INPLASY PROTOCOL

Corresponding author:
Joel Guillen

joel.guillen@uab.cat

Author Affiliation:
Department of Basic Psychology and Sport Research Institute, Universitat Autonoma de Barcelona.

Ecological Momentary Assessment of the stress-recovery process through technology mHealth in sports: a scoping review protocol

Guillen, J[1]; Capdevila, L[2]; Losilla, JM[3]; Parrado, E[4].

Review question / Objective: The objective of this scoping review is to identify the EMA methodologies through mHealth technology to monitor the sport load or the stress-recovery process in athletes. The specific objectives are: - To describe the relationship between the external (distance, accelerations, decelerations, etc.) and internal (physiological, cardiovascular, neuromuscular, subjective, etc.) parameters, and the technology used for the monitoring. - To describe and classify the methodologies and the technology used according to individual or team sports. - To analyse the relationship between the subjective and objective parameters of the internal measures.

INTRODUCTION

Review question / Objective: The objective of this scoping review is to identify the EMA methodologies through mHealth technology to monitor the sport load or the stress-recovery process in athletes. The specific objectives are: - To describe the relationship between the external (distance, accelerations, decelerations, etc.) and internal (physiological, cardiovascular, neuromuscular, subjective, etc.) parameters, and the technology used for the monitoring. - To describe and classify the methodologies and the technology used according to individual or team sports. - To analyse the relationship

between the subjective and objective parameters of the internal measures.

Background: The evolution of technology has allowed to the development of non-invasive, valid, and reliable monitoring systems. The term mHealth has been defined as "the use of mobile computing and communication technologies in health care and public health" (Free et al., 2010). In the same way, in the 71st World Health Assembly (2018), mHealth was defined as "the use of mobile wireless technologies for public Health" and eHealth was defined as "the use of information and communication technologies in support of health and health-related fields". The use of this technology allows, among many other things, an Ecological Momentary Assessment (EMA) methodology through which the ecological validity of the data that is collected is maximised, since it is obtained in real-time repeatedly in the natural context (Shiffman et al., 2008).

In sports science, monitoring and understanding the state of athletes have become an important goal to reduce the risk of injury, illness or non-functional overreaching (Halson, 2014; McGuigan,2017) and guarantee readiness for performance (Hausswirth & Mujika, 2013; Halson 2014). This state can be affected by multiple factors, so it should be taken as holistically as possible (Heidari et al., 2019; Kellmann et al., 2018; Thorpe et al., 2017). The methods used to monitor have been summarised by Bourdon et al. (2017), both internal (rating perceived exertion, heart rate, oxygen uptake, etc.) and external measures (time, speed, acceleration, etc.). Measuring the external load gives information about the work done by the athletes, while measuring the internal load relates to knowing the stress that the body has been subjected to. Both are important, but it is the relationship between external and internal load the key to determine if the athlete is fatigued or not (Halson, 2014).

For this reason, different authors conducted systematic reviews for classifying the measures to examine the state of the athletes (Fox et al., 2018; Petway et al., 2020; Saw et al., 2016;

Teixeira et al., 2021) and the technological devices employed for the monitoring (Adesida et al., 2019; Cummins et al., 2013). A meta-analysis by McLaren et al. (2017) highlighted associations between measures obtained through wearable devices (e.g., Polar or Catapult), for example the heart-rate-derived training impulse (TRIMP) with the total distance covered by the athletes. Recently, Helwig et al. (2023) reviewed a wearable-based relationships between external and internal measures, displaying the relation most studied among the session RPE (sRPE) and load variables based on accelerometry. Both studies focused on team sports athletes but did not consider individual sports athletes.

Rationale: Considering the definitions of EMA and mHealth outlined and given the high number of technological devices available and the different sports, it is appropriate the realization of a scoping review for the identification of methodologies through this technology to monitor the sport load or the stress-recovery process in sports.

METHODS

Strategy of data synthesis: The search for the primary studies will be carried through four databases: APA PsycInfo by ProQuest, PubMed by US National Center for Biotechnology Information, Web of Science Core Collection by Clarivate, and SPORTDiscus by EBSCOHost.

The search strategy will follow the Peer Review of Electronic Search Strategies (PRESS) (McGowan et al., 2016) and PRISMA for Searching (PRISMA-S) guidelines (Rethlefsen et al., 2021), and consisted of three groups of search terms referring to a) sports and physical activity, b) wireless/wearable technologies and mobile applications, and c) sports load or stress-recovery state. We also added a fourth group of terms preceded by the boolean operator NOT to improve the specificity of the search strategy.

