Research Article

Reliability of Conducting The 30-Second Chair Stand Test Virtually Among Individuals with Osteoarthritis

Ethan Simpson[1,2,3], Somayyeh Mohammadi[1,2,4], William C Miller[1,2,3]*, Natalie Yu[1,2], Wendy Watson[5], Anna Spillane[5] and Marie D Westby[5]

[1]Department of Occupational Science and Occupational Therapy, Faculty of Medicine, University of British Columbia, Canada

[2]Rehabilitation Research Program, GF Strong Rehabilitation Centre, Canada

[3]International Collaboration on Repair Discoveries, Vancouver, Canada

[4]Department of Psychology, Kingston University, United Kingdom

[5]Mary Pack Arthritis Centre, Vancouver Coastal Health, Canada

*Corresponding author: William C Miller, Department of Occupational Science and Occupational Therapy, Faculty of Medicine, University of British Columbia, Rehabilitation Research Program, GF Strong Rehabilitation Centre and International Collaboration on Repair Discoveries, Canada.

Abstract

Objective: The aim of this study was to explore the intra- and inter-rater reliability of virtually conducted 30-second chair stand tests (30s CST) for individuals with hip osteoarthritis (OA).

Design: Cross sectional study using data from a larger RCT.

Setting: Virtual

Participants: All participants had hip OA, were ≥50 years of age, and waitlisted for a total hip replacement surgery.

Interventions: We provided participants with standardized instructions for the 30s CST and a one-to-one virtual meeting where they performed the test once over Zoom. Four months after data collection, the video recorded sessions were reviewed by the original rater and an experienced physical therapist (blinded to baseline scores).

Main Outcome Measure: We calculated intra- and inter-rater reliability with ICC estimates and their 95% confidence intervals using SPSS.

Adverse: A total of 46 participants performed the 30s CST (Mean age: 64 years, 54% female) and no adverse events were observed. The intra-rater reliability ICC was 0.99 (95% CI 0.98, 1.00) and the Bland-Altman plot showed a mean difference of -0.1522. The inter-rater reliability ICC was also 0.99 (95% CI 0.98, 0.99) and the Bland-Altman plot showed a mean difference of -0.0227. The scores indicate excellent intra- and inter-rater reliability.

Conclusion: Reliably conducting the 30s CST virtually provides a valuable option for clinicians and researchers to conduct a measure of physical function for adults with hip OA. Future research should explore the feasibility, reliability, and safety of conducting the 30s CST across other phases of joint replacement recovery and in other populations.

Keywords: Osteoarthritis; Telemedicine; Physical Functional Performance; Reproducibility of Results

Introduction

Lower extremity (LE) muscular strength is important for maintaining physical function and mobility. With a general age-related decline in LE strength, the risk of mobility issues and falls increases [1]. A repeated chair stand test is commonly used to assess LE strength in older adults [2]. Originally the test measured the time taken to perform either five or ten sit-to-stand repetitions but as many individuals in the target populations were unable to meet the minimum requirement it resulted in a floor effect [2,3]. The test was then modified to become the 30-second chair stand test (30s CST), which measured the number of sit-to-stand repetitions an individual could perform during a 30-second period. Essentially shifting from a pre-determined number of repetitions to a pre-determined time interval in order to capture a wider range of ability levels [2].

The 30s CST is a recommended performance-based measure for assessing physical function in individuals with hip osteoarthritis (OA) [4,5]. OA is a leading cause of disability among older adults and can cause substantial functional impairment [6]. Previous research has affirmed in-person validity and reliability of the 30s CST among individuals with OA, but with the COVID-19 pandemic there has been a need to pivot to virtual assessments [4,8]. It is, therefore, important to explore the impact of conducting the 30s CST virtually. Bowman and associates confirmed the safety and validity of conducting the test virtually, but reliability was not examined [7]. To our knowledge, there are no studies that demonstrate the reliability of conducting the 30s CST virtually. Our objective was to explore the intra-rater and inter-rater reliability of the 30s CST when administered virtually among individuals with hip OA.

Methods

Design/Sample

This cross-sectional study was part of a larger ongoing RCT, which is evaluating the feasibility of "HIPPER", an eHealth approach to hip replacement prehabilitation education [9]. The participants were referred by the Osteoarthritis Service Integration System (OASIS) in Vancouver, Canada. To be included, participants had to be ≥50 years of age, have hip OA, be waitlisted for a total hip replacement surgery, and have access to the Internet. Individuals were excluded if they were unable to communicate in English, anticipated a health condition/procedure that could interfere with their surgery, or had already had a previous total hip replacement. Ethical approval was obtained from the university Research Ethics Board (H16-02553) and the Vancouver Coastal Health Research Institute (V16-02553).

