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Estimation of potential sports injury risk based on left-right differences in jumping height

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Introduction Sports injuries pose a significant concern for middle and high school students engaged in athletic activities. Traditional approaches to estimating potential sports injury risks have relied on the expertise of physiotherapists or specialized equipment usage. However, these methods present challenges regarding risk management for the students, the high cost, and the low portability of specialized equipment. To address these issues, this study aimed to utilize smartphone sensors to assess daily injury risks users face in a simplified manner.

Methods This study focused on the hypothesis that differences in muscle strength between the left and right foot contribute to an increased risk of injury. Over three-months, jumping data from rebound jumps using the left and right foot were collected for 30 junior high school students. The Jumping height was calculated by analyzing the acceleration data and determining the dwell time of each jump. The relationship between the differences in jumping height and the potential risk of sports injury was analyzed. The estimation of potential sports injury risk involved the following steps: decomposing the acceleration data of the jumping motion into frequency components using the Discrete Fourier Transform, dimensionally reducing the obtained frequency spectrum through Singular Value Decomposition to extract features, and utilizing the obtained features as explanatory variables. The k-nearest neighbor method was then employed to estimate five items: (1) repeatability, (2) stability, (3) strength, (4) trunk-out, and (5) knee-in. Items 1 to 3 were rated on a five-point scale, while items 4 and 5 were binary grades.

Results The precision between the calculated left-right difference and the physiotherapist's evaluation was low, at 30%, with an accuracy of approximately 48%. A chi-squared test revealed no statistically significant correlation between these evaluations (p-value = 0.78). Despite the absence of substantial abnormalities in the five estimated factors, the analysis showed a consistent long-term difference of 15% or more in the left-right difference of jumping height. This discrepancy significantly increased the risk of injury, and the subsequent diagnosis confirmed a sports injury. These findings suggest that the left-right difference in jumping height could serve as an early indicator of potential sports injuries.

Discussion Since the precision and accuracy were both low values in this study, the left-right difference evaluated by the physiotherapist was presumably determined by focusing on aspects other than the jumping height. Therefore, considering the displacement of the landing position other than the height will be closer to the physiotherapist's evaluation.

Keywords sports injury risk, jumping height, smartphone, rebound jump