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GAIT FUNCTION AND ITS ASSOCIATION WITH FUNCTIONAL INDEPENDENCE, QUALITY OF LIFE, AND COMMUNITY REINTEGRATION IN STROKE SURVIVORS

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ABSTRACT

Background and Aims: The major outcome of stroke rehabilitation is the recovery of the ability to walk. However, a large proportion of stroke survivors are discharged to the community with gait deficiency which impairs their functional independence, and quality of life increasing the burden of care on caregivers especially their lack of functioning in the community. This study assessed the gait functional performance in community-dwelling stroke survivors and explored its association with functional independence, quality of life, and community reintegration in community-dwelling stroke survivors. **Materials and methods:** This study involved 115(59 males and 56 females) community-dwelling stroke survivors. Their gait functional performance was assessed using the 10-meter walk test (10MWT) while their functional independence was assessed with the functional independence measure (FIM). Their quality of life (QoL) was assessed using the Stroke-specific QoL scale while community functioning and productivity were assessed using the community integration questionnaire (CIQ). Their scores on the assessments were compared with the normative data of their age and sex-matched healthy individuals. Data was analysed using Spearman's correlation coefficient and Chi-Square at $p<.05$. **Results:** Participants' ages ranged between 27 to 78 years (mean=60.48±37.84 years). More participants (56.7%) had right hemispheric lesions and 43.3% had lesions in the left hemisphere. Their gait function, functional independence performance, QoL, and community reintegration functions were significantly ($p<0.05$) lower than their age and sex-matched normative data. There was a significant ($p<0.05$) association and relationship between their gait functional performance and each of the functional independence performance, QoL, community reintegration, and productivity. **Conclusion:** Gait functional performance in community-dwelling stroke survivors is significantly lower than in age and sex-matched healthy individuals and it is significantly associated with low functional independence performance, low quality of life, poor community functioning, and lack of productivity in stroke survivors, Abnormal gait pattern is related to poor functional independence, poor quality of life and low productivity.

KEYWORDS: Gait Function, Functional Independence, Quality of Life, Community reintegration, Stroke Survivors.

INTRODUCTION

Mobility is an important attribute of human beings that allows movement from one place to the other to relate and interact with the environment. However, for efficiency and effectiveness, walking follows a predictable pattern which is known as the gait pattern. With appropriate gait patterns, human movement and activities become productive and the interaction with the community becomes mutually beneficial to all. Hence, gait is an essential predictor of functional independence and long-term survival after a stroke [1,2]. Mobility and appropriate gait ability have important health implications in providing protective effects against secondary complications common after stroke [3, 4]. Therefore, mobility performance and activities are the most important functions for normal day-to-day human life in confidence without losing balance and translate to functional activity and physical functioning of stroke survivors. [5].

Gait function after a stroke has far-reaching implications on how effectively a stroke survivor performs independent activities of daily living especially as it is related to self-care as grooming, eating, dressing, washing, cooking, and the performance of household shores with minimal assistance. Improvement in gait function will reduce the burden of stroke both on the stroke survivors and their informal caregivers alike mutually improve their quality of life, and confidence, and further improve community functioning and social participation [3, 5, 6]. It will put a stroke survivor in an appropriate position to return to pre-stroke activities and roles. It will reduce psychological fall avoidance, risk of falls and falls as well as complications of falls among stroke survivors thereby improving their quality of life and community functioning. Improvement in mobility and gait will improve the overall health of stroke survivors and prevent further health complications common after stroke.

Given the importance and relevance of mobility and gait to everyday life, it is not surprising that improvement in gait function has become a focus for rehabilitation among stroke survivors to optimize functioning through increased muscle strength and coordination, gait velocity, and endurance, flexibility and agility, cardiovascular fitness, functional independence, quality of life and community integration. This study, therefore, evaluated the gait functional performance in community-dwelling stroke survivors and explored its association with functional independence, quality of life, and community reintegration.

