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ORIGINAL ARTICLE

Reliability and minimal detectable change of the timed up and go test and the two-minute walk test in total hip arthroplasty.

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ABSTRACT… Objective: To find out the reliability and low detectable change (MDC) of the Timed Up and Go (TUG) test and 2-Minute Walk Test (2MWT) in study participants after total hip arthroplasty (THA). **Study Design:** Prospective Observational study. **Setting:** Indus Hospital and Health Network in Karachi. **Period:** From June and November 2025. **Methods:** The proposed pre-post intervention study took place within a sample population comprising of 37 adults (18-60 years) undergoing primary total hip arthroplasty at least 6 months prior to the study. The TUG and 2MWT reliability and minimal detectable change (MDC) were calculated and responsiveness measured using the Cohen d. SPSS vol.26 was used to analyze data <0.05 was to be significant value. **Results:** The study was accomplished by a total of 37 participants. The TUG test and 2MWT were found to be highly reliable tests with regard to the test-retest reliability (ICC: 0.92 and 0.94, respectively). TUG and 2MWT had minimal detectable changes (MDC95) of 2.1 s and 14.7 m respectively. Large responsiveness was suggested by the standardized effect sizes (Cohen d: 1.05 TUG, 0.98 2MWT). After rehabilitation, functional performance was significantly improved as well as pain. **Conclusion:** The TUG and 2MWT are valid, responsive and clinically pertinent instruments in measuring restoration n of function following total hip arthroplasty. The MDC values developed during this research can serve as objective standards of determining real changes in mobility and endurance.

Key words: Gait, Hip Arthroplasty, Pain Measurement, Physical Functional Performance, Rehabilitation.

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INTRODUCTION

Total hip arthroplasty (THA) is widely recognized as a proven procedure for discomfort relief and functional recovery of patients with the advanced hip pathology; nevertheless, the physical functioning recovery after the surgery differs significantly across different individuals. Performance-based outcome measures are therefore necessary to accurately measure functional recovery and determine rehabilitation post-THA.[1] The most typical measures of these include the Timed Up and Go (TUG) test and walking-based tests because they are simple, feasible, and clinically relevant.[2]

TUG test is the assessment of ambulatory function, balance, and transitional movements, whereas walking tests assess the efficiency of gait and endurance mostly.[3,4] Such tests reflect elements of physical performance that may not be well reflected in the patient-reported outcome measures, hence their usefulness in the postoperative evaluation of THA. It has also been shown that performance-based tests are useful in the prediction of short-term functional recovery when performed preoperatively, an indicator they possess a prognostic value in the perioperative environment.[5]

Functional performance tests have demonstrated excellent measurement properties such as reliability, validity, and responsiveness; hence their application in clinical practice and research situations has been well-researched in populations with hip disorders.[6] As objective monitoring has progressed, performance-based tests keep a significant place in measuring functional recovery when lower-limb arthroplasty is done.[7] Recent systematic reviews highlight the significance of ensuring that the chosen outcome measures reflect functional domains will be determined by the Global framework for describing health and disability (ICF), which further supports the applicability of standardized performance tests following THA.[8,9]

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Although the 6-minute walk test is also frequently utilized tool for assessing functional ability, the 2-Minute Walk Test (2MWT) has become an alternative, especially when using in patients with short endurance, as a shorter but valid outcome of functional change. Further, objective gait and mobility measures have been found to be complementary to patient-reported, giving a more detailed assessment of postoperative functioning following THA.[10]

Although both Timed Up and Go (TUG) test and Two-Minute Walk Test (2MWT) are widely used, there is little evidence on reliability and minimum detectable change (MDC) in a patient who undertook total hip arthroplasty (THA). Since postoperative functional recovery of THA patients is not similar to other populations, it is necessary to define population-specific measurement properties. The proposed research will deliver dependable MDC values to assist clinicians to differentiate actual and functional improvement after the treatment and measurement error, as well as provide substantial rehabilitation assessment.

