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Relationship between multiple morbidities and performance on the Timed Up and Go test in elderly patients: a cross-sectional study

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ABSTRACT

Objective To investigate how various morbidities affect older patients' performance on the Timed Up and Go (TUG) test.

Design Cross-sectional study.

Setting The seven government hospitals of Lahore, Pakistan, included are major tertiary care centres, representing an older patient population of Punjab, Pakistan.

Method 160 elderly participants completed the TUG test, frailty evaluations and Charlson Comorbidity Index (CCI) scoring to assess mobility, frailty and comorbidity burden. The Student's t-test analysed differences between TUG groups (<10 vs ≥10 s). Multivariate linear regression pinpointed key predictors of CCI scores. All analyses were performed using SPSS software.

Results A total of 160 participants (mean age: 67.2±6.9 years and body mass index (BMI): 28.7±4.9 kg/m²) were included. Those with TUG test times under 10 s had lower CCI scores (5.06±1.8) and frailty index (0.15±0.07), compared with those with longer times (CCI: 8.6±4.3 and frailty index: 0.42±0.1). Multivariate regression analysis revealed that TUG time (β=0.342, p=0.001), frailty index (β=0.680, p=0.003), age (β=0.128, p=0.002) and BMI (β=0.098, p=0.027) were significant predictors of CCI. Additionally, higher Mini-Mental State Examination scores (β=−0.092, p=0.017) were associated with lower comorbidity burden. These results highlight mobility, frailty and cognitive function as a predictors of comorbidities in the elderly.

Conclusion Our study highlights a significant relationship between mobility, frailty and cognitive function with the comorbidity burden in older adults. Incorporating these metrics into routine care can guide targeted interventions, promoting healthier ageing and improved quality of life.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study comprehensively evaluated mobility, frailty and cognitive function as predictors of comorbidities.
⇒ Validated tools such as the Timed Up and Go (TUG) test, Charlson Comorbidity Index and Mini-Mental State Examination were used for accurate assessments.
⇒ The study was conducted at specific hospitals, potentially affecting generalisability.
⇒ While the TUG test is widely used in clinical practice, its ability to capture all aspects of functional performance relevant to daily activities may be limited.

INTRODUCTION

The Timed Up and Go (TUG) test is a widely used clinical assessment tool designed to evaluate mobility, balance and fall risk in older adults. It was developed by Podsiadlo and Richardson in 1991 as a modification of the earlier Get Up and Go test, which was introduced by Mathias *et al* in 1986.[1] Additionally, the validity of the TUG has been demonstrated by its correlation with measurements like the functional indexes, the residential status, falls,[2] and mortality of patients as well as by gait speed/time,[3] stair climbing[4] and the Berg Balance Scale.[5]

Clinically significant findings, such as mortality and quality of life, are correlated with the ability to conduct daily living activities as assessed by particular physical tests.[6] Given that comorbidities and ageing may significantly impair skeletal muscle performance, it may be essential for elderly hospital patients to have physical examinations.[7]

Age is a significant factor in both the frequency and quantity of comorbidities in population studies.[8] Subclinical pathology in several organ systems is likely to exist even in healthy older persons and individuals with a single clinically apparent condition. Furthermore, even in the absence of a clinically evident illness process, many older men and women endure a progressive deterioration in their physical strength, gait speed, manual dexterity, memory and cognitive abilities.[9]

When it comes to forecasting mortality risk, the Charlson Comorbidity Index (CCI) is a useful tool for evaluating how comorbid

illnesses affect patient outcomes. It enables medical professionals to categorise patients according to their current state of health by allocating weights to different comorbidities based on their severity. In therapeutic settings, where treatment decisions might be informed by knowledge about a patient's general health, this index is particularly pertinent.[10]

The outcomes of TUG tests and CCI scores are significantly correlated. The association between higher CCI scores and longer TUG test completion times suggests that people with higher comorbidity burdens may have more severe functional impairments.[11]

The TUG test is conducted as outlined in the original derivation study, with the patient being timed as they get out of an armchair (seat height approximately 46 cm), move at a safe and comfortable rate to a line on the floor 3 m away, circle back to the chair and sit down once more. Before the test is timed, the subject completes it once to get a feel for it. The participant dons their usual shoes.[12]

The need for a deeper comprehension of the connection between comorbidities and mobility in the senior population is the driving force for this research. It is imperative to clarify the ways in which comorbidities affect functional capacities, given the global ageing population and the high incidence of chronic illnesses among the elderly. Our goal is to shed light on the difficulties faced by older people with many medical illnesses by examining the relationship between TUG test performance and CCI scores. To develop healthcare practices catered to the needs of senior populations and ultimately improve their overall quality of life and well-being, this research ultimately aims to guide focused interventions.

