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Reliability Of TUG COG In Middle-Aged Adults

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ABSTRACT

Timed up and go (TUG) is a quick test used in clinical practice as an outcome measure to assess functional ambulatory mobility or dynamic balance in adults. TUG Cognitive (TUG-COG) a dual-task dynamic measure for identifying individuals who are at risk for falls used in Parkinson's , Stroke patients and patients with vestibular dysfunctions.
However, its reliability in middle-aged adults, a demographic often overlooked in research, remains underexplored. Hence, the purpose of our study was to assess the intra-rater reliability of TUG-COG test in middle aged adults.

Aims & Objectives
To assess intra rater reliability of Timed Up And Go Test in Cognitive (TUG Cog) in middle aged adults.

Materials and Methods:

Subjects performed TUG COG three times consecutively while performing a cognitive task and time was recorded during each task.

Results:

The TUG COG test shows strong reliability in middle-aged adults, with an ICC of 0.813 indicating high consistency in measurements. Similarly, a Cronbach's Alpha of 0.813 confirms strong internal consistency, suggesting the test reliably measures cognitive-motor performance in this group.

Conclusion:
The TUG COG test is a reliable tool for assessing cognitive and motor function in middle-aged adults, demonstrating strong intra-rater and internal consistency reliability. It is valuable for both clinical and research use in evaluating functional performance.

Keywords: Intra rater reliability , TUG COG , middle aged adults , Intraclass Correlation Coefficient.

INTRODUCTION

Functional mobility is a key determinant of an individual's ability to live independently and maintain quality of life. Among the many physical assessments available, walking speed has been identified as the "sixth vital sign," as it predicts not only mobility but also future health outcomes and survival [(1)]. The Timed Up and Go (TUG) test is a widely used, simple, and cost-effective clinical measure that evaluates functional mobility by assessing balance, gait speed, and transitional movements such as standing and turning [(2,3)]. It has demonstrated strong validity and reliability across various age groups and clinical populations, particularly in older adults [(2)].

However, traditional mobility assessments like the TUG may not fully capture the complexity of everyday tasks, which often require individuals to perform motor and cognitive tasks simultaneously—such as walking while conversing, thinking, or using a mobile device. This real-life scenario has led to the development of dual-task assessments such as the Timed Up and Go with Cognitive Task (TUG-COG). The TUG-COG introduces a simultaneous cognitive demand (e.g., counting backward, naming animals) during the physical task, thereby evaluating the interaction between motor and cognitive systems [(4)]. Dual-task assessments have proven particularly valuable in identifying individuals at risk for falls and cognitive decline, especially in neurologically vulnerable or elderly populations [(5)].

While TUG and TUG-COG have been extensively validated in older adults and those with neurological conditions, their application in middle-aged adults (ages 40–60) remains underexplored. This is a significant oversight, as research suggests that subclinical changes in cognition and mobility may begin as early as midlife, even in healthy individuals [(6,7)]. Early functional decline during this period may go unnoticed in single-task assessments, potentially delaying interventions that could prevent more serious deterioration in later life.

Emerging evidence also highlights that aging is associated with gradual reduction in the volume and integrity of cerebral white matter, particularly in brain regions involved in executive function, attention, and motor coordination. These microstructural changes, often observable through neuroimaging techniques such as diffusion tensor imaging (DTI), can disrupt communication between key neural pathways. As a result, individuals may experience declines in processing speed, dual-task performance, and working memory—factors that are strongly linked to the risk of developing dementia and related neurodegenerative conditions [(8,9)]. Importantly, such changes may occur without overt clinical symptoms, reinforcing the need for functional tools that can sensitively detect early cognitive-motor interference.

The dual-task paradigm used in the TUG-COG reflects the cognitive-motor challenges of everyday life and places demand on executive functioning, which is one of the first cognitive domains to show age-related decline [(10,11)]. Assessing the test-retest reliability of TUG-COG in middle-aged adults is therefore essential to validate its use as a functional screening tool for early detection of subtle impairments. Reliable and reproducible measures are critical not only for baseline assessment but also for tracking changes over time, evaluating intervention outcomes, and informing preventive care strategies.

