

Effect of Gait Parameters On Balance and Quality of Life in Recovering Stroke Patients- A Correlation Study

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Abstract

Introduction: Stroke is neurovascular disease caused by disruption of blood flow to brain, result in neurological deficit. As a consequence of stroke there will be loss of leg strength and impaired balance that may affect walking ability. Gait parameters are also affected as a consequences of stroke. Overall affection of gait parameters and balance will affect Quality of Life.

Objective: The study is conducted to find out relationship between Gait parameters, Balance and Quality of Life in recovering stroke patients- A Correlation Study”

Material and Methodology: Total 32 patients were screened as per inclusion and exclusion criteria. Demographic data was taken. At the time of discharge from the hospital Health status was assessed with use of stroke Impact scale. TUG was taken to measure the Balance. Gait velocity was calculated by use of 6 minute walk test.

Result: Total 32 Recovering stroke Patients have participated in the study. All the stroke patients who have participated in the study were having mean age of 52.65 years and participants of both the genders were included. Amongst the participants' males were 78.21% and females were 21.9%. Were included in the study. Participants with both sided strokes were consider for data collection. Stroke impact scale score has found to have positive correlation with Gait velocity, and stride length, and negative correlation with TUG. ($P = .001$ to $P = .031$). TUG score correlated negatively with Gait Velocity and Stride Length.

Conclusion: Gait parameters have impact on Quality of Life have but will not produce much difference on balance. There is no significant influence of gait parameters on Balance.

Keywords: Balance, Gait Velocity, Stride Length, SIS, Quality of Life, TUG

Introduction

Donkor stated that stroke is a universal health-care problem and is very common, severe, and disabling [1]. In most nation state, stroke is the leading medical condition responsible for death and the main cause of development of disability in adult. According to the Global Burden of Diseases (GBD) study in 1990, stroke was the second important cause of death worldwide the prevalence of stroke-related burden is predictably increase within the next two decades [2]. This indicated an increase in 26% of global stroke death rate during the past two decades.

Stroke is very important causes of death and debility in India [3]. Among all the shared incapability of stroke patients, motor disabilities are one of the most prevailing and disabling. Hemiparesis is very common and the first priority for rehabilitation. The functional capabilities of the patient also depend on the severity of the hemiparesis.

Independent Walking is a significant part of the functional recovery in stroke survivors. Gait is a major element for independent ac-

tive life. Therefore, it is not astonishing that improvement of walking function is the most usually stated importance for the stroke survivors. In stroke, Balance problems are the most common as a consequence of neurological deficit, and they leads to poor regaining of activities of daily living (ADL), movement and may also increase fall risk in stroke survivors [4]. Balance disability is stated as the “inability to maintain an upright position within the limits of stability or base of support.” Studies of balance impairments shows that there is an altered weight distribution pattern, in which less weight bearing is on the weak leg, and can have less expeditions while moving their body around the fix base of support, specifically in the direction of the weaker leg. Above mention pattern is observed in all aspects of balance including static, dynamic, or in responses to external perturbation and it is also very common in stroke survivors who have high functional level for example community ambulatory. Some studies have demonstrated that measures for the balance impairment are related to activity level, which other studies failed to demonstrate this relationship. There are many possible reasons for the above mentioned findings. Balance problems have been associated with poor recovery of functions including activities of daily living (ADL) and mobility and will result in increased risk of falls [5]. Balance problem will lead to uneven weight distribution on lower limb, so that less weight bearing will occur on the weak leg, and they have reduce ROM while shifting their weight around the fix base of support, especially in the direction of the weaker leg.

Walking dysfunction is the most commonly stated functional constraint followed by stroke and will also affect objectivity, quality of life, and involvement in various activities. As per the outmoded opinion, gait improves within first 3 to 6 months following stroke and then remain constant. Additionally leads to, continue with restrictions for walking followed by stroke e.g., more energy expenditure, balance control, and musculoskeletal injury of the non-paretic lower extremity which may lead to restriction of their activity, though they have a capacity for autonomous walking [6]. This leads to the reduced mobility post stroke described by Wade and colleagues. Gait is a major factor contributing for independent living. That is the reason why improvement in walking function is at highest priority for stroke survivors with residual deficits.

