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Analysis of Factor Effect on Ground Reaction Force During Stair Climbing

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Abstract: Stair climbing is one of the most important human daily activity and presents challenges for all human beings including old adults, younger adults and children. Various factors, such as stair height, climbing mode, and climbing style, make the climbing more or less hazardous. In order to provide a safe and less hazardous use of the stairs, research needs to be done to determine the effects of these factors. The objective of this study is to explore the effect of these factors on the Ground Reaction Force (GRF) and thus on the hazardousness of stairs climbing. Two-axis force platform was used to measure the GRF. Five (5) younger adults were asked to use climbing mode (ascent and decent) at three different height stair heights (7, 6.8 and 6.5 inch) by using two climbing styles (walking and running). In addition, participants' body weight, stature and average time spent on each condition were recorded. The experiment was repeated two times. The data collected was analyzed using mixed level factorial design. Results of data analysis indicated that the highest average GRF (762.05 N) was related to highest stair height (7 inch). However, the effect was more significant in case of climbing mode and style ($P < 0.05$). Moreover, the contour plot results indicated that stair descent is more difficult and risky than ascent (about 300 N more force required) as well as running required more GRF energy than walking (about 200 N more force required). These results inferred that individuals should take caution while they try to run during the stair decent. Future study may include more participants as well as consideration of stair climbing speed and parallel reaction force effect to predict the joint kinematics and kinetics during the stair climbing.

Keywords: Stair Climbing, Effect, Ground Reaction Force