METHODOLOGY

This cross-sectional study was conducted from July 2023 to December 2023 at seven different government hospitals in Lahore. The study included 160 elderly individuals all from Punjab, aged ≥65 years with a body mass index (BMI) <30 kg/m^2, admitted to the hospital between the first and seventh day of hospitalisation and who reported walking independently before hospitalisation. The sample size for the study was calculated using Epitool software to estimate a proportion with specified precision.[13] The inputs used for the calculation were an estimated true proportion of 0.3 (30% prevalence of the condition of interest), a desired precision of ±0.07 (7% margin of error), a confidence level of 0.95 (95%) and a population size of 1000, representing the finite population from the study area. Based on these parameters, the software estimated a required sample size of 142 participants. However, to enhance the robustness of the study and account for potential variability or dropouts, a total of 160 participants were recruited. This ensured adequate statistical power for the analysis and strengthened the reliability of the study outcomes. Exclusion criteria comprised peripheral oxygen saturation (SpO2) lower than 90% during evaluation, an increase in heart rate (HR) of more than 40% of the baseline value and the presence of dyspnoea or discomfort during the tests.

Initially, anthropometric measurements were recorded, and the TUG test was administered to evaluate physical performance each person was instructed to get up from a seated posture, walk 3 m and then return to the same chair, while a trained physical therapist or trainer measured the time(s) required to perform this task.[14] Subsequently, patient records were reviewed to gather information on admission diagnoses, admission profile, frailty index and CCI score.

The CCI was used to quantify the comorbidity burden of participants. This scoring system assigns weights to 17 specific conditions, with scores ranging from 1 to 6 points based on their impact on mortality risk. Additional points are added for age, starting at +1 for ages 50–59 years and increasing incrementally for older age groups. The total CCI score is the sum of all comorbidity points plus age-related points.[15]

The frailty index was used as a measure of participants' overall health and vulnerability. It was calculated based on the presence of health deficits, including physical, cognitive and chronic disease-related impairments. Each deficit was assigned a value of 1 (present) or 0 (absent), and the FI was computed by dividing the total number of deficits by the total possible deficits. Scores were categorised as non-frail (FI ≤0.1), mildly frail (0.11–0.25), moderately frail (0.26–0.5) and severely frail (FI >0.5).[16]

BMI was computed by dividing body weight (in kg) by squared height (in m), with classifications based on WHO criteria.[17] The CCI was used to assess comorbidities, and Mini-Mental State[18] Examination (MMSE) questionnaire was employed to assess the mental state of patients.

Descriptive statistics, including means and SD, were used to summarise numerical data. Between-group comparisons were conducted using the Student's t-test, with a TUG test threshold of ≥10 s. This threshold is supported by clinical and research evidence as a reliable indicator of functional independence. Individuals completing the test in ≤10 s are generally considered to have better mobility and lower frailty levels, whereas those requiring >10 s are at a higher risk of impaired mobility and functional decline.[19] Additionally, a multivariate linear regression model was implemented to identify factors influencing CCI scores. Key predictors included TUG test time, age, BMI, gender, MMSE score and duration of hospitalisation. A p value threshold of <0.05 was used to determine statistical significance throughout the analysis. All statistical analyses were conducted using SPSS V. 24.0.

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting or dissemination plans of this study.

RESULTS

Table 1 shows data of 160 elderly patients, including 137 males and 23 females. The average age of participants was 67.2 years, with a SD of 6.9 years. The average BMI was

Table 1 Baseline characteristics

Categorical variable	Percentage
Gender (male)	86
Gender (female)	14
Clinical admission profile	64.7
Cardiovascular disorders	36.1
Respiratory disease	28.1
Abdominal disorders	12.24
Variables	**Mean±SD**
Age (years)	67.2±6.9
Body mass index	28.7±4.9
Length of hospitalisation (days)	4.62±2.82
Comorbidity Index Score	8.10±3.89
Mini-Mental State Examination score	22.4±4.05
Timed Up and Go test time (s)	11.87±5.99

28.7 kg/m² ±4.9 kg/m². The primary reasons for hospitalisation were cardiovascular diseases, respiratory diseases and abdominal disorders. On average, patients stayed in the hospital for 4.62 days, with a SD of 2.82 days. The mean CCI score was 8.10, with a SD of 3.89.

Out of the total 160 patients, 46% (77 out of 160) of individuals had a CCI score of 5 or above, while the remaining 54% (83 out of 160) of patients had a score of 7 or above. Among the first group (table 2) with a CCI score of 5, those patients completed the TUG test in less than 10 s. Conversely, in the second group (table 3) with a CCI score of 7 or above, patients took more than 10 s to complete the TUG test.