There are various measures of balance after stroke. Post stroke persons are more predisposed to fall due to impairment in weight bearing on affected lower limb and spasticity. Falls can be forecasted as well as prevented. Frequent falls are common if proper preventive measures are not taken. Fall incidence are common during the hospital stay and may produce an adverse effect, which require special attention. Thus, it is necessary to identify which stroke survivor is at a risk of fall and need to provide fall prevention interventions can be taken. This may be achieved by proper assessment of the patients with most commonly use clinical tests with good validity and reliability. Prediction of risk of fall had been done in many countries with the use of TUG, BBS and 6 Minute Walk Test.

Clinical tool like Time up and Go test which is objective in nature is use to test functional mobility, balance, and Fall risk [5]. In TUG, the time taken for an individual to get up from a chair is noted, then they have to walk 3 meters, turn, walk again and sit down

[6]. It doesn't state low performance while performing a simultaneous task [7]. The TUG has demonstrated excellent inter-rater reliability (ICC value, 0.99) and intra-rater reliability (ICC value, 0.99) with healthy older adults [7].

Even though improved function is the ultimate aim for rehabilitation. Two most important gait-specific parameters applicable to the stroke population are gait velocity and stride length which can be measure with various measures and is a mostly used measure for the gait performance and can be used to discriminate the levels of disability in the stroke survivors.

The Six-Minute Walk Test was primarily used as a simple walking test for patients with respiratory or cardiac problems for determining their functional capacity and endurance in activity of daily living [1, 2]. Recently, it has been suggested that the distance covered in the 6MWT can be used as a clinical measure for evaluating the walking strength in patients with neurologic disorders, including post stroke patients. The distance covered in the 6MWT has been used to assess the efficiency of intervention from 4 to 12 weeks long in improving walking endurance in subjects with different severity of stroke subjects with various duration of stroke [7-9]. The reliability of the 6MWT is already recognized in various studies performed on stroke survivors with subacute and chronic stroke [10-13]. Test-retest reliability is found to be good for the 6MWT with stroke patients [14]. Therefore, the covered distance during the 6MWT is scrutinized clinically sensitive to encounter the changes in stroke survivors.

A stroke specific outcome measure, the Stroke Impact Scale (SIS) is multi-dimensional self-reported measure of health-related quality of life (HRQoL) for individuals recovering from stroke [4]. It was discovered to detect the important consequences of stroke, especially in mild to moderate strokes [8]. The SIS assesses various domains of health which includes physical health, memory and thinking, communication, emotion, and level of participation [9]. There is no stroke particular outcome measure developed that measure various dimensions of health-related quality of life: emotion, communication, higher mental function like thinking and memory, and functions related to social role which are included in SIS. The instrument provides useful information beyond clinical status, and allows patient to quantify the perspectives. For e.g., the SIS had been found to be highly complex in recognizing motor deficits in stroke survivors who have been classified by standard clinical outcome tools as having minimal or no disability.

Need of the Study

Community Walking is significant part of objectivity and quality of life (QOL) that stances challenges for stroke Survivors. The Study is perform to investigate effect of spatiotemporal gait parameters on balance and QOL in recovering stroke Patients.

Methodology

The study was approved by Ethical committee of Parul University (PU IECHR). Data was collected from the stroke patients referred for Physiotherapy from IPD and Physiotherapy OPD of Parul Sevashram Hospital.

Stroke Patients included in the study were assessed for cognitive

functions and the Walking capability. Participant demographic data and stroke characteristics were recorded.

Stroke impact scale taken to find health-related QOL to assess the various domains like physical problems, Higher mental functions like thinking and memory, emotional status, communication, Activities of Daily Living, Functional Mobility, Hand function, Participation in various activity.

Pearson correlations were used to identify relationship between various gait parameters like step length, stride length, gait velocity and Quality of Life and Gait parameters and Balance.

Screening for Cognitive Function and Gait Velocity

Mini Mental state Examination (MMSE) is widely use to screen for cognitive impairments with scores less than 24 excluding volunteers [15]. the 6MWT was taken as a screening tool for gait ensuring participants could walk safely and independently. Time was noted with a stopwatch; steps taken were counted and velocity was calculated. The 6MWT is a reliable and valid measure for use with individuals with stroke [16, 17].