METHODS

This study involved 115 (59 males and 56 females) community-dwelling stroke survivors older than 18 years in a metropolitan city in Nigeria. They were consecutively recruited from the outpatient rehabilitation department of a tertiary health institution in the city. Participants were excluded if they had no pre-existing or comorbid neurological or psychiatric conditions, visual impairment not amenable to corrective visual aids, or concomitant health conditions that would limit community functioning or quality of life. The protocol for this research was approved by the Health Research and Ethics Committees of the College of Medicine of the University of Lagos (CMUL), Lagos, Nigeria

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A 10-meter walk test (10MWT) was used to assess gait parameters specifically the number of steps, step length, stride length, and speed (natural and maximum gait speed). The assessment was conducted according to standard protocol [7]. Participants were instructed to keep their feet in water-soluble ink and walk on a white carpet which is a 12-meter marked distance. The 2m away from the 10-meter walkway was such that a uniform step would be established before getting to the walkway. Participants stood at the starting position and walked naturally and as fast as possible across a 12-meter marked distance. The measurement began at the marked 2 meters from the starting position and the measurement was completed at the marked 10-meter distance from the starting. The steps and time used to complete the distance between the 2 meters and 10 meters from the starting position were noted and recorded. The step length (cm) was obtained by measuring from the affected limb to the unaffected limb. The stride length (cm) was obtained by measuring the linear distance from one heel strike of the affected limb to the next heel strike of the same limb. The natural gait speed (walking velocity) (m/s) was determined by dividing the length of the walkway by the time taken by the subject at his natural pace from one end of the walkway to another. The maximum gait speed (m/s) was obtained by dividing the length of the walkway by the time taken by the subjects to walk at their maximal safe speed from one end of the walkway to the other. The cadence (step/minute) was determined by dividing the number of steps in a minute [8].

A functional independence measure was used to assess the functional independence of the participants. The scale is a self-report scale containing 18 items in 2 subscales: the motor and cognition subscales. The motor subscale has 13 items: eating, grooming, bathing, dressing-upper body, dressing-lower body, toileting, bladder management, bowel management, transfers-bed/chair/wheelchair, transfers-toilet, transfers-bath/shower, walk/wheelchair, and stairs while the cognition subscale has 6 items: comprehension, expression, social interaction, problem-solving, and memory. Each item was rated on a 7-point Likert scale summed score of 18 – 126 where 18 represents complete dependence/total assistance and 126 represents complete independence. Stroke-Specific Quality of Life scale was used to determine the QoL of participants. The scale is a self-report scale containing 49 items in 12 domains: mobility, energy, upper extremity function, work/productivity, mood, self-care, social roles, family roles, vision, language, thinking, and personality. Each item was rated on a 5-point Likert scale summed score of 49-245 with higher scores indicating better function. The work/productivity domain of the QoL was used for productivity assessment. Community integration questionnaire (CIQ) was used to examine community re-integration of participants. The scale is 15-item self-report questionnaires with 3 subscales: home integration, social integration, and productive activities. The three subscales are summed to yield a total score for community integration ranging from 0-29, with higher scores indicating a greater degree of community integration.

Data Analysis

Data collected were analyzed using Statistical Package for Social Science version 22 (SPSS 22). Data was analysed using Spearman's correlation coefficient and Chi-Square at $p<.05$.

RESULTS

Participants' age was between 27 years and 78 years and the mean age was 60.48±37.84 years. More participants (56.7%) had right hemispheric lesions and 43.3% had lesions in the left hemisphere. The gait functions were significantly ($p<0.05$) abnormal and lower compared to their age and sex-matched healthy individuals. The gait patterns have (step length, stride length, natural gait speed, maximum gait speed) direct relationship with overall functional independence except for cadence which has an indirect significant ($p<0.05$) relationship ***(Table 1)***. There was a positive correlation between step length, stride length, cadence, and overall QoL except for natural and maximum gait speed which has a significant ($p<0.05$) negative correlation ***(Table 1)***. There was a significant ($p<0.05$) positive correlation between step length, stride length, and community functioning and productivity. However, natural, and maximum gait speed has a significant ($p<0.05$) negative correlation with community functioning and productivity ***(Table 1)***.

