Validation of a low-cost sensor for kinematic assessment in cyclists.

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INTRODUCTION

The use of inertial measurement sensors (IMUs), in the search for a more ecological measure, is spreading among sports professionals with the aim of improving the sports performance of cyclists. The kinematic evaluation using the IMU sensors has become popular.

The present study aimed to evaluate the reliability and validity of a novel IMUs Sensor by measuring the angular kinematics of the lower extremities in the sagittal plane during pedaling at different intensities compared to a gold-standard motion capture camera system.

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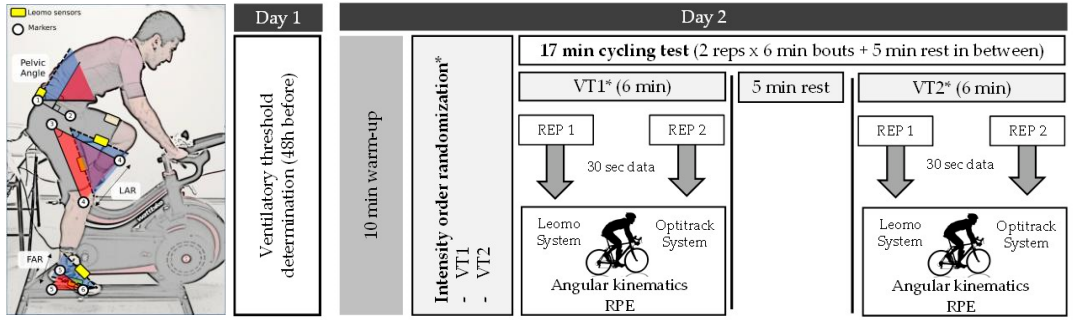
MATERIAL AND METHODS



Twenty-four male elite cyclists were recruited from national and international cyclist club teams. Inclusion criteria were, to be selected by the National Cyclist Federation, to be injuries-free in the last half year; not to be taking medication that alters normal cycling; not to suffer musculoskeletal disorders, neurological disorders, or heart failure that could affect normal pedaling.

RESULT

This IMU show a **high validity and was consistently excellent** (ICC-VT1 between 0.91 and 0.95 and ICC-VT2 between 0.88 and 0.97) in:

- **foot angular range Q1 (FAR (Q1)**
- **foot angular range (FAR)**

While showed a **modest validity** (ICC-VT1 from 0.52 to 0.71 and ICC-VT2 between 0.61 and 0.67) in the variables:

- **leg angular range (LAR)**
- **pelvic angle**

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Compared with Optitrack, this IMU **overestimated all the variables, especially the LAR and pelvic angle values, in a range between 12 and 15.**

DISCUSSION

Our results indicate that this IMU have a high validity and are consistently excellent across FAR (Q1) and FAR, with both variables having an ICC ranging between 0.91 and 0.95 for the VT1 intensity condition and between 0.88 and 0.97 for the VT2 intensity condition. Conversely, the LAR and Pelvic Angle variables showed a modest validity, with the ICC ranging from 0.52 to 0.71 for the VT1 intensity condition and between 0.61 and 0.67 for the VT2 intensity condition.

CONCLUSIONS

This IMU is a reliable and valid tool to analyze the ranges of motion of the cyclist's lower limbs in the sagittal plane, especially for the variables FAR (Q1) and FAR. However, even though its error is systematic, it must be considered that for the **LAR and pelvic angle values, this IMU overestimates them between 12 and 15.** Therefore, it is necessary to improve the algorithms that these devices use to extract the data, and the results of these variables should be interpreted with caution.

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