INPLASY PROTOCOL

To cite: Clemente et al. Validity and reliability of the mobile applications for human's strength, power, velocity and change-of-direction assessment: A systematic review. Inplasy protocol 202110089. doi: 10.37766/inplasy2021.1.0089

Received: 22 January 2021

Published: 22 January 2021

Corresponding author:
Filipe Clemente

filipe.clemente5@gmail.com

Author Affiliation:
Escola Superior Desporto e Lazer, Instituto Politécnico de Viana do Castelo, Rua Escola Industrial e Comercial de Nun'Álvares, 490

Support: **None.**

Review Stage at time of this submission: **Formal screening of search results against eligibility criteria.**

Conflicts of interest:
None declared.

Validity and reliability of the mobile applications for human's strength, power, velocity and change-of-direction assessment: A systematic review

Clemente, FM[1]; Lima, R[2]; Akyildiz, Z[3]; Pino-Ortega, J[4]; Rico-González, M[5].

Review question / Objective: **This systematic review aimed to: (1) identify and summarize the studies that have examined the validity of apps for measuring human strength, power, velocity and change-of-direction; and (2) identify and summarize the studies that have examined the reliability of apps for measuring human strength, power, velocity and change-of-direction.**
Condition being studied: **Validity and reliability of mobile applications for human strength, power, velocity and change-of-direction.**
Information sources: **Electronic databases (Cochrane Library, PubMed, Scielo, and Web of Science) were searched for relevant publications prior to the January 16, 2021.**

INPLASY registration number: This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 January 2021 and was last updated on 22 January 2021 (registration number INPLASY202110089).

INTRODUCTION

Review question / Objective: **This systematic review aimed to: (1) identify and summarize the studies that have examined the validity of apps for measuring human strength, power, velocity and change-of-direction; and (2) identify and summarize the studies that have examined the reliability of apps for measuring human strength, power, velocity and change-of-direction.**

Rationale: Mobile applications (apps) have been progressively growing for fitness and performance assessment in humans. The low-cost and friendly characteristics of these technological solutions help to spread the possibilities of using objective methods for fitness and performance assessment in a wide range of contexts. However, the accuracy and precision of these alternatives are of paramount importance, since they are assessing human movements that are typically variable and sensitive in nature.

Condition being studied: Validity and reliability of mobile applications for human strength, power, velocity and change-of-direction.

METHODS

Search strategy: Electronic databases (Cochrane Library, PubMed, Scielo, and Web of Science) were searched for relevant publications prior to the January 16, 2021. Keywords and synonyms were entered in various combinations in the title, abstract or keywords: ("sport*" OR "exercise*" OR "athletic performance" OR "physical performance" OR "movement*") AND ("mobile app*" OR "app*" OR "smartphone" OR "iphone") AND ("Validity" OR "Accuracy" OR "Reliability" OR "Precision" OR "Varia*" OR "Repeatability" OR "Reproducibility" OR "Consistency" OR "noise") AND (power OR velocity OR strength OR "change of direction"). Additionally, the reference lists of the studies retrieved were manually searched to identify potentially eligible studies not captured by the electronic searches. Finally, an external expert has been contacted in order to verify the final list of references included in this scoping review in order to understand if there was any study that was not detected through our research. Possible errata were searched for each included study.

Participant or population: Tests were conducted in healthy athletes or recreationally healthy active adults strength (e.g., resistance training exercises/movements), power (e.g., jumping, lifting movements), velocity (e.g., linear sprinting) and change-of-direction.

Intervention: Estimation of movement velocity, movement time (e.g., a difference of time to complete a movement), and movement displacement (e.g., jump height).

Comparator: In the case of validity, the apps were compared to recognized gold-standard: (1) Movement velocity (e.g., radar gun; isoinertial dynamometer consisting in cable-extension linear position transducer; optoelectronic system) (2) Movement time (e.g., photocells) (3) Movement displacement (e.g., force plates, optoelectronic system).

Study designs to be included: Observational study designs.

