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A Commentary on Unlocking the Insights Movement as a Digital Biomarker for Chronic Pain Rehabilitation: An Embedded Analysis of an RCT of a Virtual Reality Solution for Adults with Chronic Pain

Sammeli Liikkanen*

Department of Research and Development, Orion Pharma Ltd., Turku, Finland

***Corresponding author:** Dr. Sammeli Liikkanen, Department of Research and Development, Orion Pharma Ltd., Turku, Finland, E-mail: sammeli.liikkanen@orionpharma.com

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Description

Chronic Low Back Pain (CLBP) poses a significant public health challenge, demanding innovative approaches for measurement and treatment assessment. The recent study by Liikkanen, et al. delves into the potential of body movement data collected from wearable devices as a digital biomarker for assessing the efficacy of chronic pain rehabilitation, shedding light on a promising avenue in the realm of personalized pain management.

Pain is inherently subjective and complex, posing challenges for reliable measurement. This study capitalizes on the increasing availability of wearable technology, leveraging movement data collected from Oculus Quest VR headsets and handheld controllers, along with Empatica Embrace2 and Garmin Vivosmart4 wearables. By focusing on a Digital Therapeutic (DTx) for CLBP, the researchers probed how wearable data could serve as a surrogate or associative digital endpoint for pain management interventions.

An intriguing aspect of this study is the utilization of longitudinal movement data as a potential biomarker. The authors observed a pattern of increased movement velocity among participants over the course of the study. This positive trajectory of movement suggests potential functional improvement. Significantly, this increase in movement velocity correlates with improvements in clinical scales, including the Tampa Scale of Kinesiophobia (TSK), Overall health Visual Analogue Scale (VAS), and EuroQoL-5D-5L Quality of Life (QoL) score.

The study's findings align with previous research showing that increased activity levels correlate with reduced chronic pain severity and functional recovery. The strength of this correlation is particularly notable with the head and right-hand sensors. Surprisingly, head movement emerged as a robust predictor of clinical outcomes, potentially indicating an association between cognitive factors and physical improvement. However, the authors emphasize the need for further research and validation, as well as more nuanced analysis to uncover the underlying movement patterns driving these correlations.

The implications of this study are substantial. Identifying movement-based digital biomarkers can revolutionize pain management by offering real-time, objective, and quantifiable indicators of rehabilitation progress. Such biomarkers could guide treatment adjustments, enhance personalized interventions, and even enable remote monitoring of patient outcomes, thereby addressing the challenges of current pain assessment methods.

Nonetheless, this study also highlights the complexities and limitations of wearable data analysis. Electrodermal data for example, exhibited noise and instability diminishing its utility for clinical interpretation. Similarly, while heart rate data offers potential insights, the aggregation of daily data limits its precision for clinical applications. These challenges underscore the need for refined methodologies, improved wearables and advanced data processing techniques to unlock the full potential of wearable data in pain management.

Liikkanen, et al. study exemplifies the integration of cutting-edge wearable technology with clinical research, presenting movement as a promising digital biomarker for chronic pain rehabilitation. The potential to objectively track rehabilitation progress and correlate it with clinical outcomes represents a significant stride toward precision pain management. While the findings warrant cautious optimism, further studies with larger and diverse populations, refined data collection techniques, and comprehensive validation efforts are essential to fully harness the power of movement-based digital biomarkers. As wearable technology continues to advance, the future of pain rehabilitation appears more data-driven and patient-centred than ever before.