Comparative biomechanical analysis of knee injuries in skiing and snowboarding using Artificial Intelligence 3D modelling

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Introduction
The aim of the study was to understand the biomechanical differences between knee injuries sustained during skiing and snowboarding and to analyze the movements of knee joints during these activities using artificial intelligence and 3D modelling, supported by current available literature.

Methodology
The study used a skiing simulator and three cameras to capture the knee joint movements and assess the forces and angles exerted on them.

Results and Discussion
The results showed significant differences in the forces exerted on the knee joint in skiing compared to snowboarding. The highest vertical force and plantar pressure were found during backside rotations, and the right ankle angle contracted more than the left during turns, resulting in a sinking toe edge into the snow. There action force was found to be the main factor affecting the knee joint, and its distribution was complex and time-dependent.

Snowboarders were found to be younger, with a median age of 20 years, and had a considerably lower Injury Severity Score compared to skiers, who had a median score of 27. Torn ligaments, especially the anterior cruciate ligaments (ACL) and medial collateral ligaments (MCL), were the most common knee injuries sustained during snowboarding, with 4.9-16% of snowboarding accidents occurring in the ankle joint and 6.4-17% in the knee joint. Snowboarding accidents were also found to be less severe and to have distinct injury patterns compared to skiing accidents.

The study underscores the importance of protecting the knee joint when participating in winter sports and the need for further research using modern technologies such as skiing simulators. The findings can be used to improve learning processes and minimize the risk of knee injuries, particularly in inexperienced athletes or professional athletes engaging in excessive tactics. The use of 3D modelling and AI provides a new tool for researchers to better understand the stresses on knee joints during skiing and snowboarding and ultimately lower the likelihood of accidents and injuries. The study concludes that research using current technology is critical for improving our understanding of the biomechanics of knee injuries in winter sports.