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RESEARCH ARTICLE

Association between Balance-Related Functional Mobility and Quality of Life among Community-Dwelling Stroke Patients in Indonesia

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ABSTRACT

Introduction: Stroke is one of the leading causes of long-term impairment globally, with serious consequences for an individual's physical, psychological, and social functioning. One of the most prevalent post-stroke impairments is balance impairment, which adversely affects mobility, independence, and overall quality of life (QoL). This study aimed to examine the association between TUG-assessed balance-related functional mobility and SF-36-assessed quality of life among community-dwelling Indonesian stroke patients. This study provides evidence from community-dwelling Indonesian stroke patients, a population that remains under-represented in rehabilitation research.

Methods: A cross-sectional study was conducted using purposive sampling. Data were collected from *Posyandu Lansia* at *Puskesmas* Dinoyo and *Puskesmas* Kendalsari between January and March 2025. A total of 99 participants who met the inclusion criteria were recruited. Eligible participants were aged ≥ 50 years, had been diagnosed with stroke within the previous 6 months, had no cognitive impairment (MMSE > 23), and were able to mobilise independently or with assistive devices. Balance-related functional mobility was assessed using the Timed Up and Go (TUG) test, while QoL was measured using the Indonesian Short Form-36 (SF-36) questionnaire. The exploratory SF-36 composite score was calculated as the arithmetic mean of the eight domain scores. Data normality was assessed using the Kolmogorov–Smirnov test. Because the data were not normally distributed, Spearman's rho correlation was used. Multivariable linear regression was used to assess associations between the predictors and QoL.

Results: The mean TUG time was 32.45 ± 3.24 seconds, and the exploratory SF-36 composite score was 62.61 ± 2.87. The mean Physical Component Summary (PCS) and Mental Component Summary (MCS) scores were 59.7 ± 22.3 and 62.3 ± 20.7, respectively. Across the eight SF-36 domains, mean scores ranged from 50.7 ± 21.1 for general health to 74.0 ± 25.9 for social functioning. These values are reported descriptively because the composite score is exploratory and no validated cut-off or reference population was available for qualitative classification in this sample. A statistically significant negative correlation was observed between balance-related functional mobility and QoL ($r = -0.413$, $p < 0.001$). In the multivariable model, longer TUG time was associated with lower QoL ($B = -0.42$, $\beta = -0.24$, 95% CI −0.75 to −0.09, $p = 0.015$), although the overall model was not statistically significant ($R^2 = 0.15$; adjusted $R^2 = 0.043$; $F(11, 87) = 1.40$; $p = 0.19$).

Conclusion: Poorer balance-related functional mobility, reflected by longer TUG time, was associated with lower SF-36 QoL scores; balance assessment may therefore be clinically relevant in community-based post-stroke rehabilitation planning.

Keywords: Balance; Quality of Life; Stroke

INTRODUCTION

Stroke is one of the leading causes of long-term disability globally, with serious consequences for an individual's physical, psychological, and social functioning (1). Stroke commonly produces persistent functional impairments that extend beyond the acute phase (2). One of the most prevalent post-stroke impairments is balance impairment, which adversely affects mobility, independence, and overall quality of life (QoL) (1).

Balance is an important component of motor control and is required for activities of daily living such as standing, walking, turning, and transitioning between positions (3). Damage to the central nervous system in stroke patients frequently results in poor postural control, an increased risk of falls, and limitations in functional mobility (4). Balance impairment is central to post-stroke disability because it affects transfers, gait, turning, fall risk, and confidence in movement (5). These impairments not only impede physical recovery but also reduce self-efficacy, social participation, and emotional well-being (6). Postural control deficits after stroke are often associated with reduced lower-limb strength, gait performance, coordination, and functional mobility. Therefore, post-stroke mobility impairment is often multifactorial rather than attributable solely to balance deficits (7).

The Timed Up and Go (TUG) test is a commonly used clinical measure of balance-related functional mobility. The test requires individuals to rise from a chair, walk, turn, return, and sit down, thereby incorporating several components of physical function, including dynamic balance, lower-extremity strength, gait capacity, transfer ability, postural control, and movement confidence (8). Performance is also affected by the use of assistive devices and the individual's capacity to perform functional tasks encountered in daily life. Thus, TUG performance should be viewed as a measure of balance-related functional mobility rather than a stand-alone measure of balance.

Quality of life (QoL) is a multifaceted construct that includes a person's perception of physical health, psychological state, level of independence, social relationships, and interactions with the surrounding environment (9). QoL in stroke patients is influenced by several factors, including the severity of motor deficits, functional independence, emotional state, and ability to reintegrate into society. Previous studies have shown that physical impairments, particularly those affecting movement and balance, are associated with reduced QoL in this population (10). From a biopsychosocial perspective, balance-related functional mobility deficits may affect quality of life through several pathways. Reduced mobility can limit participation in daily and community activities, increase dependence on carers, limit social engagement, reduce confidence in movement, and contribute to fear of falling. These effects can impair multiple domains of health-related quality of life, including physical functioning, role participation, emotional well-being, social functioning, vitality, and perceived overall health (11).