Table 4 shows the results of a multivariate regression analysis examining factors influencing CCI scores. TUG test time (β=0.342, p=0.001) and age (β=0.128, p=0.002) were found to be significant predictors, with higher values indicating greater comorbidity burden. BMI (β=0.098, p=0.027) also showed a positive association. Conversely, MMSE scores (β=−0.092, p=0.017) were negatively associated with CCI scores, suggesting that better cognitive function is linked to lower comorbidity. Gender (male) and hospitalisation duration were not statistically significant predictors. This analysis underscores the role of mobility and cognitive performance in predicting comorbidity burden.

Table 2 Timed Up and Go test completed in less than 10 s with low Charlson Comorbidity Index scores

Variables	Mean	P value
Age (years)	68.62±7.2	0.003
Charlson Comorbidity Index score	5.06±1.8	0.002
Mini-Mental State Examination score	22.2±4.9	0.003
Duration of hospitalisation (days)	4.9±3.2	0.02
TUG test time (s)	8.1±3.1	0.003
Frailty index	0.15±0.07	0.001

Table 3 Timed Up and Go test completed in more than 10 s with higher Charlson Comorbidity Index scores

Variables	Mean	P value
Age (years)	69.92±7.6	0.002
Charlson Comorbidity Index score	8.6±4.3	0.001
Mini-Mental State Examination score	25.6±4.3	0.001
Duration of hospitalisation (days)	5.5±3.7	0.024
TUG test time (s)	12.67±7.1	0.002
Frailty index	0.42±0.1	0.004

According to table 5, there is a positive correlation between higher CCI scores and age (β=0.067, p=0.004), TUG test time (β=0.220, p=0.001) and frailty index (β=0.680, p=0.003). This suggests that older people, those with slower mobility and those with higher levels of frailty are more likely to have comorbidities. Lower CCI scores are associated with higher MMSE scores (β=−0.072, p=0.021), indicating that improved cognitive performance correlates with fewer comorbidities. Hospital stay duration also contributes to higher comorbidity scores (β=0.055, p=0.045).

Table 6 revealed significant factors influencing CCI scores. Age (β=0.082, p=0.002) and TUG test time (β=0.430, p=0.004) were positively associated with higher comorbidity burdens. In contrast, better cognitive function, reflected by higher MMSE scores (β=−0.103, p=0.009), was linked to lower CCI scores. The frailty index (β=1.150, p=0.005) showed the strongest association, highlighting frailty as a key determinant of comorbidity burden. Hospitalisation duration (β=0.070, p=0.075) approached significance but was not statistically conclusive.

DISCUSSION

Our findings align with earlier research, showing that slower TUG test times are associated with greater comorbidity burdens. These findings suggest that the TUG test could be a valuable tool for primary care physicians to objectively assess and monitor physical function in patients with chronic illnesses across various age groups. Additionally, our study highlights the TUG's potential in patient-centred medical home models, as it correlates

Table 4 Multivariate linear regression analysis of factors associated with Charlson Comorbidity Index scores

Variables	Coefficient (β)	SE	P value
Timed Up and Go test time (s)	0.342	0.054	0.001
Age	0.128	0.029	0.002
Body mass index (kg/m²)	0.098	0.034	0.027
Gender (male)	−0.183	0.172	0.091
Mini-Mental State Examination score	−0.092	0.038	0.017
Duration of hospitalisation (days)	0.088	0.043	0.076

Table 5 Multivariate linear regression analysis of factors of comorbidity index in participants with faster Timed Up and Go performance

Variables	Coefficient (β)	SE	P value
Age (years)	0.067	0.021	0.004
Mini-Mental State Examination score	−0.072	0.031	0.021
Duration of hospitalisation (days)	0.055	0.027	0.045
Timed Up and Go test time (s)	0.220	0.051	0.001
Frailty index	0.680	0.190	0.003

slower TUG times with perceived declines in physical and mental health. In integrated behavioural health settings, where functional improvement is a key goal, the TUG could serve as a key measure for tracking progress in behavioural activation and holistic patient care.

This study also underscores the strong connections between mobility, frailty, cognitive function and comorbidity burden in elderly individuals. Slower TUG test times were significantly linked to higher CCI scores (β=0.342, p=0.001), indicating that reduced mobility correlates with greater comorbidities. Frailty emerged as the most influential factor, particularly in participants with slower TUG performance (β=1.150, p=0.005). Furthermore, better cognitive function, as reflected by higher MMSE scores, was associated with lower comorbidity burden (β=−0.092, p=0.017). These findings highlight the importance of addressing mobility, frailty and cognition in managing comorbidities in the elderly population.