Protocol

Once recruited, participants agreed to have a one-to-one virtual meeting with author 1 using a secure Zoom account. Prior to their meetings, all participants were asked to have a firm chair with a 17" (43 cm) seat height in a place that was visible by their camera. To start, we asked participants to provide contact details and their address in case emergency services needed to be sent to their location. Participants were then provided with a standardized set of instructions regarding the 30s CST and performed the test once. We recorded the 30s CSTs on Zoom, and the scores were logged. All data were stored in password protected files.

Intra-rater reliability

Approximately four months after conducting all 30s CSTs, the participant IDs associated with each video were randomized for the purposes of blinding, and the 30s CST recordings were reviewed by author 1 again. The second set of scores were then compared to the initial scores. Author 1 is a trained research assistant with a background in kinesiology and qualitative research.

Inter-rater reliability

Simultaneously to author 1''s second review, the recordings were independently reviewed by an experienced physical therapist (author 6), who was blinded to the previous scores. The two raters' scores were then compared.

Statistical analysis

We calculated the intra-rater ICC estimates and their 95% confidence intervals using SPSS based on a single-rater, absolute agreement, two-way mixed-effects model. Inter-rater ICC estimates and their 95% confidence intervals were calculated based on a single-rater, absolute agreement, two-way random-effects model. Bland-Altman plots were used to display and compare differences in the measurements. Generally, ICC values less than 0.5 indicate poor reliability, values between 0.5 and 0.75 indicate moderate reliability, values between 0.75 and 0.9 indicate good reliability, and values greater than 0.90 indicate excellent reliability [10].

Results

A total of 46 participants performed the 30s CST. Participants mean age was 64.24 ± 8.74 years, and 25 were female. Only 44 30s CSTs were available for intra-rater reliability analysis due to missing baseline scores. No injuries, adverse events, or safety issues were observed/reported.

Intra-rater reliability

The ICC value was 0.99 (95% CI: 0.98-1.00), indicating excellent intra-rater reliability. The Bland-Altman plot (Figure 1) shows a mean difference of -0.1522 with 89% of values falling within the 95% CI for the Limits of Agreement.