Eligibility criteria: Inclusion criteria: (i) Test of a mobile application in sport and exercise; (ii) Tests were conducted in healthy athletes or recreationally healthy active adults strength (e.g., resistance training exercises/movements), power (e.g., jumping, lifting movements), velocity (e.g., linear sprinting) and change-of-direction; (iii) Estimation of movement velocity, movement time (e.g., a difference of time to complete a movement), and movement displacement (e.g., jump height); (iv) In the case of validity, the apps were compared to recognized gold-standard: Movement velocity (e.g., radar gun; isoinertial dynamometer consisting in cable-extension linear position transducer; optoelectronic system) and/or Movement time (e.g., photocells) and/or Movement displacement (e.g., force plates, optoelectronic system); (v) In the case of validity, one of the following measures were included: (1) typical error; (2) mean absolute error; (vi) In the case of reliability, one of the following measures were included: (i) intraclass correlation test; (ii) coefficient of variation; (iii) standardized typical error; and (iv) standard error of measurement.; (vii) Only original and full-text studies written in English. Exclusion criteria: (i) Other instruments than mobile application (e.g., computer software); (ii)

The tests were not conducted in athletes (e.g. pregnancy, elderly) or in health active adults (i.e. injury) strength, power, velocity, and change-of-direction related movements (e.g., assessment of instruments without human action involved); (iii) Estimation of other outcomes than movement velocity, movement time, and movement displacement; (iv) For validity, the apps were not compared with recognized gold-standard methods or were compared with other apps; (v) For validity, outcomes presented are not typical error or mean absolute error; (vi) For reliability, outcomes presented are not (1) intraclass correlation test; (2) coefficient of variation; (3) standardized typical error; and (4) standard error of measurement; Written in other language than English. Other article types than original (e.g., reviews, letters to editors, trial registrations, proposals for protocols, editorials, book chapters and conference abstracts).

Information sources: Electronic databases (Cochrane Library, PubMed, Scielo, and Web of Science) were searched for relevant publications prior to the January 16, 2021.

Main outcome(s): In the case of validity, one of the following measures were included: (i) typical error; (ii) mean absolute error; (iii) correlation coefficient; and (iv) standard error of the estimate. In the case of reliability, one of the following measures were included: (i) intraclass correlation test; (ii) coefficient of variation; (iii) standardized typical error; and (iv) standard error of measurement.

Quality assessment / Risk of bias analysis: Two authors (JPO and MRG) performed the methodological assessment of the studies eligible for inclusion using an adapted version of the STROBE assessment criteria, as was used in O´Reilly et al. (2018) . Hence, each article was evaluated using 10 specific criteria. If any disagreement appears, it was discussed and solved by consensus decision. The study rating was qualitatively interpreted following O´Reilly et al. (2018): from 0 to 7 scores, the study was considered as risk of bias (low quality); while, if the study was rated from 7 to 10 points, it was considered as a low risk of bias (high quality).

Strategy of data synthesis: The following information was extracted from the included original articles: (i) validity measure (e.g., typical error, absolute mean error, correlation coefficient); and (ii) reliability measure (e.g., intraclass correlation coefficient [ICC] and/or typical error of measurement [TEM] (%) and/or coefficient of variation [CV] (%) and/or standard error of measurement [SEM]). Additionally, the following data items were extracted: (i) type of study design, number of participants (n), age-group (youth, adults or both), sex (men, women or both), training level (untrained, trained); (ii) characteristics of the apps and comparator (for the case of validity studies); (iii) characteristics of the experimental approach to the problem, procedures and settings of each study.

Subgroup analysis: None.

Sensibility analysis: None.

Language: English.

Country(ies) involved: Portugal; Spain; Turkey.

Keywords: sports technology; smartphone; accuracy; precision; athletic performance; fitness.

Contributions of each author:

Author 1 - Filipe Manuel Clemente - FMC lead the project, established the protocol and wrote and revised the original manuscript.

Author 2 - Ricardo Lima - Wrote and revised the original manuscript.

Author 3 - Zeki Akyildiz - Wrote and revised the original manuscript.

Author 4 - José Pino-Ortega - Wrote and revised the original manuscript.

Author 5 - Markel Rico-González - MRG run the data search and methodological assessment and wrote and revised the original manuscript.