

2-2023

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Recommended Citation

Li, HongYe (2023) "Effects of Body Composition on Weight-Bearing Staging in Firefighters: Based on Linear, PLS Regression Model Analysis," *International Journal of Physical Activity and Health*: Vol. 2: Iss. 1, Article 12.

DOI: <https://doi.org/10.18122/ijpah.020112.boisestate>

Available at: <https://scholarworks.boisestate.edu/ijpah/vol2/iss1/12>

Effects of Body Composition on Weight-Bearing Staging in Firefighters: Based on Linear, PLS Regression Model Analysis

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Abstract

Firefighters are often exposed to traumatic events such as high temperatures, heavy fumes, and toxic gases during rescue services. The challenges require firefighters to have a higher level of physical performance compared to a typical person. In urbanized settings, weight-bearing staging is a necessary skill for firefighters. Currently, research has found a positive correlation between firefighter body composition and occupational activity performance. This study aims to examine effects of body composition on the weight-bearing staging performance of firefighters, providing guidance for firefighters' daily training routines. Participants were 47 male firefighters in Yangjiang City, Guangdong Province (age: 25.2 ± 3.9 ; height: 169.8 ± 5.1 cm; 68.9 ± 8.0 kg; 24.2 ± 2.4 kg / m²). Load climbing tests were organized by the fire rescue brigade in Yangjiang City. The tested wore a full set of fire protective clothing, carried a positive pressure air respirator and carried two water belts (with a total load of 30kg), climb to a 10-story building and record the test completion time by manual timing. For body compositions, body weight, body fat, skeletal muscle content and lean weight were measured by machine with the help of Inbody 360 body composition tester. Linear and PLS regressions were used for data analysis. In the Gray's association degree analysis, the association degree of the weight indicators was ranked first, meaning that weight had the strongest association with weight-bearing indoor performance. In linear regression analysis, the model equation was derived as follows: weight-bearing floor performance (s) = $16.20 + 0.9056 * \text{weight (kg)}$, and the R-square of the model was 0.1927, implying that body weight could explain 19.27% of the variance in weight-bearing floor performance. An F-test of the linear model yielded $F = 10.74$, $P < 0.05$. In the PLS regression analysis, the principal component of 1 was the optimal number of extractions from the projection importance index VIP value, and the final result was that the regression of weight and body fat on weight-bearing dengue performance had a significant effect. Based on the results, the highest association emerged between weight and weight-bearing performance; weight had a significant effect on the weight-bearing performance, with greater weight-bearing sitting time; weight and body fat had significant effects on weight-bearing staging performance. To maintain adequate occupational mobility, firefighters are recommended to manage body composition through aerobic endurance and strength training.

Keywords: firefighters, strength training, weight bearing, body composition