Demographics and Characteristic of Stroke

Participant demographics and stroke characteristics such as age, gender, side of lesion, side of Hemiparesis and type of stroke (ischemic or haemorrhagic), Hand dominance were recorded at the time of interview.

Measures of Spatiotemporal Gait Parameters

Gait velocity was taken as Temporal Gait Parameter and stride Length was taken for Spatial Gait parameters. Gait velocity was calculated with use of formula Distance/Time. Time taken to complete 6MWT was noted and velocity was calculated. Stride Length was measured from:

Quality-of-Life Measure

The Stroke Impact Scale includes eloquent dimensions of function and health-related quality of life 1 it is self-report questionnaire [1,10]. The Stroke Impact Scale consists of 20 questions across the domains of physical problems, Higher mental functions like thinking and memory, emotional status, communication, Activities of Daily Living, functional Mobility, Hand function, activity Participation Scoring was performed using the overall utility score [18]. Scores are between 0 and 1, with higher scores representing higher QOL.

Balance Measure

The TUG test, clinical assessment tool for measuring mobility, is comprised of standing from a chair, walking in a straight line for 3 m, and turning at a designated turning point [11]. It is a simple and useful test for examining gait and balance abilities, and it is widely used in patients with impaired mobility due to stroke [12]. Functional assessment of stroke patients requires assessment of not only gait speed but balance and functional mobility as well. The TUG test is an assessment tool for measuring mobility, balance, and risk of falling [13].

Study Protocol

Testing sessions were performed at Neurophysiotherapy depart-

ment of Parul Sevashram Hospital. Demographics and stroke characteristics were recorded at the start of the session. The Stroke impact scale was taken for health-related QOL, the TUG test was taken to assess balance, and then the 6MWT were completed to establish independent walking ability (with or without an aid). The TUG was then undertaken with 3 trials of the first walking at a comfortable speed. Each scale was explained and demonstrated prior to the participant's performance. The participant was offered the opportunity to rest as required to minimize fatigue. The spatiotemporal gait parameters of participants were measured during walking on the marked walkway.

Data Management and Analyses

Demographic, health-related QOL and data for the clinical measures of gait were entered into a Microsoft Excel prior to analysis. The individual gait parameters from each trial on the walkway were recorded. Statistical analysis was performed in SPSS (version 20).

Descriptive analyses were used to present demographic characteristics. Multiple correlation analyses were performed to examine the effect of Gait Parameters. Pearson correlations were used to check for correlations between gait velocity and Stride Length. Pearson correlations were used to check for correlations between Gait Velocity and Stride Length with Balance and Quality of Life

Result

Correlation was calculated on Total 32 Recovering stroke Patients who were recruited for study. Participants had a mean age of 52.65 years, and included both males and females (78.10% male and 21.90% female). Individuals presented with both left (18.70%) and right-sided (81.25%) strokes. Stroke impact scale score was found positively correlated with velocity, and stride length, and negatively with TUG. (P = .001 to P = .031). TUG score correlated negatively with Gait Velocity and Stride Length.

Table 1: Participant's Characteristics

Participant's Characteristics:	Mean	SD
Age	52.65	3.87
Gender		
Male	78.10%	0.40
Female	21.90%	
Side of stroke		
Left	18.70%	0.44
Right	81.25%	
MMSE score	28.12	0.90
Gait velocity	.28	0.04
Stride Length	28.40	6.06
TUG	17.37	3.75
SIS	44.58	6.67

Table 2: Correlation between Stroke Impact scale, Time up and Go test, Gait Velocity and Stride Length

		SIS	TUG
SIS	Pearson Correlation	1	-.221
	Sig. (2-tailed)	.	.225
	N	32	32
TUG	Pearson Correlation	-.221	1
	Sig. (2-tailed)	.225	.
	N	32	32
Gait velocity	Pearson Correlation	1	-.367*
	Sig. (2-tailed)	.	.039
	N	32	32
Stride length	Pearson Correlation	.085	-.515**
	Sig. (2-tailed)	.644	.003
	N	32	32

From the Correlations table, it can be seen that the correlation coefficient for SIS and TUG (r) equals -0.221, For TUG and Gait velocity(r) is -0.367 indicating a weak relationship. TUG and Stride Length (r) is -0.515 indicating statistically significant relationship. p=0.003

Discussion

In this study data was analysed for 32 patients to find the relationship of Gait parameters with Balance and Quality of Life.