The Timed Up and Go (TUG) test is a prominent clinical measure of functional mobility and balance (1), and the Short Form-36 (SF-36) questionnaire is a validated instrument for assessing health-related quality of life. These measures were selected because impaired balance-related mobility may restrict safe mobility, reduce confidence during transfers and ambulation, increase fear of falling, limit participation in domestic and community activities, and contribute to psychological distress or reduced perceived autonomy. These mechanisms correspond to SF-36 domains such as physical functioning, role limitations, vitality, social functioning, emotional role limitations, and mental health.

Although the relevance of balance to functional recovery has been recognised, evidence regarding its association with QoL among community-dwelling stroke patients in Indonesia remains limited (12,13). This study may make a meaningful contribution because it focuses on community-dwelling stroke patients in Indonesia. This context is important because stroke recovery often continues beyond hospital discharge and depends on community resources, family support, access to rehabilitation, and the ability to function in everyday environments. Evidence from community settings can therefore complement hospital-based rehabilitation studies and inform local service planning (14).

Although the importance of balance to post-stroke recovery is well recognised, much of the available research comes from hospital-based rehabilitation programmes or high-income countries where structured post-discharge rehabilitation services are more accessible (15). It therefore remains unclear whether the association between balance-related functional mobility and quality of life (QoL) observed in these contexts also applies to community-dwelling stroke survivors in low- and middle-income countries such as Indonesia. Indonesia provides an important community setting for post-stroke rehabilitation through primary healthcare facilities such as Puskesmas and Posyandu Lansia, where many community-dwelling stroke survivors receive follow-up monitoring and health promotion after hospital discharge (16). Family members also often provide important support with day-to-day care (17). These contextual variables may influence stroke recovery and quality of life but were not directly evaluated in the present study. They should therefore be treated as potential contextual factors rather than established drivers of the observed associations. Accordingly, this study provides evidence from a community-engaged sample of Indonesian stroke survivors rather than establishing the effects of specific components of community rehabilitation. Any possible contribution of family caregiving, primary healthcare services, or access to rehabilitation is proposed as a hypothesis for future studies that directly measure these factors.

The association between balance-related functional mobility and quality of life among community-dwelling stroke survivors in Indonesia is examined in a healthcare context that has received limited attention in the rehabilitation literature. The present study assesses whether an association between functional mobility and quality of life is evident in a community-engaged Indonesian population. It does not assess the effectiveness of community-based rehabilitation programmes. The findings may inform future research and the development of community-based screening and rehabilitation approaches. Further studies should include measures of rehabilitation access, carer support, and healthcare utilisation to evaluate mechanisms underlying these associations.

Therefore, investigating the association between balance-related functional mobility and QoL in Indonesian community settings is not simply a replication of previous findings; it provides an opportunity to assess whether this association remains clinically relevant in a rehabilitation environment characterised by community-based care and variable access to post-discharge services. Such evidence may help inform screening strategies, rehabilitation prioritisation, and community-based stroke management in resource-constrained settings. Accordingly, this study aimed to examine the association between TUG-measured balance-related functional mobility and SF-36-measured quality of life among community-dwelling stroke survivors in Indonesia. In health-promotion practice, identifying mobility limitations through a brief functional assessment may help community health services prioritise fall-prevention education, self-management support, and referral for further rehabilitation assessment without implying that mobility itself causes quality-of-life outcomes.

From a rehabilitation perspective, balance-related functional mobility is hypothesised to influence quality of life through several interrelated pathways. Stroke survivors with mobility impairments often experience difficulty with fundamental activities of daily living, including standing, walking, turning, transferring, and negotiating community environments. These limitations may impede independent functioning, increase dependence on family carers, and restrict participation in household, recreational, and social activities (18). In addition, mobility impairment can increase fear of falling, reduce confidence in movement, and contribute to a perceived loss of autonomy (19).

These effects are not limited to physical disability; they may also affect psychological well-being, social participation, and perceived overall health. From a biopsychosocial perspective, mobility restrictions could therefore influence multiple domains of health-related quality of life simultaneously. These mechanisms correspond closely to domains evaluated by the SF-36 questionnaire. Reduced mobility may adversely affect physical functioning and role limitations due to physical health problems, while fear of falling and reduced participation may influence vitality, social functioning, emotional well-being, and perceptions of general health (20).

Therefore, balance-related functional mobility is not only a physical-performance construct but also a rehabilitation outcome with wide-ranging implications for quality of life. This conceptual model provides the rationale for investigating the association between balance-related functional mobility, as assessed by the TUG, and quality of life, as assessed by the SF-36, in community-dwelling stroke survivors.

METHODS

Study Design and Participants

This study used a cross-sectional design with purposive sampling. Because there were few eligible stroke patients in the community, purposive sampling was used. Participants were recruited from *Posyandu Lansia* at *Puskesmas* Dinoyo and *Puskesmas* Kendalsari between January and March 2025. Participants were identified through medical records, community health worker lists, and Posyandu attendance records. Recruitment through Posyandu Lansia and the related Puskesmas was appropriate because these community health services regularly follow older people and have access to community-dwelling stroke survivors. However, this recruitment method may have introduced selection bias. People who use community-based health services may differ from stroke survivors who are homebound, socially isolated, more severely disabled, institutionalised, or unable to access healthcare services. Conversely, people attending these programmes may also have substantial healthcare needs and ongoing rehabilitation difficulties. The study sample should therefore be considered a community-engaged group of stroke survivors rather than representative of all stroke survivors in Indonesia.