Inter-rater reliability

The ICC value was 0.99 (95% CI: 0.98-0.99), indicating excellent inter-rater reliability. The Bland-Altman plot (Figure 2) shows a mean difference of -0.0227 with 96% of values falling within the 95% CI for the Limits of Agreement.
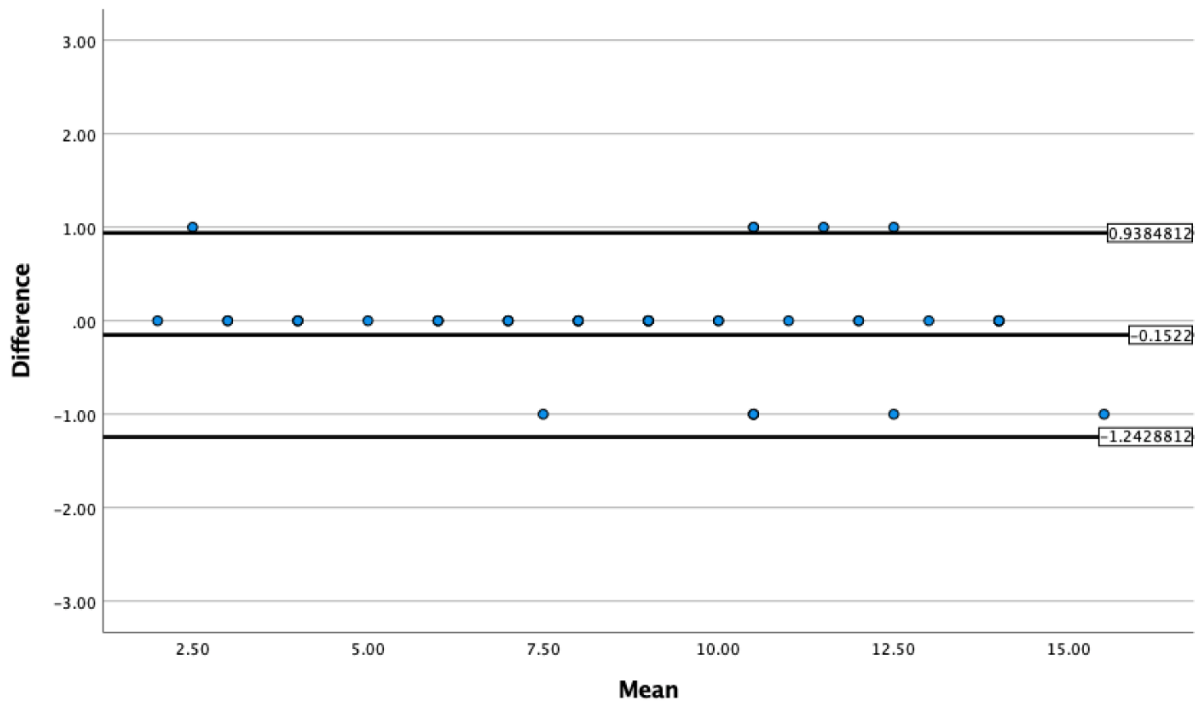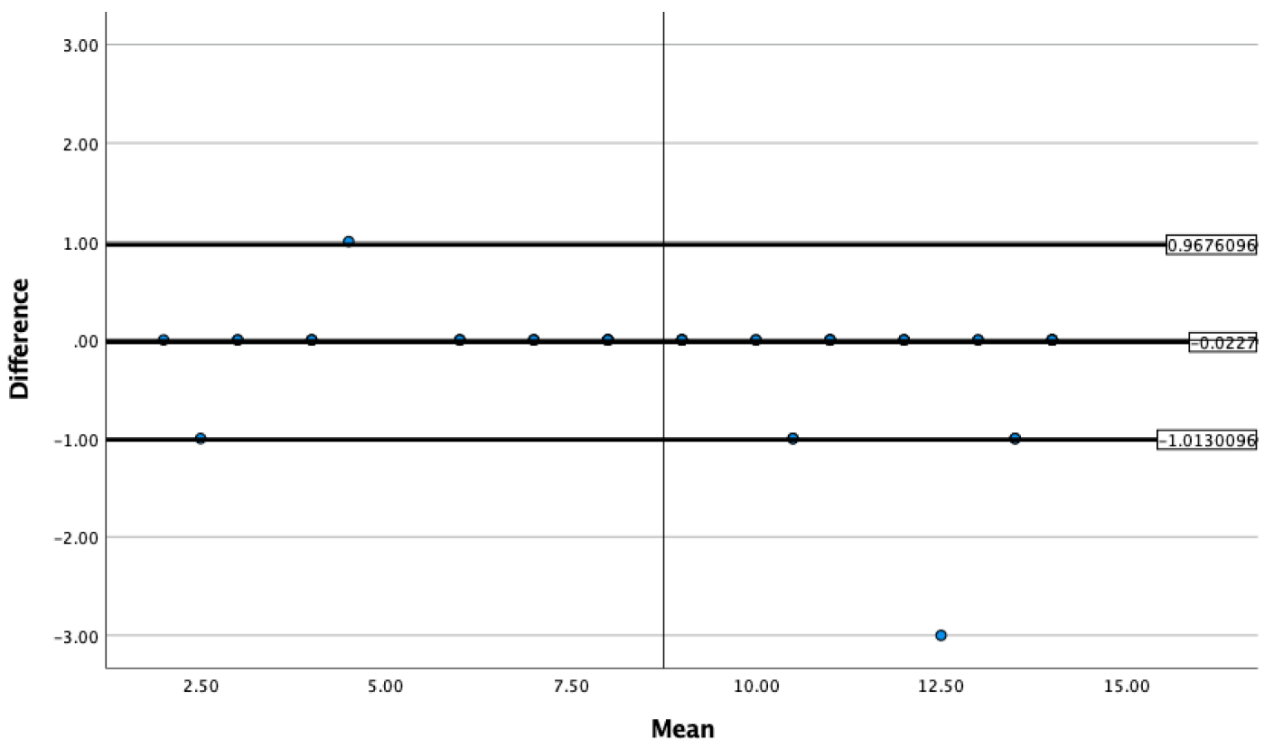
Figure 1:

Figure 2:

Discussion

The purpose of this study was to explore the intra-rater and inter-rater reliability of the 30s CST when administered virtually. Our findings suggest that the 30s CST can be safely administered virtually with excellent reliability.