Relationship between Gait parameters and Balance

a) Gait Velocity and Balance

The study showed weak negative correlation of Gait velocity with Balance. There are many reasons for affection of Gait velocity but balance will not be affected much in the stroke patients. One of the study conducted previously concluded that hemiplegic patients have shorter swing phase on unaffected side and longer on affected side, shorter weight bearing duration on affected side and longer weight bearing duration on unaffected side, shorter hemiplegic side weight bearing and longer swing phase on hemiplegic side which may affect the Gait velocity but with more use of unaffected side patient will be able to maintain balance [19]. Another reason for less affection of balance is weakness of dominant limb has a greater effect on balance and daily activities than loss of function of the monodominant limb. In this study 81.25% of patients are having affection of monodominant limb so they may have ability to maintain their balance. G. Rode has found in his study that Right hemi paretic patients shown restored functional abilities, specifically in activities involving upright standing, balance, and gait [20]. So this may be the reason for less affection of balance [15]. E. F. Chagas found in his research that other gait parameters like step length, stride length, Gait velocity, stance, and cadence, did not differ much between healthy and affected limbs may be one of the reason for maintenance of Balance in the stroke Patients. M. A. Dettmann et al. in his study assessed gait parameters and stability in a weight bearing position and found that hemi paretic patients recompense for a loss of balance with smaller step length and re-

duced Gait speed [16]. Which will reduce Gait velocity but maintain Balance. Salbach NM et al. concluded that “stroke patients with walking speed of 0.3m/s or less require inpatient rehabilitation more while patients who walk with speed of 0.6m/s or faster are likely to return home from the acute-care hospital” it indicates that if Gait velocity is more than 0.6m/s or more than that then patients will be functional ambulators and will be able to maintain their balance for the daily activities [17]. So the inference is drawn from above study that if desirable gait speed is achieved than there are less chances of losing the balance. This may be the reason for negative correlation between balance and gait velocity. In one of the study it was observed that Improvements in gait speed does not always lead to changes in walking performance may be one of the reason for negative correlation between balance and Gait velocity. In study performed by Sıdıka Büyükvural Şen it was found that isokinetic training improved walking speed significantly but it did not change TUG scores significantly indicates that intervention may improve gait velocity but balance may or may not improve along with improvement in Gait velocity [21]. Johnson et al. found that Strength improvements can lead to improvements in self-confidence and dynamic balance which may have positive impact on walking ability and Activities of Daily Living.

b) Stride Length and Balance

The result showed weak negative correlation between Balance and stride Length means if the stride Length is affected it is not going to affect Balance. Larsson et al demonstrated a linear relation for walking speed, cadence and step length, at various speeds in healthy adults and concluded that there is a formal relationship between postural control in gait and other gait variables. Affection of stride Length may affect the Gait velocity but it may not affect the Balance. Improvement in balance can be achieved by improving the postural control but it is not necessary that improvement in stride length will improve Balance. Turnbull GI in his study found that Decrease in walking speed will result in reduced stride length which may affect standing balance in hemiplegic Patients [22].

Gait Parameters and Quality of Life

a) Stride Length and Stroke Impact

Stride Length and SIS shows weak positive correlation. In one of the study performed by Park, JinHee and Yoon, Gilwon it was observed that Gait speed, step length of the affected limb, and step length of the unaffected limb were also have correlation with quality of life [23]. More stride length and longer step length with reduce cadence were pronounced in stroke survivors with a very low-gait speed which may lead to compromised quality of life in stroke patients.

b) Gait Velocity and Stroke Impact

The gait speed is correlated with the SIS score. The relation between the gait speed and major components of the SIS like strength, mobility, hand function, ADL, emotional status, social activity and thinking are also statistically significant.