There was a significant ($p<0.05$) association between functional independence and gait functions of natural gait speed, maximum gait speed and cadence, dressing/lower body in maximum gait speed, transfers-toilet in cadence, stairs in maximum gait speed, comprehension in maximum gait speed and cadence ***(Table 2)***. There was a significant association between QoL in the work/productivity domain and stride length ***(Table 3)***. However, there was no significant ($p>0.05$) association between gait function and community functioning ***(Table 4)***.

Table 1 *(Relationship Between Gait Parameters and Functional Independence, Quality of Life, Community Functioning, and Age of the Participants.)*

Variables	Functional Independence		Quality of Life		Community functioning		Age	
	r	p	r	p	r	p	r	p
Step length	0.062	0.641	0.085	0.518	0.380*	0.003	-0.109	0.409
Stride length	0.075	0.568	0.107	0.417	0.347 *	0.007	-0.721	0.000*
Natural gait speed	0.023	0.861	-0.106	0.422	-0.430*	0.001	-0.009	0.945
Maximum gait speed	0.059	0.654	-0.069	0.600	-0.415*	0.001	-0.014	0.918
Cadence	-0.054	0.683	0.064	0.629	0.317	0.014	-0.001	0.996

Age	0.126	0.339	0.213	0.102	-0.020	0.878	-0.157	0.230

Table 2 *(Association Between Gait Parameters and Functional Independence.)*

Domains	X^2-Value	p-value
Eating		
Step length.	161.700	0.832
Stride length.	192.943	0.921
Natural gait speed	344.400	0.023*
Maximum gait speed	318.200	0.023*
Cadence	107.028	0.016*
Grooming		
Step length.	155.568	0.906
Stride length.	219.913	0.527
Natural gait speed	269.318	0.846
Maximum gait speed	260.742	0.646
Cadence	66.130	0.829
Bathing		
Step length.	156.122	0.900
Stride length.	228.844	0.362
Natural gait speed	252.597	0.961
Maximum gait speed	230.870	0.959
Cadence	63.685	0.879
Dressing, upper body		
Step length.	147.509	0.542
Stride length.	173.792	0.712
Natural gait speed	238.523	0.605
Maximum gait speed	210.900	0.741
Cadence	67.365	0.396
Dressing, lower body		
Step length.	167.494	0.739
Stride length.	206.245	0.769
Natural gait speed	306.782	0.292
Maximum gait speed	312.421	0.039*
Cadence	62.773	0.895
Toileting		
Step length.	136.437	0.779
Stride length.	168.508	0.802
Natural gait speed	246.819	0.455
Maximum gait speed	227.307	0.444
Cadence	68.691	0.353

Bladder management		
Step length.	63.182	0.365
Stride length.	51.545	0.978
Natural gait speed	89.455	0.719
Maximum gait speed	111.955	0.058
Cadence	18.559	0.854
Bowel management		
Step length.	131.667	0.220
Stride length.	111.933	0.988
Natural gait speed	193.824	0.531
Maximum gait speed	182.971	0.424
Cadence	34.194	0.973
Transfer bed/chair.		
Step length.	104.870	0.839
Stride length.	124.491	0.920
Natural gait speed	205.696	0.303
Maximum gait speed	200.400	0.142
Cadence	43.741	0.785
Transfers-toilet		
Step length.	167.333	0.742
Stride length.	192.302	0.926
Natural gait speed	318.000	0.161
Maximum gait speed	285.262	0.250
Cadence	111.675	0.007*
Transfers-bath/shower		
Step length.	111.962	0.991
Stride length.	170.093	0.777
Natural gait speed	247.907	0.436
Maximum gait speed	236.785	0.282
Cadence	63.972	0.513
Walk/wheelchair.		
Step length.	160.000	0.856
Stride length.	254.952	0.064
Natural gait speed	311.167	0.235
Maximum gait speed	284.167	0.265
Cadence	73.046	0.637
Stairs		
Step length.	215.069	0.875
Stride length.	262.550	0.920
Natural gait speed	375.403	0.718
Maximum gait speed	405.393	0.049*

