

Smartphone Applications for Range of Motion Measurement in Clinical Practice: A Systematic Review

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Abstract. The aim of this study was to investigate the validity and reliability of range of motion measurement via smartphone applications. This literature review included 26 articles after the selection process. The validity and reliability analysis showed good mean results (ICC or $r > 0.83$). Thus, in clinical practice, photographic, goniometric and inclinometric smartphone applications can be used to measure joint angle, but with caution for cervical, hip and shoulder motions.

Keywords. Range of motion – application – smartphone - validity – reliability

1. Introduction

Many smartphone applications have been launched in recent years for patient management in clinical practice, as well as range of motion tools. However, before generalizing these tools, it is necessary to know the psychometrics qualities of these new smartphone applications. *The aim* of this study was to provide a systematic review about validity and reliability (intra and inter-raters) of range of motion measurement (upper-limbs, lower limbs and trunk movements) via smartphone application.

2. Study

2.1. Method

The research was conducted, in English, using the following keywords such as « healthy subjects », « phone », « range of motion », validity », « reliability » et « repeatability » on the databases: PubMed/ Medline, ScienceDirect and Pedro. A synthesis was carried out and the qualities of each study was evaluated by the Qaref score.

2.2. Results

563 articles about smartphone applications used in healthy subjects were identified. Following the selection criteria, 26 articles were included which are six articles for cervical, thoracic and lumbar motions, 11 for lower limb and 9 for upper limb motions.

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These studies included 818 healthy subjects. The mean Qarel score for all studies was 7.36/12 (min:6/max:9). The synthesis showed that the for validity was good ($r = 0.83$ [min:0.40, max:0.99]). The intra-rater reliability analysis showed an ICC=0.88 (min:0.05 – max:0.99), investigated by 23 studies. The inter-rater reliability was assessed by 20 studies with a mean ICC result (ICC=0.85 [min:0.07 – max:0.99]). The results highlighted no difference between the type of applications (inclinometer or goniometer) and the phone system (iPhone vs. Android).

2.3. Discussion

This systematic review showed the existence of numerous studies on the psychometric qualities of smartphone applications to measure range of motion in clinical practice for healthy subjects. All studies presented a consistent methodology with the stated objective and tested validity prior to reliability. The data suggest that smartphone with the angle apps is a viable substitute for using a usual goniometer or an inclinometer when measuring angular changes that typically occur when examining range of motion and demonstrate the capacity of multiple examiners to accurately use smartphone-based angle apps. The trunk, upper limb and lower limb range of motion were assessed for validity and intra-rater reliability in healthy subjects. The inter-rater reliability has not been studied for hip movements. The best values were obtained for the wrist, the elbow, the ankle, the knee, the lumbar and thoracic range of motion, whatever application was used. No study at the time of the review was found on the finger movements.

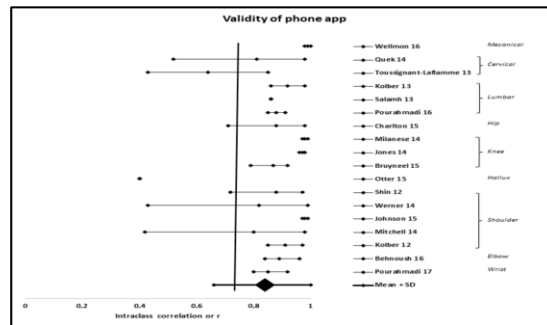


Figure 1. Synthesis of validity results.

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