Eligibility criteria reported for recruitment were age ≥ 50 years, a stroke diagnosis within the previous 6 months, MMSE > 23, and the ability to mobilise independently or with an assistive device. The reported exclusion criteria were MMSE ≤ 23, severe musculoskeletal or neurological problems that could compromise balance assessment, acute cardiovascular instability, and inability to complete the assessment safely.

Sample-size estimation for the primary correlation analysis was performed a priori using G*Power. The minimum required sample was 84 participants, assuming a moderate correlation coefficient (r = 0.30), a two-sided significance level (α) of 0.05, and 80% statistical power. We screened potentially eligible community-dwelling stroke survivors (n = 105) for recruitment. Six people were excluded because they did not meet the predefined eligibility criteria (MMSE ≤ 23, n = 2; severe musculoskeletal or neurological problems that might compromise balance assessment, n = 2; acute cardiovascular instability, n = 1; unable to complete the assessment safely, n = 1). All eligible participants consented to participate. All 99 enrolled participants completed the study assessments; therefore, data were available for the Timed Up and Go test, the SF-36 questionnaire, and all covariates included in the analysis. A complete-case analysis was conducted, and no imputation for missing data was required. Multivariable linear regression was performed as an exploratory analysis to assess whether the observed association between balance-related functional mobility and quality of life persisted after adjustment for selected demographic and clinical variables. The regression results should be interpreted as exploratory and hypothesis-generating because the sample-size calculation was based on the primary correlation analysis rather than the multivariable regression model.

Measurements

Variables included balance-related functional mobility, quality of life (QoL), clinical variables (stroke type, time since stroke, affected side, walking-aid use, and fall history), and sociodemographic characteristics. Participants completed the TUG test, SF-36 questionnaire, and clinical and sociodemographic questionnaires.

Timed-Up and Go (TUG) test

Balance-related functional mobility was evaluated using the Timed Up and Go (TUG) test. The TUG is often used to assess balance but is more accurately described as a measure of functional mobility with substantial balance demands. During the test, participants were asked to stand up from a chair, walk 3 m, turn around, return, and sit down. Successful performance requires integration of dynamic balance, lower-extremity strength, gait performance, transfer ability, and postural control. Longer completion times indicate poorer balance-related functional mobility. Participants were allowed to use their usual assistive devices during the TUG test. This is particularly important in stroke populations because assistive-device use may affect both safety and completion time and may better represent real-world mobility. The reliability of this measure in stroke populations was reported as 0.83 (21). To improve measurement consistency, the TUG test was conducted using a standardised procedure. Participants completed one practice trial before the formal assessment to familiarise themselves with the test sequence. Two measured trials were then completed, and the best performance time was used for analysis. All assessments were administered by trained physiotherapists who had received prior instruction in standardised TUG administration. Testing was conducted in a quiet, well-lit environment using a standard armless chair with a seat height of approximately 45 cm. A clearly marked 3 m walking pathway was used for all participants. Participants were instructed to wear their usual comfortable footwear and were allowed to use their customary assistive devices to ensure safety and reflect daily functional mobility. The same assistive device was used throughout the testing session for each participant. Safety monitoring was implemented during assessment. Assessors remained close to participants to prevent falls or instability, and testing was discontinued if a participant experienced dizziness, excessive fatigue, or other adverse symptoms.

Short Form-36 (SF-36) Questionnaire

Health-related quality of life (HRQoL) was assessed using the Indonesian version of the Short Form-36 (SF-36), which includes eight domains: physical functioning, role limitations due to physical problems, bodily pain, general health, vitality, social functioning, role limitations due to emotional problems, and mental health (22). Domain scores were derived according to the published SF-36 scoring manual and transformed to a 0–100 scale, with higher scores indicating better perceived health-related quality of life. The eight domain scores were reported, and Physical Component Summary (PCS) and Mental Component Summary (MCS) scores were generated using the usual SF-36 scoring procedures. The exploratory SF-36 composite score was calculated as the arithmetic mean of the eight domain scores (Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, and Mental Health). This composite score is presented as an exploratory summary because no validated Indonesian total SF-36 index currently exists. Questionnaires were checked immediately after completion. There were no missing SF-36 items; therefore, no imputation was required, and all scores were derived from complete questionnaires.

Clinical Variables

Clinical variables included stroke type (ischaemic/haemorrhagic), time since stroke, affected side (left/right), walking-aid use (yes/no), and fall history (yes/no).

Sociodemographic Characteristics

Sociodemographic information was collected using a self-reported questionnaire. Variables included age (50–64, 65–74, or 75–90 years), sex (male/female), and body mass index (BMI) category (underweight, normal, overweight, or obese).

Statistical Analysis

The primary analysis examined the association between balance-related functional mobility and the exploratory SF-36 composite score. This composite was calculated as the arithmetic mean of the eight SF-36 domain scores (Physical Functioning, Role Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role Emotional, and Mental Health). Because this composite is not a standard validated global SF-36 outcome, it was treated as an exploratory summary measure. All statistical analyses using QoL as an outcome, including Spearman's rho correlation and multivariable linear regression, used the same arithmetic-mean SF-36 composite variable. Thus, the outcome variable used in the correlation analysis, regression analysis, and scatterplot was identical. The analysis included all 99 participants, with no missing data.

