Development and usability of app-based self-administrable clinical tests of physical function
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Purpose Objective measures of physical function in older adults are widely used to predict health outcomes such as disability, institutionalization, and mortality (Cesari et al., 2008). Most smartphones are equipped with sensors such as accelerometers, gyroscopes, and magnetometers, and have high computational power; they can be considered as an inertial measurement unit (IMU) enabling an objective and reliable assessment of the functional capacity (Mellone, Tacconi & Chiari, 2012). App-based clinical tests allow users to assess their own physical function and have objective tracking of changes over time by use of their smartphones. We developed three smartphone apps with instrumented versions of the 'Timed Up and Go' (Self-TUG), 'Standing tandem' (Self-Tandem) and 'Five times sit-to-stand' (Self-STS), respectively. Features computed from the sensor signals derived from the test trials provide a more accurate assessment of the user's performance compared to the traditional outcome measures (Weiss et al., 2011). Results from these tests can potentially guide interventions remotely and provide detailed longitudinal information about the participants' physical performance to inform users, researchers, therapists and other health care personnel. Our aim was to develop and test the usability of three smartphone app-based self-tests of physical function. **Method** The apps were tested through three iterations; the first and second in a lab-setting, and the third in a home-based study. Participants were healthy adults between 60 and 80 years of age. Assessors observed participants while performing self-administered the tests without any guidance. Errors were recorded and usability problems defined. Separate problems were addressed in each subsequent iteration. Usability in the home-based setting was assessed by the System Usability Scale (SUS), the User Experience Questionnaire (UEQ) and semi-structured interviews. **Results and Discussion** The first iteration revealed 7 usability problems related to instructional videos on how to correctly perform the test, confusion on when to start the test, and placement of smartphone. Improvements related to the usability problems decreased the proportion of trials performed incorrectly from 32% in the first iteration to 16% in the second. For the third iteration the proportion increased to 32% incorrect trials. For the home-based test, changes included updating the instruction videos with voiceover and graphical elements, description of test set-up in text, adding a warning message that appears if the user tries to start test without watching the instruction video first, adding a real-time verbal step-by-step instructions that is initiated after the test is started in the app, and changing the menu structure and elements. Mean score on the SUS was 77.63 ± 16.1, and 80-95% of the participants reported the highest or second highest positive rating on all items in the UEQ. However, testing the apps in a home-setting gave rise to some new usability problems, indicating that the apps require further improvements and validation in a natural setting before being made available to end-users.

References
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