collisions between the foot and ground during a 30-minute run. The magnitude of this impact can be 1.5 to 3 times body weight. With each collision, a shock wave of energy is transmitted throughout the body. Adult runners absorb approximately 80% of the shock but the amount of shock absorbed by pre-adolescent runners is not known.

Objective

Determine the shock attenuation characteristics for children while running on a treadmill at different speeds and during running overground.

Design And Setting

For the first experiment, a 1 (treadmill) x 3 (speed) within-subjects design was used, while for the second experiment a 1 (speed) x 2 (treadmill, overground) within-subjects design was used. The study took place in a University Biomechanics Laboratory.

Subjects

Children (n=14; age 10±1 yrs; mass 38±10.1kg, height 142.0±8.0 cm) free from lower extremity injury participated in this investigation.

Measurements

Experiment 1: subjects ran at speeds that were 0.5 m/s slower (S) and faster (F) than a self-selected (SS) speed for a total of three speed conditions (S, SS, F). Self-selected speed was determined by having a subject select a speed that could be maintained for 15 minutes. Experiment 2: subjects ran overground with running speed matched to SS.

One accelerometer was secured to the anterior-medial region of the distal aspect of right tibia; another at the frontal region of the head. Peak impact acceleration was recorded for the leg (LgPk) and head (HdPk) acceleration profiles. SA was calculated as [1-(HdPk/ LgPk)]*100.

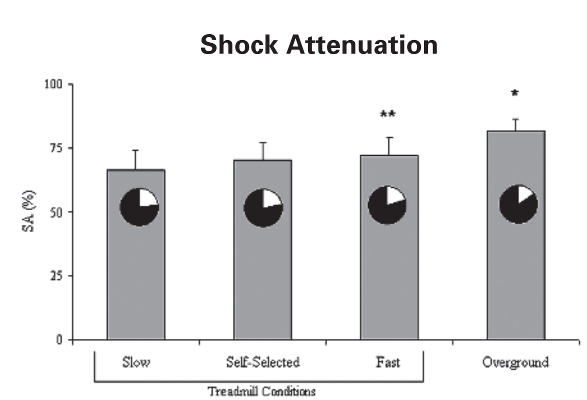

Figure 1: Illustration of Shock Attenuation (SA) during different running conditions. The embedded pie chart illustrates the proportions of leg (black) and head (white) impact accelerations. Note: *: SA different during Overground and Treadmill Self-Selected speed ($P<0.05$). **: SA different across running speeds ($P<0.05$).

Results

Shock attenuation was significantly different ($P<0.05$) between treadmill (66.7 ± 4.8%) and overground (79.4 ± 6.2%) conditions. LgPk was not different ($P>0.05$) between treadmill (4.2 ± 2.0 g) and overground (6.2 ± 2.8 g). HdPk was not different ($P<0.05$) between treadmill (1.4 ± 0.6 g) and over ground (1.2 ± 0.6 g) conditions. There was no difference in the running speeds used per condition (Treadmill: 2.6 ± 0.4 m/s; Overground: 2.6 ± 0.4 m/s, $P>0.05$).

The Actual and Expected shock attenuation magnitudes were not different for treadmill running (Actual = 66.7 ± 4.8%, Expected: 68.7 ± 1.8%; $P>0.05$) but were different for overground running (Actual = 79.4 6.2, Expected: 68.7 1.8%; $P<0.05$).

Conclusions

Shock attenuation in children is dynamic and dependent on the impact shock, which varies with running speed and surface changes.

Principal Investigator:

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Dr. John Mercer is the Director of the Biomechanics Laboratory and Co-Director of the Center of Disability and Applied Biomechanics at the University of Nevada, Las Vegas. Dr. Mercer is also the Associate Dean of the School of Allied Health Sciences and co-chair of the Biomedical Institutional Review Board. Dr. Mercer has conducted research on understanding how impact forces during locomotion are related to overuse injuries and in understanding how the human adjusts locomotion behavior relative to the impact phenomenon. His research has focused on how a person absorbs the energy due to the collision between the foot and ground during walking, running, as well as landing movements.

Publication & Presentation List

Bhanot K, Mercer JA., Dufek JS, Freedman JA., House A.J, Griffin JR. Effect of Change in Running Speeds on Shock Attenuation among Children. 2006. Proceedings of the Southwest Chapter of the American College of Sports Medicine Annual Meeting

Mercer JA, Dufek JS, Bhanot K, Freedman JA, House AJ, Griffin JR, Rubley MD, Mangus BC. Shock attenuation for children running on a treadmill and overground. *Journal of Athletic Training.* 2007;42:116.

Printing by:

Ellington Printery, Ellington, CT

Funded by NFL Charities

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