Descriptive statistics were used to summarise sociodemographic variables, clinical variables, TUG performance, the eight SF-36 domains, PCS, MCS, and the exploratory SF-36 composite. The Kolmogorov–Smirnov test was used to assess normality. Because TUG time and the exploratory SF-36 composite were not normally distributed, Spearman's rho correlation was used to examine their association.

A multivariable linear regression model was subsequently fitted using the exploratory SF-36 composite score as the dependent variable and TUG time together with selected sociodemographic and clinical variables as predictors. The Enter method was used. Age was entered as a continuous variable, whereas sex, BMI category, stroke type, affected side, walking-aid use, and fall history were entered as categorical variables using dummy coding. Model performance was assessed using R^2, adjusted R^2, the F statistic with its degrees of freedom and p value, regression coefficients, 95% confidence intervals, and diagnostic statistics. All analyses were performed using IBM SPSS Statistics version 20. Multicollinearity was evaluated using variance inflation factors and tolerance values, and influential observations were assessed using Cook's distance.

Ethical Considerations

All participants provided informed consent before data collection. Participant confidentiality was protected, and participation was voluntary. Participants could withdraw without adverse consequences. Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Health Science, University of Muhammadiyah Malang (No. E.4.d/117/KEPK/FIKES-UMM/XI/2024).

RESULTS

Table 1 presents the sociodemographic and clinical characteristics of the 99 participants. Most participants (61.6%) were female, and the largest age group was 75–90 years (55.56%). By BMI category, most participants (53.54%) had normal weight. Haemorrhagic stroke was reported in 54.54% of participants, the right side was affected in 51.51%, 89.89% used a walking aid, and 68.68% reported a history of falls. The mean time since stroke was 4.32 ± 1.22 months, indicating that most participants were in the subacute phase of recovery. The mean TUG time was 32.45 ± 3.24 seconds.

The mean exploratory SF-36 composite score was 62.61 ± 2.87 (mean ± SD). The Physical Component Summary (PCS) and Mental Component Summary (MCS) scores were 59.7 ± 22.3 and 62.3 ± 20.7, respectively. Across the eight domains, mean scores ranged from 50.7 ± 21.1 for general health to 74.0 ± 25.9 for social functioning. The highest domain scores were observed for social functioning (74.0 ± 25.9), bodily pain (72.6 ± 27.6), and mental health (71.4 ± 19.6), whereas the lowest were observed for general health (50.7 ± 21.1) and role limitations due to physical problems (51.9 ± 40.6). These values are presented descriptively because no validated cut-off or reference population was available for the present sample.

Table 1. Participant sociodemographic and clinical characteristics (n = 99)

Variable	Frequency (n)	Percentage (%)	Mean (SD)
Sex			
Male	38	38.4%	
Female	61	61.6%	
Age			
50–64	24	24.24%	
65–74	20	20.20%	
75–90	55	55.56%	
Body mass index (BMI)			
Underweight	11	11.11%	
Normal	53	53.54%	
Overweight	25	25.25%	
Obese	10	10.10%	
Stroke type			
Ischaemic stroke	45	45.45%	
Haemorrhagic stroke	54	54.54%	
Time since stroke (months)			4.32 (1.22)
Affected side			
Left	48	48.48%	
Right	51	51.51%	
Walking-aid use			
Yes	89	89.89%	
No	10	10.10%	
Fall history			
Yes	68	68.68%	
No	31	31.31%	
Balance-related functional mobility (TUG test), s			32.45 (3.24)
Quality of life (QoL) (exploratory SF-36 composite score)			62.61 (2.87)
Physical functioning			64.7 (28.0)
Role limitations due to physical problems			51.9 (40.6)
Bodily pain			72.6 (27.6)
General health			50.7 (21.1)
Vitality			58.5 (21.6)
Social functioning			74.0 (25.9)
Role limitations due to emotional problems			57.1 (40.0)
Mental health			71.4 (19.6)
Physical Component Summary (PCS)			59.7 (22.3)
Mental Component Summary (MCS)			62.3 (20.7)

The Kolmogorov–Smirnov test indicated that TUG time and the exploratory SF-36 composite score were not normally distributed ($p = 0.03$ and $p = 0.04$, respectively; Table 2).

Table 2. Normality test for TUG time and the exploratory SF-36 composite score (n = 99)

Variables	p value
Balance-related functional mobility (TUG time)	0.03
Quality of life (exploratory SF-36 composite score)	0.04

$p < 0.05$ indicates a non-normal distribution.

Because these variables were not normally distributed, Spearman's rho correlation was used to examine their association. As shown in Table 3, balance-related functional mobility was negatively correlated with QoL ($r = -0.413$, $p < 0.001$). The negative correlation indicates that participants with longer TUG times, reflecting poorer balance-related functional mobility, tended to have lower QoL scores.

