順天堂大学大学院スポーツ健康科学研究科 和文抄録
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身長の異なる走高跳選手の踏切局面におけるキネマティクス変数の差異

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【目的】
身長の異なる走高跳競技者について、踏切局面におけるキネマティクス変数の差異を明らかにする。本論文では、以下2つの仮説が示された。低身長競技者は高身長競技者と比べて、踏切離地時の鉛直速度、および踏切局面の速度変換率が高いということ(仮説1)、そして踏切局面における膝関節の動作は身長の違いにより異なる(仮説2)ということが示された。

【方法】
被験者は男性走高跳競技者10名であった。身長に基づき被験者を低身長群(160～170cm:3名)、中身長群(171～180cm:3名)、高身長群(181cm以上:4名)に分類した。被験者に全助走で走高跳を数本行わせた。被験者の内省に基づき、成功試技の内1本を選出し、分析試技とした。バーの高さは、2021年シーズンベストの90%とした。ハイスピードカメラ2台を用いて踏切動作の撮影を行った。撮影した映像を動作解析システムに取り込み、3次元DLT法により身体分析点の3次元座標を求めた。阿江による身体部分係数を用いて、身体部分重心および合成重心の座標を算出した。

【結果】
踏切局面における踏切離地時の鉛直速度と、踏切局面の速度変換率は、いずれも身長による群間に有意差はみられなかったため仮説1は棄却された。これは被験者によって試技の余裕度に差があったためだと考えた。
接地時の膝関節角度は、中身長群より低身長群の方が有意に大きく($p < 0.05$)、また最大屈曲時は、低身長群の方が中身長群および高身長群より有意に大きかった($p < 0.05$)。つまり、踏切局面における膝関節の動作は身長群によって異なっていた。膝関節の動作は身長によって最適化されていたと考えられ、仮説2は採択された。

【結論】
低身長競技者は高身長競技者に比べて踏切接地時と最大屈曲時における膝関節角度が大きく、踏切局面における踏切接地時間は小さかった。したがって、身長によって踏切局面のキネマティクス変数に違いがみられた。

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Differences in Kinematics Parameters in the Takeoff Phase of High Jumpers of Different Heights

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[Purpose]

This study aimed to clarify the differences in kinematic parameters during the take-off phase for high jumpers of different heights. We hypothesized that the vertical velocity at take-off phase is higher in shorter athletes than in taller athletes and the transferring rate from the horizontal to vertical velocity at take-off phase is higher (Hypothesis 1) and that the knee joint motion during the take-off phase varies depending on the height of the athletes (Hypothesis 2).

[Methods]

The participants were 10 male high jumpers who were classified into three groups based on their height: short (160–170 cm, n=3), medium (171–180 cm, n=3), and tall (181 cm or taller, n=4). They were requested to perform several high jumps with full approach. Based on the participants introspection, one of the successful trials was selected as the trial for analysis. The bar height was set at 90% of the 2021 season's best. Two high-speed cameras were used to film the take-off movements. The video images were stored on a personal computer, and the 3D coordinates of body analysis points were obtained via the 3D DLT method using a motion analysis system. Additionally, the segmental partial center of gravity and composite center of gravity coordinates were calculated using the body part coefficients by Ae (1992).

[Results]

Hypothesis 1 was rejected because there was no significant difference in the vertical velocity at toe off during the take-off phase and with respect to the efficiency of transferring rate the horizontal velocity to vertical velocity at during the take-off phase. This might be due to the differences in the margin of trial performance among the participants. The knee joint angle at touch down was significantly greater in the short height group than that in the middle height group ($P<0.05$), and the knee joint angle at flexion peak was significantly greater in the short height group than that in the middle height group or the tall height group ($P<0.05$). Therefore, the behavior of the knee joint during the take-off phase differed by height, and the behavior of the knee joint during the take-off was optimized according to height. Thus, Hypothesis 2 was adopted.

[Conclusion]

Compared to the taller athletes, the shorter athletes had a larger knee joint angle at touch down and KFpeak, and a smaller CT in the take-off phase. Therefore, there were differences in the kinematic parameters of the knee joint during take-off phase according to height.