Wearable Sensors in Sports

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Wearable sensor technology provides an alternative to classical laboratory-based assessments of human performance that enables real-time monitoring in natural environments, without the cumbersome set-up procedure and limitations related to space. We conducted a scoping review, aiming to present an overview of existing methods for assessments of shock impacts using wearable sensor technology within two domains: sports and occupational settings.

Keywords: wearable sensor technology ; inertial measurement unit ; optimal load ; sports ; occupational health ; foot strike ; landing impacts ; head impacts

1. Introduction

Shock impacts during activity may cause damage to the joints, muscles, bones, or inner organs. To define thresholds for tolerable impacts, there is a need for methods that can accurately monitor shock impacts in real-life settings. Therefore, we conducted a scoping review to present an overview of existing methods for assessments of shock impacts using wearable sensor technology within two domains: sports and occupational settings. Online databases were used to identify papers published in 2010–2020, from which 34 papers that used wearable sensor technology to measure shock impacts accomodated the inclusion criteria.

2. Results and conclusions

To our knowledge, this is the first scoping review to address the use of wearable sensor technology for assessments of shock impacts within the domains of sports and occupational settings. A generic limitation of the scoping review methodology is that it does not allow for a formal evaluation of study quality and the level of evidence, as the included papers represent a wide array of study designs and methods This is valid also for this study. The scoping review approach was chosen with intent to provide an overview of the body of literature within the two defined contexts and to identify apparent knowledge gaps, which may guide future initiatives for research within this field.

No studies were found on occupational settings, and this is the most prominent knowledge gap identified in this study. For the sports domain, accelerometry was the dominant type of wearable sensor technology utilized for assessing shock impacts, interpreting peak acceleration as a proxy for impact. All the included studies from the sports domain included some kind of accelerometer, except for four studies that used insoles with force sensors. The type of accelerometer varies, from uni- to triaxial, and it also varies whether the accelerometers were embedded in an IMU that also included a gyroscope and a magnetometer. With regard to which type of data most often is extracted from the accelerometer/IMUs, peak acceleration is the dominant outcome measure. This applies to studies assessing running (foot strike), different landings, as well as head impacts. For studies utilizing insoles, force and pressure distribution is the outcome of interest.

Of the 34 studies included, 28 assessed foot strike in running, head impacts in invasion and team sports, or different forms of jump landings or plyometric movements. The methodology of included studies revealed that there is a lack of consensus regarding sensor placement and interpretation of the results. Furthermore, a majority of the included studies aimed to validate the use of wearables up against established gold standard methods. This finding supports previous concerns that wearable sensors alone at the present time are not adequate to ensure valid and accurate data on shock impacts in the field. There is a need for further high-quality research to find the appropriate sensors and methodology to utilize the potential of measuring shock impacts in the field by wearable sensor technology.