Table 3. Spearman's rho correlation between TUG time and the exploratory SF-36 composite score

Variables	r	p value	95% CI	n
TUG time and exploratory SF-36 composite score	-0.413	< 0.001*	-0.56 to -0.24	99

*$p < 0.05$

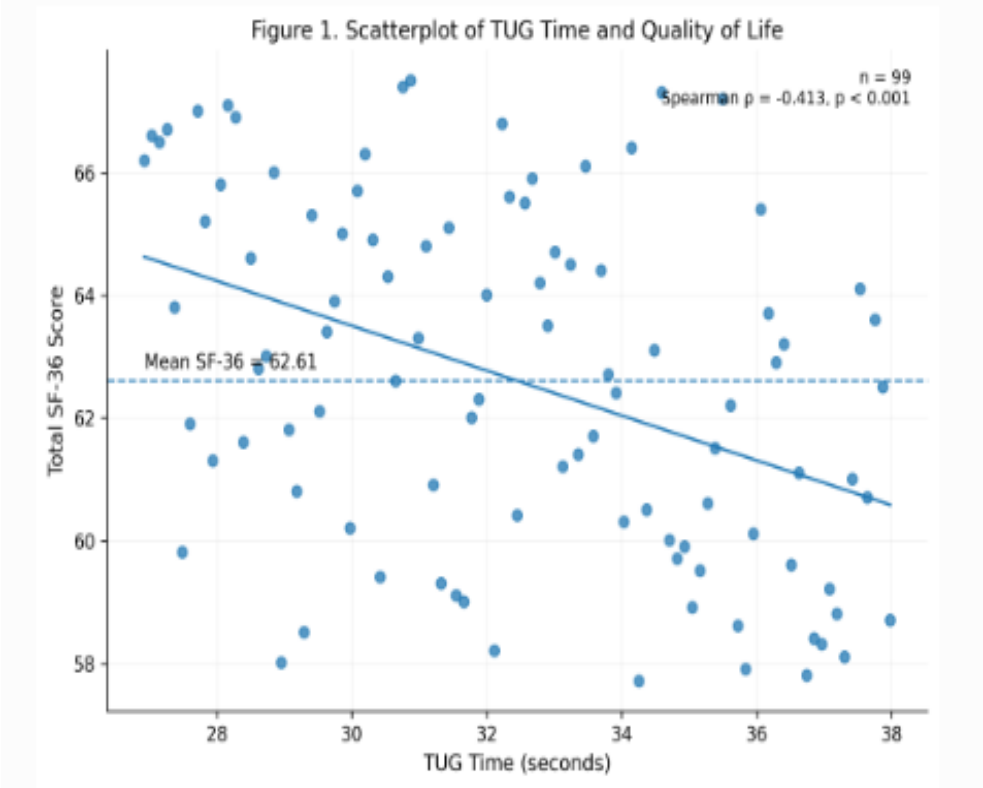


Figure 1. Scatterplot of timed up and go (tug) time (seconds) against the exploratory sf-36 composite score (arithmetic mean of the eight domain scores) for 99 participants. each point represents one participant; the solid line shows the fitted linear trend, and the dashed horizontal line indicates the sample mean sf-36 composite score. the annotation reports spearman's rho and its p value. higher tug times indicate poorer balance-related functional mobility.

Table 4. Multivariable linear regression of the exploratory SF-36 composite score

	Unstandardized Coefficients		Standardized Coefficients	t	95% CI for B	p value
	[redacted]	SE	[redacted]			
Constant (Intercept)	1.69	1.18	-	1.43	-0.66 to 4.04	0.16
Sex	1.84	2.15	0.07	0.86	-2.39 to 6.07	0.39
Age	-0.08	0.11	-0.06	-0.73	-0.30 to 0.14	0.46
Body mass index (BMI) (ref: underweight)						
a. Normal	1.27	2.68	0.05	0.47	-4.00 to 6.54	0.63
b. Overweight	2.15	2.81	0.07	0.77	-3.38 to 7.68	0.44
c. Obese	1.88	3.22	0.05	0.58	-4.46 to 8.22	0.56

	Unstandardized Coefficients		Standardized Coefficients	t	95% CI for B	p value
	B	SE	β			
Stroke type (ref: ischaemic)	-2.41	2.73	-0.08	-0.88	-7.78 to 2.96	0.38
Time since stroke	0.09	0.07	0.10	1.29	-0.05 to 0.23	0.19
Affected side (ref: left)	1.53	2.04	0.06	0.75	-2.48 to 5.54	0.45
Walking-aid use (ref: yes)	-3.26	2.51	-0.11	-1.30	-8.20 to 1.68	0.19
Fall history (ref: yes)	-2.17	1.96	-0.09	-1.11	-6.03 to 1.69	0.27
Balance-related functional mobility (TUG test)	-0.42	0.17	-0.24	**-2.47**	**-0.75 to -0.09**	**0.015***

*p < 0.05; model summary: $R^2 = 0.15$; adjusted $R^2 = 0.043$; $F(11, 87) = 1.40$; $p = 0.19$
Reference categories: sex = female; BMI = underweight; stroke type = ischaemic stroke; affected side = left; walking-aid use = yes; fall history = yes.