This study aims to investigate the intra-rater reliability of the Timed Up and Go with Cognitive Task (TUG-COG) in healthy middle-aged adults. By addressing a gap in current mobility assessment practices, this research supports the integration of dual-task testing into routine midlife health evaluations and contributes to the development of proactive strategies for maintaining cognitive and functional health across the lifespan.

MATERIALS & METHODS

Method

Data Collection - Residents Of Ahmedabad
Population – Middle - aged adults (40-60)
Study Design – Observational Study
Sample Technique – Convenient Sampling Method
Sample Size – 50

Materials

Chair with armrest
Measure Tape
Chalk
Stopwatch
Straight 3m Path

Methodology

Ethical approval for the study was obtained from the Institutional Ethics Committee prior to the commencement of data collection. Participants were selected based on predefined inclusion and exclusion criteria. Upon selection, the entire procedure was thoroughly explained to each participant in a language they could understand. Informed consent was then obtained from all participants prior to their involvement in the study. Following this, the Timed Up and Go with Cognitive Task (TUG-COG) assessment was administered as per standardized protocol.

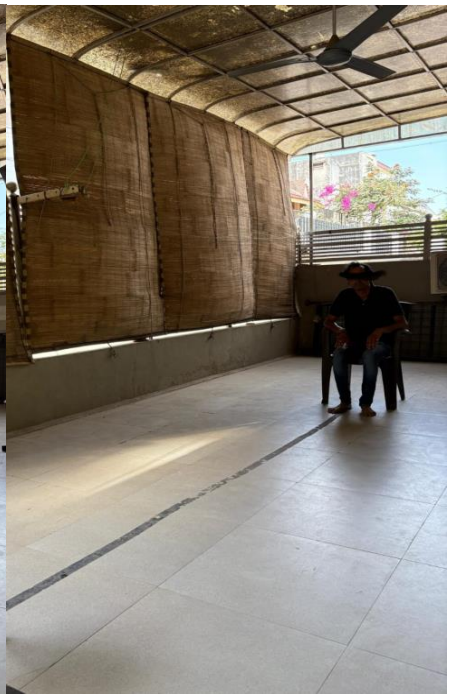
The study will include participants aged 40–60 years who are willing to provide consent, able to walk independently or with the help of a walking aid, have no severe pain or disability, and possess the physical ability to perform the required tests. Individuals will be excluded if they have severe visual or hearing impairments, mild cognitive impairment, severe dependency on a walking aid, neurological or vestibular disorders, are on medications that affect cognitive or physical function, or have severe psychological conditions.

During the administration of the Timed Up and Go with Cognitive Task (TUG-COG)**,** participants were required to perform an additional cognitive task simultaneously while completing the standard physical components of the test. The cognitive tasks were administered while the participant walked along the 3-meter path, thereby creating a dual-task condition to assess cognitive-motor interference.
Three types of verbal cognitive tasks were randomly assigned across trials to prevent task familiarity:

- **Number Sequencing Task**: Participants were instructed to continuously speak either odd or even numbers in sequential order (e.g., 2, 4, 6... or 1, 3, 5...) as directed by the therapist.
- **Phonemic Fluency Task**: Participants were asked to generate words beginning with a specified letter sound (phoneme) (e.g., "S" – sun, sand, song…) while walking, assessing their verbal fluency and executive function.
- **Word Repetition Task**: Participants were required to recall and repeat a set of five unrelated words provided by the therapist immediately prior to the trial. This task evaluated short-term memory and attention under mobility stress.

Each participant was instructed to perform the verbal task continuously and aloud throughout the walking phase of the TUG**,** without pausing or stopping. The objective was to assess how concurrent cognitive loading influenced the participant's gait speed, stability, and overall performance during the mobility task.