METHODS

The Prospective observational study that took place in the Department of Orthopedics and Trauma, Indus Hospital and Health Network (IHHN), Karachi, from June 2025 and November 2025, after the Institutional Review Board approved it (Approval No. IHHN_IRB_2025_03_017). All participants gave informed consent in writing.

Sample size was calculated with G*Power software taken size of effect as 0.5, 80% power, and an alpha of 0.05, According to these parameters the sample size needed was 37 participants which is in agreement with what was done in earlier research.[11] The selection was made by means of non-probability consecutive sampling of either gender aged 18 to 60 years with 6 Months prior THA. The exclusion criteria were revision THA, inability to follow instructions, resting pain more than fifty millimeter on the VAS scale, or the presence of gait disorders due to neurological or orthopedics pathologies.

All the participants had their baseline information collected, age, sex, height, weight, body mass index (BMI), and pain intensity measured using the Numeric Pain Rating Scale (NPRS). In TUG test patient had to get up from the chair and then do a walk (in 3m), turn back, and go to the chair, and the time to do all this was in seconds. In the Two-Minute Walk Test (2MWT), patients were evaluated at minimum of 6 months subsequent to total hip arthroplasty and had gone through the usual rehabilitation following surgery and had the ability to walk without support. The subjects were asked to take a two-minute stroll at the comfort speed on a 30 meters walk and the distance was measured in meters. Two experiments were carried out and there was an interval of 5 minutes between trials and the mean was taken to analyze the trials. The level of pain was measured prior to and immediately after the tests. All were done by qualified physical therapists in case of all the assessments according to the standard protocols.

All the participants had gone through an ordinary postoperative rehabilitation programme that consisted of early mobilization, range-of-motion exercises, progressive muscle strengthening (especially, hip abductors and extensors), gait training and functional mobility exercises. Rehabilitation normally started within the first two weeks of operation and continued further within weeks based on patient tolerance and clinical progress. At the program conclusion, NPRS, TUG, and 2MWT were measured under the same conditions to determine the changes in pain, mobility, and functional performance.

The analysis of data was conducted with SPSS 26.0. Mean standard deviation was used to describe continuous variables, and frequencies and percentages were used to describe categorical variables. Normal test was done using the Shapiro-Wick test. The chi-square test was applied in examining the relation between categorical variables. Statistical significance of a p-value with a threshold of 0.05 was considered significant.

The TUG and 2MWT reliability were tested and minimal detectable change (MDC) values were calculated. Standardized effect sizes (Cohen d) were used to measure responsiveness of the tests, where small (0.2), moderate (0.5), and large (> 0.8) were interpreted as small, moderate, and large

respectively.

RESULTS

A total of 37 participants of primary total hip arthroplasty (both cemented and uncemented) completed the study. Baseline demographic and clinical characteristics of the participants are summarized in Table-I.

TABLE-I

Baseline demographic and clinical characteristics of participants

Characteristic	Mean ± SD / n (%)
Age (years)	54.2 ± 6.8
Sex (Male/Female)	19 (51.4%) / 18 (48.6%)
Height (cm)	165.3 ± 8.2
Weight (kg)	70.6 ± 12.4
BMI (kg/m²)	25.8 ± 3.9
NPRS (pre-rehabilitation)	5.6 ± 1.2

Functional performance and pain improved significantly after rehabilitation, as indicated by changes in TUG, 2MWT, and NPRS scores. (TABLE-II).

TABLE-II

Functional Performance and Pain Pre- and Post-Rehabilitation

Measure	Pre-Rehabilitation (Mean ± SD)	Post-Rehabilitation (Mean ± SD)	P-Value
TUG (s)	15.6 ± 3.2	12.4 ± 2.8	<0.001
2MWT (m)	120.8 ± 18.5	145.3 ± 20.1	<0.001
NPRS	5.6 ± 1.2	2.3 ± 0.9	<0.001

Both TUG and 2MWT demonstrated excellent test-retest reliability, with intraclass correlation coefficients indicating high consistency (Table-III).

