THE COMPARISON OF DYNAMIC MOTION AND STATIC POSTURAL CONTRAL IN OBESE AND NORMAL FEMALE CHILDREN

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SUMMARY
The purpose of this study was to examine dynamic and static ability of balance and postural control in obese (n=5, age 9.0±2.1yrs) and normal (n=6, age 9.7±0.5yrs) female children. The subjects were instructed to perform walking, running and counter-movement jump separately on the force platform. The measurements of kinematic data during each movement were collected by using motion capture system. The center of pressure (COP) displacement of the ground reaction force was recorded at a frequency of 20 Hz. While the subjects were taking stationary standing position with opened eyes or closed eyes on the force platform for 30 seconds, and the total length of COP (LNG) displacements was calculated. Body composition was measured by bio-impedance method. There was a significant difference between obese female children and healthy male adults in BMI (27.8±2.7 vs. 17.5±0.8, p<0.01) and %fat (43.9±5.7 vs. 17.2±2.0%, p<0.01). In running and CMJ, angular displacement of knee flexion was significantly higher in normal adults than in obese children. The LNG of open and closed eyes was significantly larger in the normal children than in the obese children. It indicated that obese children could not perform general motion in intensive exercise. Also, obese children was more stable than normal children in a static potion because a lot of body weight. It seemed that obese children are less dynamic balance ability. These results indicate a higher risk of fall in the obese children during the exercise.

INTRODUCTION
In childhood fractures of the distal forearm (wrist) are extremely common, affecting 1% of the pediatric population aged 3-/15 years annually [1]. It has been shown that overweight children have a greater risk of sustaining these fractures than leaner children [2]. Wrist fractures frequently result from a modest fall but it is not known whether children suffering these fractures fall more frequently than those who have no fractures. Because children and teenagers fall frequently [3] it is not practical to obtain diary recall data to ascertain fall frequency in children with and without fractures, as is done in adults [4]. However, children with poor balance might be expected to fall more frequently and thus be more susceptible to distal forearm fractures, than those with better balance [5]. It therefore seemed valuable to determine whether or not children with a history of previous wrist fractures have similar balance and postural sway as those who have never broken their bones. The purpose of this study was to examine dynamic and static ability of balance and postural control in obese and normal female children.

METHODS
Obese female children (n=5) and normal female children (n=6) participated in this study. Before the experiment, all procedures and any potential risks were explained to each subject, and an informed consent document was signed previous to participation. This study was approved by Japanese Red Cross Hokkaido College of Nursing Review Board for Health Sciences Research Involving Human Subjects. The body composition of the subjects was measured by bio-impedance method (BC-612, TANITA, Tokyo, Japan). The physical characteristics of the subject shows table 1. The subjects were instructed to walk and run with bare feet at a self-selected speed over a 6.7 × 1.2 m platform. Additionally, the subjects performed counter-movement jump (CMJ) on the force platform (1.8 × 1.2 m). The subject carried out each movement on platform 2 to 5 times. After that, we recorded static postural control ability using force platform. The measurements of kinematic data during the walking, the running, and the jumping were established using the VICON 460 motion analysis system (Oxford’s Metrics, Oxford, UK) with six cameras at 120 Hz placed on the laboratory ceiling. The each motion of the subjects was recorded with this system and reflective markers. VICON Workstation software was used to calculate position of the subject’s center of gravity (CG) and the relative angles between coordinate systems of each segment in the lower limb and the laboratory coordinate system. Kinematic and ground reaction force (GRF) data were collected and synchronized at a sample frequency of 120 Hz. Data were analyzed in the sagittal plane after smoothing with a uni-directional second-order low-pass Butterworth filter with a cutoff frequency of 10 Hz. The center of pressure (COP) displacement of the ground reaction force was recorded at a frequency of 20 Hz while the subjects were taking stationary standing position with opened eyes or closed eyes on the force platform (ECG-1500A, KYOWA, Tokyo, Japan) for 30 seconds. The total length of COP displacements was calculated as an indicator of the balance ability.

All data were expressed as mean ± SD. An analysis of variance (ANOVA) was used to determine significant differences between obese children and normal adult on measured variables. The p-value was considered significant when it was found to be less than the usual level of significance 0.05.
RESULTS AND DISCUSSION

There was a significant difference between the obese and normal female children in weight (55.0±12.2 vs. 34.2±2.7, p<0.05), BMI (27.8±2.7 vs. 22.3±3.9, p<0.05) and %fat (43.9±5.7 vs. 17.1±7.3%, p<0.01). However, there was no significance between two groups in height and muscle mass. There was no significant difference in each joint angle in obese and normal children during walking. Angular displacement of knee flexion during the running was higher in normal children than in obese children (57.0±4.4 vs. 79.2±13.7 deg, p<0.01). However, there was no significant difference between two groups in angular displacements of hip and ankle joints during the running. Angular displacement of knee flexion during the CMJ was higher in the normal adults than in the obese children (57.0±4.4 vs. 111.6±15.0 deg, p<0.01). Then, the angular displacement of ankle plantar flexion during the CMJ was higher in normal children than in obese children (27.9±7.8 vs. 83.0±13.4 deg, p<0.01). However, there was no significance between the two groups in the angular displacement of hip joint during the CMJ. The LNG was shown in Figure 1. The LNG were significantly larger in the normal children than in the obese children (open-eyes; 62.9±12.3 vs. 104.7±8.9 mm, p<0.01, closed-eyes; 60.2±10.6 vs. 107.9±16.3 mm, p<0.01).

In running and CMJ, angular displacement of knee flexion was significantly higher in normal adults than in obese children. It indicated that obese children could not perform general motion in intensive exercise. It seemed that obese children increased the instability in the running and CMJ. This suggests that the increased risk of injury during the activities motion.

Generally, overweight would reduce to static posture control ability. In this study, the LNG while standing with open and closed eyes were was significantly larger in the normal children than in the obese children (Fig. 1). It suggested that the obese children were more stable than normal children in a static potion because of their heavier body weight. Therefore, obese children have low activity levels. It seemed that the obese children had less dynamic balance ability. Relevant skills and attitude control of the injuries induced by the fall. Thus, when obese children exercise the body needs more attention.

Obesity was increasing the load to risk factors for falls and each joint injury. Additionally, it is said that obese children tend to feel tired easily when they are taking exercise. These results indicate a higher risk of fall in the obese children during the exercise.

CONCLUSIONS

We seemed that obese children are less dynamic balance ability. These results indicate a higher risk of fall in the obese children during the exercise.

ACKNOWLEDGEMENTS

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REFERENCE


Table 1: Physical characteristics of the subjects.

<table>
<thead>
<tr>
<th>Group</th>
<th>Obese children (n=5)</th>
<th>Normal children (n=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (S.D.)</td>
<td>Mean (S.D.)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>9.0 (2.1)</td>
<td>9.7 (0.5)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>139.9 (10.1)</td>
<td>139.9 (7.6)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>55.0 (12.2)</td>
<td>34.2 (2.7)*</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>27.8 (2.7)</td>
<td>17.5 (0.8)**</td>
</tr>
<tr>
<td>%fat (%)</td>
<td>43.9 (5.7)</td>
<td>17.2 (2.0)**</td>
</tr>
<tr>
<td>Muscle mass (kg)</td>
<td>28.8 (5.1)</td>
<td>26.8 (2.4)</td>
</tr>
</tbody>
</table>

*; p<0.05, **; p<0.01

![Figure 1: The comparison with between obese and normal children in the LNG.](image-url)