Table 4 presents the results of the multivariable linear regression analysis examining factors associated with the exploratory SF-36 composite score among stroke patients. The Enter method was used, and all 99 participants with complete data were included. Age was treated as a continuous variable (years), while the other demographic and clinical characteristics were included as categorical predictors with the reference categories shown in Table 4. After adjustment for sociodemographic and clinical variables, longer TUG time remained significantly associated with lower QoL (B = −0.42, β = −0.24, 95% CI −0.75 to −0.09, p = 0.015). Fall history was not significantly associated with the exploratory SF-36 composite score (β = −0.09, p = 0.27). Sex, age, BMI, stroke type, time since stroke, affected side, and walking-aid use were also not statistically significant. The overall model accounted for 15% of the variation in the exploratory SF-36 composite score ($R^2 = 0.15$; adjusted $R^2 = 0.043$) and was not statistically significant overall ($F[11, 87] = 1.40$, $p = 0.19$). The maximum variance inflation factor (VIF) was 2.31, and tolerance values exceeded 0.2, indicating no evident multicollinearity. The maximum Cook's distance was 0.18, indicating that no single observation was highly influential by this diagnostic.

DISCUSSION

Multivariable regression analysis showed that balance-related functional mobility, as measured by the Timed Up and Go (TUG) test, was associated with QoL after adjustment for selected demographic and clinical factors. However, the model had limited explanatory power ($R^2 = 0.15$; adjusted $R^2 = 0.043$), indicating that much of the variation in QoL remained unexplained. Residual confounding is therefore possible. Although the observed association supports the relevance of balance-related functional mobility in community-dwelling stroke survivors, it does not indicate that mobility is the principal determinant of quality of life after stroke. Quality of life is a multifaceted construct influenced by physical, psychological, social, and environmental factors. Important determinants not assessed in the present study include stroke severity, functional independence, cognitive impairment, depression, pain, fatigue, comorbidities, socioeconomic status, access to rehabilitation services, carer support, family structure, educational level, social participation, and environmental accessibility (17). Balance-related functional mobility should therefore be regarded as one potentially important correlate of quality of life rather than the predominant explanatory factor. The low adjusted R^2 underscores the complexity of post-stroke quality of life and indicates that important sources of variation remain unaccounted for in the present model. Future research should include a broader range of biopsychosocial factors and more comprehensive analytical models to better clarify determinants of quality of life among community-dwelling stroke survivors.

The present study also showed that balance-related functional mobility was significantly negatively associated with quality of life among community-dwelling stroke survivors. Participants with longer TUG completion times reported lower SF-36 scores, indicating that poorer functional mobility was associated with poorer perceived quality of life. This finding is consistent with previous research showing that mobility limitations are associated with reduced participation, independence, and well-being after stroke (24). However, the observed association was modest, indicating that mobility represents only one component of overall quality of life. Several factors may explain this finding. Quality of life is a complex construct encompassing physical, psychological, social, and environmental dimensions (25). Balance-related functional mobility impairment can impede safe ambulation, increase dependence on carers, and limit participation in daily activities. However, individuals may adapt to these limitations over time. Some stroke survivors may develop compensatory strategies, adjust personal expectations, or reinterpret what constitutes an acceptable quality of life (26). Consequently, mobility limitations may not correspond directly to poorer overall quality of life.

Another finding was the apparent discrepancy between substantial mobility limitations and variation across the SF-36 domains. Participants had long TUG completion times, frequent walking-aid use, and a high prevalence of falls, indicating considerable functional difficulty. However, quality-of-life scores were not uniformly low across all domains. Several factors may plausibly contribute to this pattern.

One possible explanation is that family caregiving, community participation, and engagement with primary healthcare services such as *Puskesmas* and *Posyandu Lansia* may attenuate the effect of mobility limitations on perceived well-being. However, these factors were not measured in the present study and should therefore be regarded as contextual hypotheses rather than explanations supported by the present findings.

In the Indonesian context, family caregiving may play an important role in supporting stroke survivors and could potentially reduce the perceived impact of physical limitations on well-being (27). Community engagement through local health services such as *Puskesmas* and *Posyandu Lansia* may also support social participation and continuity of care. Cultural expectations regarding ageing, disability, and family responsibility may further influence how individuals appraise their quality of life. In addition, response shift, whereby individuals alter their internal standards and expectations after major health events, may contribute to the observed SF-36 scores despite persistent disability. Because these factors were not directly assessed in the present study, they should be considered possible interpretations rather than established explanations (16). The community-based Indonesian setting also provides important context for interpreting the findings. Unlike studies conducted in specialised rehabilitation clinics, participants in the present study were recruited through community health services, where access to rehabilitation may vary substantially. Assessment of balance-related functional mobility may therefore be useful for identifying community-dwelling stroke survivors with lower quality-of-life scores (28). However, because of the cross-sectional design, the findings should not be interpreted as evidence that poor mobility causes lower quality of life or that mobility interventions will necessarily improve quality of life (16). Longitudinal and intervention studies are required to determine whether improvements in balance-related functional mobility are accompanied by meaningful changes in quality-of-life outcomes. The TUG test assesses the performance of basic mobility tasks such as standing, walking, turning, and transferring. Impairment in these activities may limit independent living, restrict community participation, increase dependence on carers, and reduce involvement in important social roles (8).