TABLE-III

Test-retest reliability of TUG and 2MWT

Test	ICC (95% CI)
TUG	0.92 (0.87–0.96)
2MWT	0.95 (0.91–0.97)

Minimal detectable changes (MDC95) for both tests were established, and standardized effect sizes revealed both TUG and 2MWT were highly responsive to functional changes after rehabilitation (Table-IV). Exploratory subgroup analyses revealed no significant differences in functional improvement or pain reduction based on gender, operated side (left vs. right), or arthroplasty type (cemented vs. uncemented) (all $p > 0.05$). This suggests that the improvements in TUG, 2MWT, and NPRS scores were consistent across these subgroups.

TABLE-IV

Minimal Detectable Change (MDC) and Responsiveness

Test	MDC95	Cohen's d	Interpretation of Effect Size
TUG	2.1 s	1.05	Large
2MWT	14.7 m	0.98	Large

DISCUSSION

The current study compared the reliability and minimal detectable change (MDC) of Timed Up and Go (TUG) test and 2-Minute Walk Test (2MWT) in the patients after total hip arthroplasty (THA). TUG and 2MWT showed good test-retest reliability, which is similar to the previous research on the physical function outcomes following physiotherapy interventions on joint disorders.[11]

These tests are responsive to the changes in our study and this reflects to past researches that show that there is a significant improvement in functional outcomes after revision THA making these tests useful in the detection of significant changes in mobility.[12] The identification of MDC values is also imperative to discriminating between real functional changes and measurement variability as is also stressed in the literature on mobility tools among patients with osteoarthritis as they await arthroplasty.[13]

Our findings justify the complementary use of performance-based evaluations and patient-reported measures because midterm post-operative studies of hip and knee arthroplasty have demonstrated that objective measures can supplement patient-reported scores.[14] Functional impairments, decreased range of movement, and muscle weakness are frequent 6 months after THA, which highlights the role of objective monitoring with standardized tests of functional impairment.[15]

The same analysis of gait patterns observed for a delayed timescale in the study of arthroplasty

further emphasizes that formal functional data are important to monitor recovery patterns and optimize rehabilitation processes.[16] Stability and validity of hip functional performance test on athletes imply that standardized mobility tests could be used in various members of the population, which strengthens the external validity of TUG and 2MWT.[17]

The identification of minimal clinically important differences is used to supplement MDC measures by giving thresholds that indicate the meaningful improvements as perceived by the patient viewpoint.[18,19] Systematic reviews show that baseline physical functioning is a robust indicator of the functional recovery after THA, and warrant the use of early and continuous functional assessment. Lastly, addition of performance measurement and patient-reported outcome improves accuracy of the functional assessment and enables customization of rehabilitation planning.[20]

LIMITATIONS

The current study was carried out in one center with a small sample size, which can be considered a limitation to generalization. Patients more than six months after primary THA were only included, hence early postoperative recovery and long-term outcomes after the rehabilitation process were not measured. Also there were no self-reported outcomes or any other functional tests which would have given a complementary information. Though the standardized rehabilitation program represents a reflection of clinical practice, it might differ across institutions, which might affect reproducibility.

CONCLUSION

TUG and 2MWT have been shown to be reliable, responsive, and clinically significant and important in evaluation of recovery of physical function after THA. The MDC values that have been determined in this study offer objective levels that can be used to interpret the actual increases in mobility and endurance. The regular use of these tests in the evaluation of post-THA patients may be used to direct their rehabilitation, progress tracking, and timely interventions to maximize patient outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Faisal Muteeb:** Conception, data collection, writing.
2	**M. Amin Chinoy:** Study supervision, design oversight.
3	**Farah Naz:** Data collection, writing.
4	**Iqra Yousuf:** Data entry, data analysis.