The present study's results are in line with earlier investigations that have consistently linked compromised TUG performance to unfavourable health consequences, such as heightened mortality risk. According to the previous study, patients with less than 20 s of TUG had a higher death HR.[20] Using various cutoffs, Schmidt *et al* and Robinson *et al* also found higher death rates in patients with poor TUG performance. Schmidt *et al* brought attention to a noteworthy rise in 1-year mortality in elderly oncological patients who were dependent on ADLs and had impaired TUG (≥10 s).[21] According to Robinson *et al*, patients undergoing colorectal and cardiac surgery who had impaired TUG (>15 s) had higher 1-year death rates, which mirrored these findings. Our research confirms the predictive value of TUG performance in assessing overall health status and mortality risk in older patients by finding a correlation between higher CCI scores and longer TUG times. This relationship offers important new information for patient management and clinical practice.

Table 6 Multivariate linear regression analysis of factors of comorbidity index in participants with slower Timed Up and Go performance

Variables	Coefficient (β)	SE	P value
Age (years)	0.082	0.028	0.002
Mini-Mental State Examination score	−0.103	0.041	0.009
Duration of hospitalisation (days)	0.070	0.074	0.075
Timed Up and Go test time (s)	0.430	0.067	0.004
Frailty index	1.150	0.250	0.005

Previous studies show that the existence of comorbid conditions, as measured by the CCI, is significantly correlated with TUG test performance. One study discovered that shorter TUG times were linked to higher CCI scores, indicating that people with more comorbidities typically had mobility impairments. In particular, a somewhat positive link between TUG times and the CCI was found, with a correlation coefficient of r=0.425, meaning that longer TUG test completion times are associated with more comorbidities.[22]

Studies have also demonstrated that frail elderly patients often characterised by higher CCI scores exhibit significantly poorer performance on the TUG test compared with non-frail individuals. For instance, frail individuals had average TUG times of approximately 14 s, indicating severe mobility limitations.[23] This disparity underscores how frailty exacerbates the effects of comorbidities on mobility

The implications of this correlation are profound. As comorbidities increase, they can lead to functional decline, which is often reflected in TUG test results. Individuals with a higher CCI may experience limitations in physical activities due to chronic diseases, thereby exhibiting poorer performance on the TUG test.[24]

Another study observed a correlation between poor physical performance and cognitive decline, indicating a potential relationship between these factors. Furthermore, the presence of high CCI scores among elderly individuals with impaired physical performance suggests that increased comorbidities may contribute to performance changes, potentially resulting from both primary and secondary sarcopenia.[25]

The TUG minimises some of the arguments for not evaluating patients' levels of physical activity by offering a reliable metric that can be applied in basic care. With reference values across the adult age spectrum, the TUG is affordable; needs minimal time, space or staff training to operate and keeps growing. The objective data from the TUG can be used by primary care physicians and their patients to identify potential causes of decreased physical ability. When patients begin physical therapy, exercise or other rehabilitation programmes, the TUG can be used as a benchmark to track their progress. Moreover, an objective assessment of physical mobility enables doctors to track their patients' advancement towards treatment objectives and notify them of potential problems with motivation or adherence in the event that outcomes fall short of expectations.

Limitations

The study's sample of 160 patients, selected from seven public sector hospitals in Lahore, may not fully represent the broader population of Pakistan, as regional healthcare variations were not addressed. However, the participating

hospitals primarily serve patients from similar socioeconomic backgrounds, minimising socioeconomic status variability within the cohort. As a result, socioeconomic status was unlikely to be a significant confounding factor in this specific population. Despite this, the focus on hospitalised elderly patients limits the applicability of findings to community-dwelling individuals or those from diverse socioeconomic and cultural backgrounds.

Medication use, a factor that could significantly influence both comorbidities and mobility, was not systematically documented. This limitation stemmed from inconsistencies in medication records across the hospitals and the challenges of relying on incomplete or self-reported data from patients. Additionally, while the TUG test is a widely recognised measure of mobility, it does not encompass all dimensions of functional performance relevant to daily life. Future studies involving more geographically and demographically diverse populations are recommended to enhance external validity.

Conclusion

This study underscores that slower TUG times and increased frailty are strong indicators of higher comorbidity, while better cognitive function is associated with reduced comorbidity burdens. These findings emphasise the value of the TUG test and frailty assessments as effective tools for identifying older adults at risk of health complications.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and was approved by The University of Lahore, Lahore Pakistan Human Research Ethics Committee (project number REC-UOL-121-12-2023). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

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