The results are similar to the study conducted by Schmidt et al. (2007) which revealed that a gain in gait speed in stroke patients affected the transition to a higher class of ambulation, especially in household ambulators who transitioned to community ambulators

that resulted in better function and quality of life assessed by the SIS. In addition to that, the community ambulators with walking speed was more than 0.8 m/sec, had a higher quality of life in the strength, mobility, hand function and ADL, social participation and thinking of recovery domains than the household or limited community ambulators [24]. Despite of walking ability may not fully account for the level of physical activity after stroke, improving sit-to-stand transitions, standing time, and walking speed are potential ways of increasing physical activity and reducing sedentary time in people with stroke which will in turn lead to improve Quality of life in the stroke survivors [25]. Brandstater et al reported that temporal gait parameters such as walking speed and the swing/phase symmetry, show a good correlation with motor recovery stage and may improve quality of Life [26]. One of the study concluded that the community ambulation is correlated with many aspects of quality of life in stroke patients. By improving stroke survivors' ability of walking, improvement in their general wellbeing and thereby advancement for better health and more community participation [18].

Conclusion

In the present study, it is found that Gait parameters including Gait velocity and stride Length have little impact on quality of life but Balance is not much affected by variation in the Gait Parameters. Hence, Gait training focusing on improvement in Gait parameters should be consider to improve the Quality of life. However, further study should be performed with use of other advance techniques of measuring Gait parameters to identify its impact on Balance.

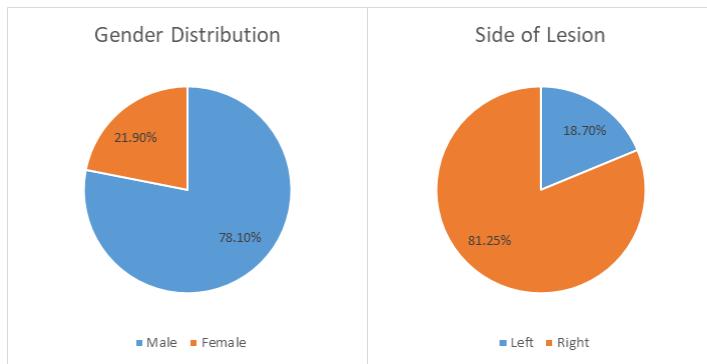


Figure 1: Gender Distribution and Side of Lesion

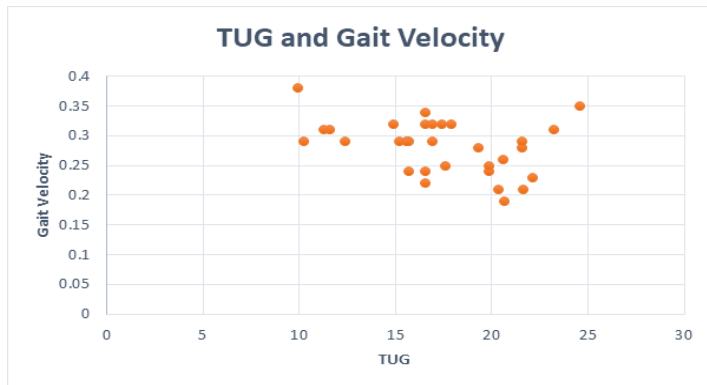


Figure 2: TUG and Gait Velocity
It shows negative correlation which is statistically not significant

(p= .039)

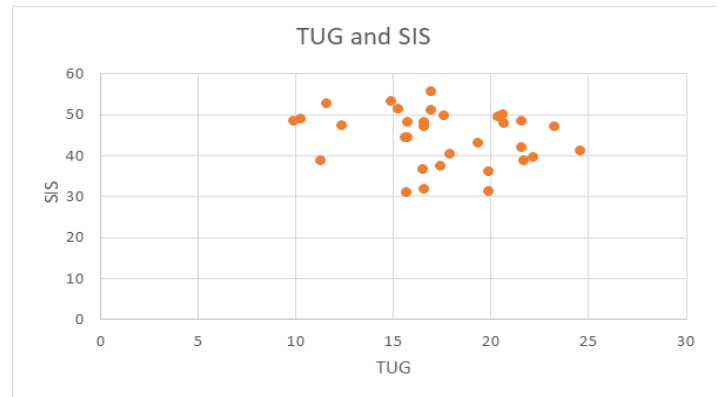


Figure 3: TUG and Stroke Impact scale

It shows negative correlation which is statistically not significant (p=.225)

