Harnessing AI for classification of the level of spinal function from video and inertial measurement units in people with non-specific low back pain.

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Non-specific Low Back Pain (NSLBP), affecting over 80% of the global population, stands as a predominant musculoskeletal disorder, presenting significant diagnostic and management challenges. At the same time, clinical assessment of spinal function in people with NSLBP is hindered by its subjective nature mainly relying on visual evaluation of spinal movement during functional movement tasks the interpretation of which is dependent on the expertise of the clinician. Addressing this gap, our study introduces 'SpineSighter', an innovative AI-based model utilising standard video recordings to automatically classify spinal function through the analysis of human pose estimation (HPE) and motion features such as angular displacement, velocity, and acceleration during forward flexion.

The initial phase of our research, focusing solely on HPE from video data, demonstrated high classification accuracy. Using a dataset of 48 high-functioning (HF) and 35 low-functioning (LF) NSLBP patients with a total of 83 patients (47 women, average age 44.7 years), SpineSighter achieved 95.13% accuracy, 93.81% sensitivity, 96.00% specificity and F1 score were 0.9442. These results particularly highlighted the pivotal role of velocity in distinguishing spinal functions, providing a strong foundation for identifying NSLBP subgroups for guiding personalised treatment plans.

Expanding our methodology to incorporate Inertial Measurement Units (IMUs) for motion feature capture, we observed unique performance characteristics: accuracy peaked at 94.27%, sensitivity at 86.48%, specificity at 100%, and an F1 score of 0.9326.

The results demonstrate the transformative potential of AI in improving healthcare delivery for musculoskeletal disorders. The integration of AI in spinal function assessment through SpineSighter represents a significant progress towards personalised, evidence-based NSLBP management. This model surpasses traditional diagnostic limits by offering an objective, scalable, and efficient classification tool utilising video and IMU data with comparative results.

Keywords: Non-specific Low Back Pain (NSLBP), Classification, Spinal function, Artificial Intelligence (AI), Human Pose Estimation (HPE), Motion Features.