With a global increase in telehealth and virtual research, the findings provide further evidence for virtual administration of a recommended performance measure for adults with OA. Virtual assessments can be more efficient and convenient for both clinical practice and research purposes. Despite the excellent reliability, there were four notable challenges to conducting the 30s CST virtually. Firstly, despite the instructions given in advance regarding the chair test, it was difficult to ensure standardization and consistency of chair seat height and it was not feasible for all to find a chair with the correct height. Secondly, there were issues related to video, audio, internet connectivity, and general participant technology competency. These were partially mitigated by using trained clinicians/researchers, providing clear instructions, doing trial runs, and closing background applications. Thirdly, given the online nature, the clinician/researcher is limited by the camera angle and the view on screen. Depending on the participant's space, this may not provide a full view. Finally, the clinicians/researchers cannot provide physical assistance when setting up the equipment or in the case of an adverse event. It is, therefore, important to develop a safety plan, including having a second person present and the address to send emergency services to.

Conclusion

The ability to reliably conduct the 30s CST virtually provides a valuable and convenient option for clinicians/researchers to conduct a widely used and recommended measure of physical function for adults with hip OA. Future research should address the described challenges and continue to explore the feasibility and reliability of conducting the 30s CST in other patient populations.

Clinical Messages

1. The 30s CST is a recommended performance-based measure for assessing physical function in individuals with hip osteoarthritis (OA) but with the COVID-19 pandemic there has been a need to pivot to virtual assessments.

2. To our knowledge, there are no studies that demonstrate the reliability of conducting the 30s CST virtually.

3. Our findings suggest that the 30s CST can be safely administered virtually with excellent intra- and inter-rater reliability.

4. The ability to reliably conduct the 30s CST virtually provides a valuable and convenient option for clinicians/researchers to conduct a widely used and recommended measure of physical function for adults with hip OA.

Acknowledgment

None.

Conflicts of Interest

None.

References

1. Marie-Louise Bird, Jane K Pittaway, Isobel Cuisick, Megan Rattray, Kiran D K Ahuja (2013) Age-related changes in physical fall risk factors: Results from a 3 year follow-up of community dwelling older adults in Tasmania, Australia. International Journal of Environmental Research and Public Health 10: 5989-5997.

2. Jones C, Rikli R, Beam W (1999) A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Research Quarterly for Exercise and Sport 70: 113-119.

3. Csuka M, McCarty D (1985) Simple method for measurement of lower extremity muscle strength. The American Journal of Medicine 78: 77-81.

4. Gill S, de Morton N, McBurney H (2012) An investigation of the validity of six measures of physical function in people awaiting joint replacement surgery of the hip or knee. Clinical Rehabilitation 26: 945-951.

5. F Dobson, R S Hinman, E M Roos, J H Abbott, P Stratford, et al. (2013) OARSI recommended performance-based tests to assess physical function in people diagnosed with hip or knee osteoarthritis. Osteoarthritis Cartilage 21: 1042-1052.

6. Barbour K, Helmick C, Boring M (2017) Vital signs: Prevalence of doctor-diagnosed arthritis and arthritis-attributable activity limitation – United States, 2013-2015. Morbidity and mortality weekly report 66: 246-253.

7. Amy Bowman, Linda Denehy, Aisha Benjemaa, Jess Crowe, Emma Bruns, et al. (2022). Feasibility and safety of the 30-second sit-to-stand test delivered via telehealth: An observational study. PM&R: The Journal of Injury, Function and Rehabilitation Pg No: 1-10.

8. Lisa M Koonin, Brooke Hoots, Clarisse A Tsang, Zanie Leroy, Kevin Farris, et al. (2020) Trends in the use of telehealth during the emergence of the COVID-19 pandemic – United States, January-March 2020. Morbidity and Mortality Weekly Report 69: 1595-1599.

9. Miller W, Mohammadi S, Watson W, Crocker M, Westby M (2021) The hip instructional prehabilitation program for enhanced recovery (HIPPER) as an eHealth approach to presurgical hip replacement education: Protocol for a randomized controlled trial. Journal of Medical Internet Research Protocols 10(7): e29322.

10. Koo, T and Li M (2016) A guideline of selecting and reporting intraclass correlation coefficients for reliability research. Journal of Chiropractic Medicine 15: 155-163.