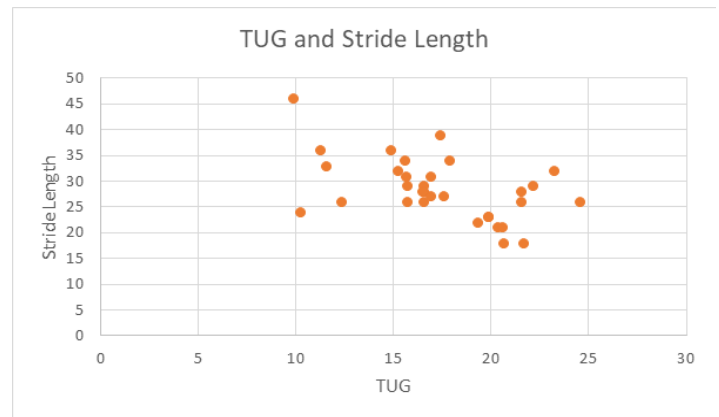


Figure 4: TUG and stride Length

It shows negative correlation which is statistically significant. (P=.003)

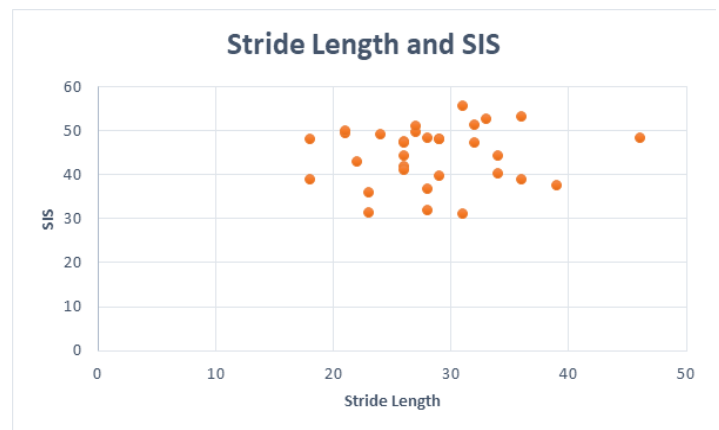


Figure 5: Stride Length and SIS

It shows positive correlation which is not statistically significant. (p=.644)

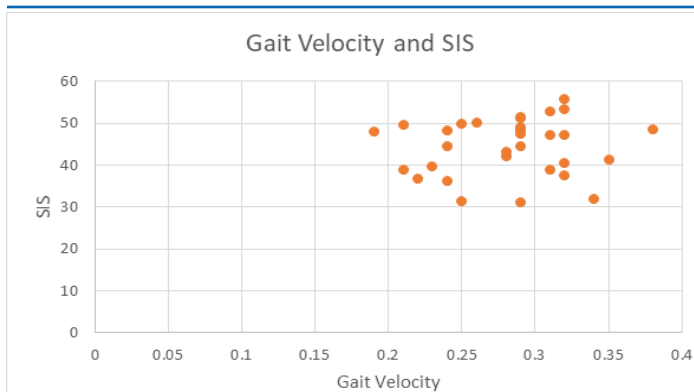


Figure 6: Gait Velocity and SIS

It shows positive correlation which is statistically significant.