The present study indicates that balance-related functional mobility is associated with quality of life among community-dwelling stroke survivors. The negative correlation between TUG performance and SF-36 scores indicates that participants who took longer to complete functional mobility tasks tended to report poorer quality of life. Importantly, the TUG test captures multiple interrelated aspects of physical function, and the findings should therefore be interpreted as reflecting broader functional mobility limitations rather than balance impairment alone. These aspects include dynamic balance, gait performance, transfer ability, lower-limb function, and mobility confidence. This interpretation is consistent with a biopsychosocial perspective of stroke recovery. Reduced balance-related functional mobility may lead to decreased independence in activities of daily living, greater care needs, restricted participation in social and community roles, fear of falling, and reduced self-efficacy (29). These physical, psychological, and social effects may negatively affect several dimensions of quality of life.

This interpretation is consistent with previous research on post-stroke balance recovery and health-related quality of life (23). Askim et al. (5) reported that better balance, measured using the Berg Balance Scale, was associated with more time spent upright during the first six months after stroke; higher Barthel Index scores were also associated with greater upright activity. These findings support a relationship between balance, functional status, and activity, but the study did not directly assess falls or SF-36 quality of life. Askim et al. should therefore be interpreted as contextual evidence for the functional-mobility interpretation rather than direct evidence of a balance–quality-of-life association. The present study adds contextual evidence from a community-engaged sample of stroke patients in Indonesia who receive follow-up care through community health services. Although the association between balance-related functional mobility and health-related quality of life is consistent with findings from other countries, the present study was not designed to evaluate the effects of community rehabilitation services, family caregiving, or healthcare access. These contextual characteristics should therefore be regarded as features of the study setting rather than explanations for the observed association (27). Basic clinical tests such as the Timed Up and Go (TUG) test may therefore be useful as low-cost screening tools for identifying patients with lower quality-of-life scores in community settings. Moreover, the availability of rehabilitation services may vary substantially across Indonesian communities, potentially affecting the long-term consequences of mobility and balance impairments for daily functioning and social participation. The present findings support assessment of balance-related functional mobility during community-based follow-up after stroke and may inform rehabilitation planning in resource-constrained healthcare settings.

Our findings extend previous evidence by demonstrating an association between balance-related functional mobility and quality of life in a community-engaged Indonesian sample. Because rehabilitation services, carer support, and community healthcare utilisation were not directly measured, the present study cannot determine whether these contextual factors explain or modify the observed association. Future research should test these pathways directly using longitudinal or mixed-methods designs.

The mean TUG duration in this study was 32.45 seconds, indicating substantial mobility limitation (21,30). Mobility limitation has been associated with reduced community participation, greater dependence, and psychological distress, all of which may reduce life satisfaction and overall well-being (31–33). More than half of the participants were aged 75–90 years. This predominantly older age distribution should be considered when interpreting the observed TUG and SF-36 scores.

This finding is clinically relevant because TUG performance reflects essential mobility tasks such as standing, walking, turning, and sitting. These tasks are fundamental to independence in daily life and may influence physical functioning, confidence, participation, and perceived health. The clinical profile of the sample indicates considerable mobility limitations. The mean TUG time was long, and the high prevalence of walking-aid use and fall history further indicates substantial functional difficulty. Many participants therefore continued to experience important mobility limitations while living in the community. The

association between balance-related functional mobility and quality of life should be interpreted in the context of a population with substantial rehabilitation needs.

The mean exploratory SF-36 composite score was 62.61 (SD = 2.87). The highest mean domain scores were observed for social functioning (74.0) and mental health (71.4), whereas the lowest was observed for role limitations due to physical problems (51.9). Because no uniform cut-off has been established for interpreting SF-36 scores in stroke populations and the present study did not include a comparison group, these findings are reported descriptively rather than classified into qualitative categories. Domain-specific scores varied across components of health-related quality of life, with lower scores in domains related to physical role limitations.

Although stroke patients may gradually adapt to their condition, persistent limitations in movement and balance can impede full reintegration into daily routines and social activities, both of which are important components of QoL (32,34,35). The high proportion of participants using walking aids and reporting a history of falls further supports the presence of substantial mobility limitations in this population. Fear of falling is commonly associated with reduced physical activity and social withdrawal among stroke survivors. This may subsequently reduce participation in community activities and adversely affect psychosocial well-being.

In the present study, balance-related functional mobility was significantly associated with quality of life, indicating that TUG performance may be useful for identifying community-dwelling stroke survivors with lower SF-36 scores. This finding is consistent with previous observational research showing that clinical and functional factors are associated with quality of life after stroke (36). However, the present study was not designed to evaluate the effectiveness of balance-focused rehabilitation interventions. The observed association should therefore not be interpreted as evidence that balance-focused interventions improve mobility or quality of life. Longitudinal and intervention studies are needed to determine whether changes in balance-related functional mobility are accompanied by clinically meaningful changes in health-related quality of life.