RESULT

IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY) calculated to summarize participant characteristics and test scores. Internal consistency of the TUG-COG scale was evaluated using Cronbach's Alpha**.** Intraclass Correlation Coefficients (ICCs) were computed using a two-way mixed-effects model (consistency type) to assess inter-rater reliability for both single and average measures. To evaluate the reliability of the TUG-COG test in middle-aged adults, both internal consistency and inter-rater reliability were analyzed.

Internal Consistency

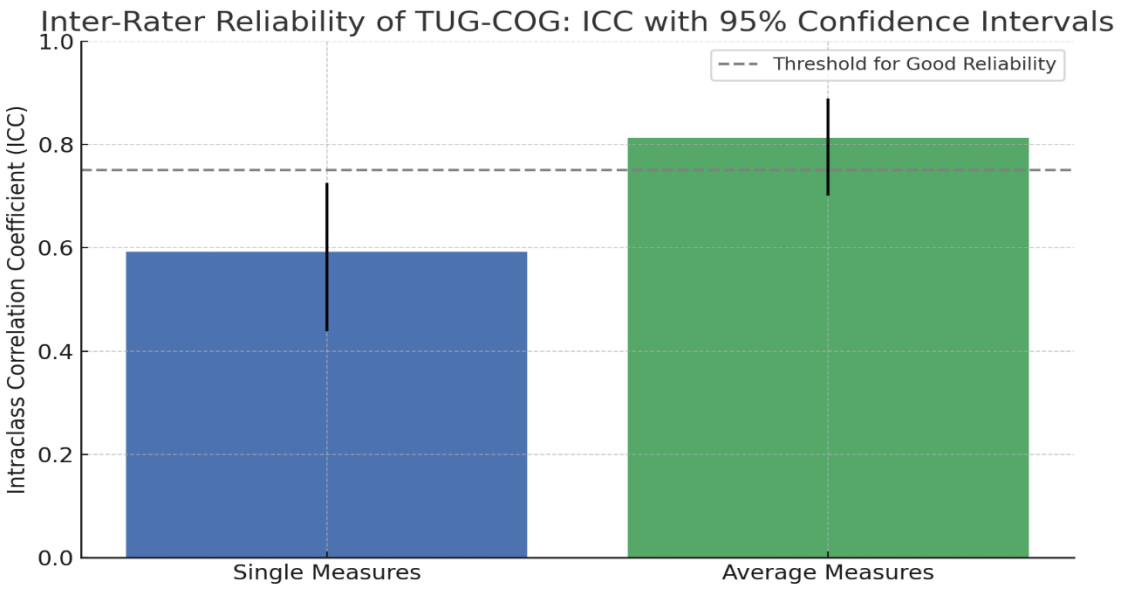
The internal consistency of the TUG-COG scale, comprising three cognitive task conditions, was assessed using Cronbach's Alpha. The analysis yielded a Cronbach's Alpha value of 0.813, indicating good internal consistency across the three items. This suggests that the cognitive conditions within the TUG-COG are reliably measuring the same underlying construct related to dual-task mobility performance.

Intraclass Correlation Coefficient (ICC)

The Intraclass Correlation Coefficient (ICC) was calculated to assess inter-rater reliability using a two-way mixed-effects model, where the people effects were random and the measurement effects were fixed (Type C, consistency definition). This model was chosen as it reflects the consistency of scores across raters rather than their absolute agreement.

- For single measures, the ICC was 0.592, with a 95% confidence interval (CI) ranging from 0.439 to 0.725. The corresponding F-test value was $F(49, 98) = 5.353$, and the result was statistically significant ($p < 0.001$). This indicates moderate reliability when considering individual ratings across raters.
- For average measures, the ICC increased to 0.813, with a 95% CI between 0.701 and 0.888, also with an $F(49, 98) = 5.353$, and $p < 0.001$. This reflects excellent reliability when the average of raters' scores is considered, supporting the robustness of the scale when used in clinical or research settings with multiple raters.

The use of the type C intraclass correlation coefficient ensures that the reliability estimate reflects consistency across raters while excluding between-measure variance from the denominator. Overall, these results demonstrate that the TUG-COG test exhibits good internal consistency and moderate to excellent inter-rater reliability, making it a suitable and dependable tool for assessing dual-task performance in middle-aged adults.