References

1. Donkor ES (2018) Stroke in the century: a snapshot of the burden, epidemiology, and quality of life. Stroke research and treatment.
2. Feigin VL, Norrving B, Mensah GA (2017) Global burden of stroke. Circulation research 120: 439-448.
3. Pandian JD, Sudhan P (2013) Stroke epidemiology and stroke care services in India. Journal of stroke 15: 128-134.
4. Tyson SF, Hanley M, Chillala J, Selley A, Tallis RC (2006) Balance disability after stroke. Physical therapy 86: 30-38.
5. Lamontagne A, Paquet N, Fung J (2003) Postural adjustments to voluntary head motions during standing are modified following stroke. Clinical Biomechanics 18: 832-842.
6. Patterson KK, Gage WH, Brooks D, Black SE, McIlroy WE (2010) Changes in gait symmetry and velocity after stroke: a cross-sectional study from weeks to years after stroke. Neurorehabilitation and Neural Repair 24: 783-790.
7. Bandara KM, Ranawaka UK, Pathmeswaran A (2020) Usefulness of Timed Up and Go test, Berg Balance Scale and Six Minute Walk Test as fall risk predictors in post stroke adults attending Rehabilitation Hospital Ragama. Journal of the Ceylon College of Physicians 51: 10.
8. Duncan PW, Wallace D, Lai SM, Johnson D, Embretson S, et al. (1999) The stroke impact scale version 2.0: evaluation of reliability, validity, and sensitivity to change. Stroke 30: 2131-2140.
9. Vellone E, Savini S, Fida R, Dickson VV, Melkus GD, et al. (2015) Psychometric evaluation of the stroke impact scale 3.0. Journal of Cardiovascular Nursing 30: 229-241.
10. Fulk GD, Ludwig M, Dunning K, Golden S, Boyne P, et al. How much change in the stroke impact scale-16 is important to people who have experienced a stroke?. Topics in stroke rehabilitation 17: 477-483.
11. Podsiadlo D, Richardson S (1991) The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc 39: 142-148.
12. Faria CD, Teixeira-Salmela LF, Nadeau S (2009) Effects of the direction of turning on the timed up & go test with stroke subjects. Top Stroke Rehabil 16: 196-206.
13. Verheyden G, Nieuwboer A, De Wit L, Feys H, Schuback B, et al. (2007) Trunk performance after stroke: an eye catching predictor of functional outcome. J Neurol Neurosurg Psychiatry 78: 694-698.
14. Ng SS, Tsang WW, Cheung TH, Chung JS, To FP, et al. (2011) Walkway length, but not turning direction, determines the six-minute walk test distance in individuals with stroke. Archives of physical medicine and rehabilitation 92: 806-811.
15. EF Chagas and M Tavares (2001) "Symmetry and weight-transfer in hemiplegic patients: relationship between this condition and functional activity performance." Revista de Fisioterapia da Universidade de São Paulo 8: 40-50.
16. MA Dettmann, MT Linder, SB Sepic (1987) "Relationships among walking performance, postural stability, and functional assessments of the hemiplegic patient." The American Journal of Physical Medicine 66: 77-90.
17. Salbach NM, Mayo NE, Higgins J, Ahmed S, Finch LE, et al. (2001) Responsiveness and predictability of gait speed and other disability measures in acute stroke. Archives of physical medicine and rehabilitation 82: 1204-1212.
18. Ada L, Dean CM, Lindley R, Lloyd G (2009) Improving community ambulation after stroke: the AMBULATE Trial. BMC neurology 9: 1-6.
19. You YY, Chung SH (2015) The effects of gait velocity on the gait characteristics of hemiplegic patients. Journal of physical therapy science 27: 921-924.
20. G Rode, C Tiliket, D Boisson (1997) "Predominance of postural imbalance in left hemiparetic patients." Scandinavian Journal of Rehabilitation Medicine 29: 11-16.
21. Şen SB, Demir SÖ, Ekiz T, Özgirgin N (2015) Effects of the bilateral isokinetic strengthening training on functional parameters, gait, and the quality of life in patients with stroke. International journal of clinical and experimental medicine 8: 16871-16879.
22. Turnbull GI, Charteris JMS, Wall JC (1995) A comparison of the range of walking speed between normal and hemiplegic subjects. Scand J Rehabil Med 27: 175-182.
23. Park J, Kim TH (2019) The effects of balance and gait function on quality of life of stroke patients. NeuroRehabilitation 44: 37-41.
24. Khanittanuphong P, Tipchatyotin S (2017) Correlation of the gait speed with the quality of life and the quality of life classified according to speed-based community ambulation in Thai stroke survivors. NeuroRehabilitation 41: 135-141.
25. Ezeugwu VE, Manns PJ (2017) Sleep duration, sedentary behavior, physical activity, and quality of life after inpatient stroke rehabilitation. Journal of Stroke and Cerebrovascular Diseases 26: 2004-2012.
26. Brandstater ME, de Bruin H, Gowland C, Clark BM (1983) Hemiplegic gait: analysis of temporal variables. Arch Phys Med Rehabil 64: 583-587.

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