INTRODUCTION

A significant number of people are currently exercising in gymnastic academies. That brings, along with the benefits of physical activity, a risk of injuries. According to Hamill & Knutzen (1999), 43% of those who exercise, and 76% of high-impact aerobics instructors suffer injuries. Biomechanics can contribute toward improved performance and toward the prevention of injuries (McGinnis, 2002). The march is a movement used in several types of gym workout. It is a basic movement that can be performed at all levels (beginners, intermediary, and advanced). This study purports to analyze the behavior of some variables related to ground reaction force when marching in three different cadences.

METHODS

Eight female subjects were used for this study, their ages ranging from 18 to 24, average height ranging 1.65 ± 0.06 m, and average body weight 569.9 ± 60.8 N. The variables studied are presented on Figure 1. They are as follows: first peak of vertical force (Fy 1), second peak of vertical force (Fy 2), stance time (∆t), time of the first peak of vertical force (∆t Fy 1), time of the second peak of vertical force (∆t Fy 2), and loading rate (LR). Force values were normalized by body weight (BW), and temporal values were normalized by the stance time.

In order to acquire the data for this study two AMTI (Advanced Mechanical Technology, Inc.) force plates were used with acquisition frequency of 900 Hz and time of acquisition of 4 s. The subjects performed the movement in three different cadences: 130, 140, and 160 bpm. Three attempts were made in each cadence and the data from all stances occurred during the acquisition time was used. Data was processed through a software developed in IDL (Interactive Data Language). In order to compare between means in the three cadences, an analysis of variance (ANOVA) was made, and the Tukey test was used whenever a statistical significant difference occurred. The significance level was 0.05.

RESULTS AND DISCUSSION

Table 1 shows the results of the study. There was a significant increase in the first peak of vertical force, with an increase in cadences from 130 to 160 bpm, and from 140 to 160 bpm. There was no significant difference between cadences 130 and 140 bpm. As to the second peak of vertical force, there was a significant decrease from 130 bpm to 160 bpm. No statistically significant difference was found in cadences 130 and 140 bpm, and in cadences 140 and 160 bpm. Stance time showed statistically significant difference in all the three cadences studied. The time of the first peak of vertical force showed significant difference only in cadences 130 and 160 bpm, and the time of the second peak of vertical force showed difference in cadences 130 and 160 bpm, and in cadences 140 and 160 bpm. All data of vertical force obtained in this study are in agreement with the literature where values of human gait were found, varying from 1.0 and 1.2 BW (Hamill & Knutzen, 1999) and 1.25 BW (Durward et al., 2001).

CONCLUSION

The results of this study demonstrated that the curve pattern of vertical ground reaction force in all cadences studied was similar to the curve of human gait. As expected, stance time decreased with the increase in cadence. The study also demonstrated that an increase in cadence tend to increase the first peak of vertical force, and to decrease the second peak of vertical force.

REFERENCES


<table>
<thead>
<tr>
<th>Cadence (bpm)</th>
<th>Fy 1 (BW)</th>
<th>Fy 2 (BW)</th>
<th>∆t (s)</th>
<th>∆t Fy 1 (%)</th>
<th>∆t Fy 2 (%)</th>
<th>LR (BW/%)</th>
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<tr>
<td>130</td>
<td>1.09 ± 0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.92 ± 0.05&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.74 ± 0.08&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.40 ± 0.06&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.70 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.80 ± 0.48&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>140</td>
<td>1.11 ± 0.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.91 ± 0.07&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.68 ± 0.08&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.39 ± 0.06&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.71 ± 0.04&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.90 ± 0.53&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>160</td>
<td>1.16 ± 0.19&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.90 ± 0.07&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.59 ± 0.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.38 ± 0.07&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.72 ± 0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.13 ± 0.80&lt;sup&gt;b&lt;/sup&gt;</td>
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