An important descriptive finding was the variation in SF-36 scores across domains despite substantial mobility limitations in the study sample. The mean scores were highest for social functioning (74.0 ± 25.9) and mental health (71.4 ± 19.6), whereas lower mean scores were observed for general health (50.7 ± 21.1) and role limitations due to physical problems (51.9 ± 40.6). The mean PCS and MCS scores were 59.7 ± 22.3 and 62.3 ± 20.7, respectively. Because the study did not include a reference population and no validated cut-off values were used to classify SF-36 scores in this population, these differences should be interpreted as descriptive variation across health-related quality-of-life domains rather than evidence of preserved or impaired quality of life.

The variation between physical and psychosocial SF-36 domains may indicate that functional mobility represents only one component of post-stroke quality of life. However, the present study did not directly assess psychosocial, environmental, or healthcare-related factors that could contribute to differences in domain scores. Previous literature suggests that family caregiving and social support may be relevant to post-stroke quality of life, particularly in Asian settings where caregiving practices may be influenced by cultural and socioeconomic contexts (27). Nevertheless, these factors cannot be considered explanations for the present findings because family support and caregiving were not measured in this study.

Similarly, participation in community-based health services, including Puskesmas and Posyandu Lansia, may provide opportunities for health monitoring and social interaction. However, participation in these services and healthcare utilisation were not assessed in the present study. Consequently, the observed variation in SF-36 scores should not be attributed to family support, community participation, healthcare access, religious coping, or psychological adaptation. These factors should instead be considered potential explanatory variables for future investigation.

One possible explanation for differences between physical functioning and self-reported quality of life is adaptation to chronic stroke-related limitations. Individuals living with persistent disability may adjust their expectations, routines, and social roles over time, potentially influencing how they evaluate their health and well-being. Response shift is another possible explanation, whereby individuals change their internal standards or conceptualisation of quality of life after a major health event. However, neither adaptation nor response shift was directly assessed in the present study; these interpretations therefore remain hypotheses rather than conclusions supported by the current data.

Overall, the findings support the multidimensional nature of health-related quality of life after stroke. Although balance-related functional mobility was significantly associated with SF-36 scores, the modest proportion of explained variance indicates that mobility-related factors alone do not account for variability in quality of life. Future longitudinal research should therefore examine psychosocial, environmental, caregiving, rehabilitation, community-participation, and healthcare-utilisation factors alongside functional mobility. Such studies may clarify which factors influence changes in quality of life over time and whether improvements in functional mobility are accompanied by meaningful improvements in health-related quality of life.

The present cross-sectional study did not evaluate intervention effects and therefore cannot determine whether improving balance-related functional mobility would improve quality of life. Longitudinal and intervention studies are required to determine whether changes in balance-related functional mobility are associated with clinically meaningful changes in health-related quality of life.

This study has several limitations. First, the cross-sectional design precludes causal inference about the association between balance-related functional mobility and quality of life. Second, recruitment through Posyandu Lansia and Puskesmas may have introduced selection bias because individuals who use community health services may differ systematically from stroke survivors who are homebound, socially isolated, institutionalised, or unable to access healthcare services. The findings may therefore not be fully generalisable to all stroke survivors. Third, the multivariable model had limited explanatory power (adjusted $R^2 = 0.043$), indicating that important biopsychosocial determinants of quality of life were not measured, including stroke severity, depression, fatigue, pain, comorbidities, cognitive impairment, fear of falling, family support, rehabilitation

intensity, socioeconomic circumstances, social participation, and environmental accessibility. Balance-related functional mobility should therefore be interpreted as one correlate rather than the principal determinant of quality of life. Fourth, the sample-size calculation was based on the primary correlation analysis rather than the multivariable model; accordingly, the regression analysis was exploratory, and the coefficients require confirmation in larger, adequately powered studies.

A further methodological limitation is the use of an exploratory overall SF-36 composite score as the primary outcome. Although the SF-36 is a well-validated multidimensional instrument, the conventional scoring framework emphasises domain scores and the Physical and Mental Component Summary scores rather than a single global score. The correlation and regression analyses based on the exploratory composite should therefore be interpreted cautiously. Future studies should replicate these findings using validated SF-36 summary measures or domain-specific analyses.

Further research should include a broader range of biopsychosocial factors and longitudinal designs to investigate the complex mechanisms influencing quality of life among community-dwelling stroke survivors.

CONCLUSION

Balance-related functional mobility measured by the TUG test was negatively associated with the exploratory SF-36 composite score among community-dwelling stroke survivors (Spearman's $r = -0.413$, $p < 0.001$). Longer TUG completion times were associated with lower SF-36 composite scores. The association remained statistically significant after adjustment for selected demographic and clinical variables ($B = -0.42$, 95% CI −0.75 to −0.09, $p = 0.015$). However, the exploratory regression model explained 15% of the variance ($R^2 = 0.15$), indicating that substantial variation in quality of life remained unexplained. These findings should be interpreted as an association rather than evidence of causality. Longitudinal and intervention studies are needed to determine whether changes in functional mobility are associated with changes in health-related quality of life.

DECLARATIONS

Author contributions: Rakhmad Rosadi, PhD: Conceptualization; Investigation; Data curation; Formal analysis. Sri Sunaringsih Ika Wardojo, PhD: Writing – original draft; Writing – review & editing; Formal analysis. Haidzir Manaf, PhD: Conceptualization; Methodology; Formal analysis. Yoyok Bekti Prasetyo, PhD: Writing – review & editing; final approval and guarantor of the article.

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