The search strategy will be adapted to the specific database syntax. For example, the search in Pubmed is: ((("Sports"[MeSH

Terms] OR "Athletes"[MeSH Terms] OR "Exercise"[MeSH Terms] OR "Team Sports"[MeSH Terms] OR "sport"[Title/Abstract] OR "athlet*"[Title/Abstract] OR "exercis*"[Title/Abstract] OR "physical activit*"[Title/Abstract]) AND ("Wearable electronic devices"[MeSH Terms] OR "Wireless Technology"[MeSH Terms] OR "Mobile Applications"[MeSH Terms] OR "mobile health"[Title/Abstract] OR "mHealth"[Title/Abstract] OR "eHealth"[Title/Abstract] OR "e-Health"[Title/Abstract] OR "wearable"[Title/Abstract] OR "wireless technolog*"[Title/Abstract] OR "microsensor"[Title/Abstract] OR "microtechnolog*"[Title/Abstract] OR "GPS"[Title/Abstract] OR "accelerometer"[Title/Abstract] OR "training monitoring"[Title/Abstract] OR "mobile app*"[Title/Abstract] OR "smartphone app*"[Title/Abstract]) AND ("Fatigue"[MeSH Terms] OR "Rest"[MeSH Terms] OR "Muscle fatigue"[MeSH Terms] OR "Mental fatigue"[MeSH Terms] OR "stress"[Title/Abstract] OR "Fatigue"[Title/Abstract] OR "load"[Title/Abstract] OR "workload"[Title/Abstract] OR "overtraining"[Title/Abstract] OR "underrecovery"[Title/Abstract] OR "staleness"[Title/Abstract] OR "overreaching"[Title/Abstract] OR "Rest"[Title/Abstract] OR "recovery"[Title/Abstract] OR "exhaustion"[Title/Abstract] OR "tiredness"[Title/Abstract] OR "readiness"[Title/Abstract])) NOT ("Athletic Injuries"[MeSH Terms] OR "injur*"[Title/Abstract])).

The search will be performed in the first term of 2023 and will be limited by time period (2012-2023) and publication language (English, Spanish).

Eligibility criteria: The inclusion criteria will be as follow:
- Study participants must be high performance, amateur or young athletes in team or individual sports, ranging in age from 13 to 65 years.
- Studies that apply EMA methodologies using mHealth technology to record sports load or stress-recovery state.
- Empirical studies with experimental (randomized and non-randomized), single-case or non-experimental (cohort, case-control and cross-sectional) research designs.

Studies a) related to the monitoring of the sport load or stress-recovery process in injured athletes, b) of validation or reliability of apps or wearable devices for the monitoring of sport load or stress-recovery process variables, c) of testing these variables in any condition (e.g., laboratory or field) without monitoring it, d) that include only internal or external measures and, e) without the relationship between external and internal measures, will be excluded.

Source of evidence screening and selection: Titles and abstracts will be screened independently by two reviewers. When decisions cannot be made from title and abstract alone, the full paper will be retrieved. Full-text inclusion criteria will also be assessed independently by two reviewers. Discrepancies during the process will be resolved through discussion (with a third reviewer when necessary). Agreement between reviewers during the study selection process will be analysed.

Data management: References identified by the search strategy will be entered into Mendeley bibliographic software, and duplicates will be removed. A data extraction protocol will be designed for the selected studies. The extracted information will include:
- General information: title, author, year of publication and journal
- Research design
- Characteristics of the target population of the study: number of participants, age, gender, sport level and sport type
- The monitoring process: technology, stress-recovery variables, periodicity and the main results
As in the search process, two review authors will extract the data of selected studies independently and discrepancies will be resolved through discussion (with a third reviewer when necessary). Agreement between reviewers during the data extraction process will be analysed.

Presentation of the results: To maximise the reporting quality of this protocol and scoping review, we will follow the PRISMA Extension for Scoping Reviews (PRISMA-ScR) recommendations (Tricco et al., 2018). The review will be presented as a narrative synthesis, in which studies will be grouped by the measures related to the sports load or stress-recovery process, the technology used for the monitoring of these variables and the periodicity of the measures. Characteristics of the study population, designs and study findings will be summarised.

Descriptive analyses of different aspects of the identified variables used to measure the sports load or stress-recovery state through mHealth technologies will be performed. The extracted information related to these variables will be reported in a table to facilitate their comparison. Some recommendations about the methodological, practical and the research applications of each variable will be made.

Language restriction: Included papers must be in English or Spanish.

Country(ies) involved: Spain.

Keywords: Ecological Momentary Assessment; EMA; mHealth; eHealth; Mobile Technology; Wearable; Stress-Recovery; Sport Load; Scoping Review.

Contributions of each author:
Author 1 - Joel Guillen.
Email: joel.guillen@uab.cat
Author 2 - Lluis Capdevila.
Email: lluis.capdevila@uab.cat
Author 3 - Josep-Maria Losilla.
Email: josepmaria.losilla@uab.cat
Author 4 - Eva Parrado.
Email: eva.parrado@uab.cat