A bar chart visualizing the Intraclass Correlation Coefficient (ICC) for both Single Measures and Average Measures with 95% confidence intervals. The dashed line at 0.75 indicates the threshold commonly considered as good reliability. As shown:

- **Single measures ICC (0.592)** reflects moderate reliability.
- **Average measures ICC (0.813)** indicates excellent reliability.

DISCUSSION

The reliability analysis of the TUG-COG test in middle-aged adults revealed encouraging results regarding its consistency and measurement accuracy. The scale demonstrated good internal consistency, with a Cronbach's Alpha of 0.813, indicating that the items used in the test reliably measure the same underlying construct—namely, cognitive-motor performance under dual-task conditions.

The inter-rater reliability, evaluated through the Intraclass Correlation Coefficient (ICC), offered a deeper understanding of the scale's stability across different raters. The single-measures ICC of 0.592 indicates moderate reliability, suggesting that individual scores may vary slightly depending on the rater. This level of reliability warrants careful consideration when using TUG-COG in settings where only one rater is present. In contrast, the average-measures ICC of 0.813 reflects excellent reliability when multiple observations or raters are used. This supports the application of the test in repeated-measures or multi-rater environments, where more consistent and accurate assessments are critical.

Additionally, the use of a Type C ICC model, which excludes between-measure variance, further enhances the validity of the findings by emphasizing consistency rather than absolute agreement. This approach is particularly relevant in clinical research, where reliable performance trends are often more important than exact score matching.

Overall, the TUG-COG test demonstrates strong psychometric properties, especially when used with averaged observations. These results affirm its potential as a robust and dependable tool for identifying early functional decline in middle-aged adults. This is particularly relevant considering the evidence linking midlife white matter changes to early cognitive decline and dementia risk. The TUG-COG may therefore serve as an important early screening tool for interventions aimed at preventing or delaying age-related impairments.

CONCLUSION

This study aimed to evaluate the reliability of the Timed Up and Go with Cognitive Task (TUG-COG) test in healthy middle-aged adults—a population often overlooked in functional mobility research. The findings demonstrated good internal consistency and moderate to excellent inter-rater reliability, particularly when multiple observations were averaged. These results suggest that the TUG-COG is a psychometrically sound tool for assessing dual-task performance and cognitive-motor integration in midlife. The test showed good internal consistency and moderate to excellent inter-rater reliability, supporting its application in both clinical and research contexts.

Middle age is increasingly recognized as a critical period for detecting early signs of cognitive and functional decline. The TUG-COG, by incorporating both motor and cognitive components, offers a realistic and sensitive assessment that reflects everyday multitasking demands. Its ability to detect subtle cognitive-motor interference makes it highly valuable for early screening**,** fall risk identification, and preventive healthcare planning.

In conclusion, the TUG-COG is a practical, efficient, and psychometrically sound tool for evaluating functional mobility under cognitive load in middle-aged adults. Its integration into routine assessments could play a significant role in promoting healthy aging and initiating timely interventions before the onset of more severe impairments.

LIMITATIONS AND RECOMMENDATIONS

Limitations

- Small sample size (24 participants) limits generalizability.
- Short intervention period (2 weeks) prevents long-term assessment.
- Participants restricted to IT professionals only.

- No long-term follow-up to check sustained effects or recurrence.
- Lack of blinding may have introduced bias.
- Outcome measures (NPRS, NDI) were subjective and self-reported.
- Single-center study reduces external validity.

Recommendations

- Conduct studies with a larger sample size.
- Include long-term follow-up to assess sustained benefits.
- Add objective measures (e.g., EMG, ROM tests) along with subjective scales.
- Compare with other manual therapy and exercise-based interventions.
- Involve participants from diverse occupational backgrounds.
- Use blinded assessors to reduce bias.
- Carry out multicenter studies to validate results.

Declaration by Authors

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