Cadence	126.574	0.066
Comprehension		
Step length.	91.154	0.446
Stride length.	80.852	0.986
Natural gait speed	166.846	0.126
Maximum gait speed	173.423	0.014*
Cadence	92.339	0.000*
Expression		
Step length.	109.487	0.744
Stride length.	138.868	0.734
Natural gait speed	188.269	0.641
Maximum gait speed	180.500	0.475
Cadence	53.366	0.421
Social interaction		
Step length.	152.242	0.434
Stride length.	181.556	0.558
Natural gait speed	265.543	0.175
Maximum gait speed	240.426	0.229
Cadence	62.517	0.564
Problem-solving		
Step length.	130.222	0.876
Stride length.	161.040	0.898
Natural gait speed	241.667	0.548
Maximum gait speed	218.600	0.608
Cadence	73.303	0.224
Memory		
Step length.	78.067	0.999
Stride length.	114.486	0.981
Natural gait speed	198.800	0.431
Maximum gait speed	177.600	0.537
Cadence	46.766	0.679
Functional Independence Function		
Step length.	816.667	0.428
Stride length.	928.095	0.946
Natural gait speed	1310.095	0.592
Maximum gait speed	1186.667	0.714
Cadence	354.225	0.442

Table 3 *(Association Between Gait Parameters and Quality of Life.)*

Domains	X^2-Value	p-value
Energy		
Step length.	252.496	0.771
Stride length.	320.826	0.674
Natural gait speed	419.433	0.763
Maximum gait speed	339.685	0.992
Cadence	111.163	0.635
Family Roles		
Step length.	213.917	0.886
Stride length.	285.214	0.663
Natural gait speed	371.000	0.770
Maximum gait speed	305.033	0.984
Cadence	103.419	0.498
Language		
Step length.	94.583	0.958
Stride length.	95.506	1.000
Natural gait speed	200.625	0.395
Maximum gait speed	182.375	0.437
Cadence	42.006	0.838
Mobility		
Step length.	325.952	0.992
Stride length.	426.526	0.965
Natural gait speed	600.268	0.849
Maximum gait speed	538.000	0.918
Cadence	190.768	0.120
Mood		
Step length.	296.250	0.550
Stride length.	347.786	0.791
Natural gait speed	454.750	0.871
Maximum gait speed	360.700	0.999
Cadence	110.345	0.893
Personality		
Step length.	176.544	0.955
Stride length.	260.373	0.464
Natural gait speed	314.381	0.864
Maximum gait speed	272.614	0.959
Cadence	107.499	0.114
Self-Care		
Step length.	324.111	0.913
Stride length.	483.667	0.094
Natural gait speed	499.048	0.997
Maximum gait speed	417.829	1.000

Cadence	167.258	0.225
Social Roles		
Step length.	287.925	0.217
Stride length.	350.770	0.241
Natural gait speed	404.804	0.891
Maximum gait speed	350.817	0.976
Cadence	125.104	0.287
Thinking		
Step length.	181.134	0.926
Stride length.	221.420	0.956
Natural gait speed	345.959	0.445
Maximum gait speed	326.895	0.310
Cadence	96.689	0.322
Upper Extremity function		
Step length.	304.583	0.839
Stride length.	443.878	0.101
Natural gait speed	493.714	0.919
Maximum gait speed	457.571	0.885
Cadence	124.500	0.865
Vision		
Step length.	131.375	0.861
Stride length.	128.185	0.999
Natural gait speed	232.500	0.707
Maximum gait speed	243.500	0.189
Cadence	60.561	0.633
Work/Productivity		
Step length.	294.149	0.150
Stride length.	381.824	0.033*
Natural gait speed	416.636	0.792
Maximum gait speed	405.136	0.489
Cadence	137.810	0.092
Total Quality of Life		
Step length.	1062.187	0.390
Stride length.	1256.339	0.775
Natural gait speed	1690.625	0.658
Maximum gait speed	1640.000	0.124
Cadence	424.539	0.844

TABLE 4 *(Association Between Gait Parameters and Community Participation.)*

Domains	Chi-Square Value	p-value
Home integration		
Step length.	169.963	0.693
Stride length.	211.768	0.678
Natural gait speed	282.868	0.669
Maximum gait speed	219.279	0.989
Cadence	72.262	0.662
Social integration		
Step length.	118.548	0.973
Stride length.	151.217	0.967
Natural gait speed	230.643	0.736
Maximum gait speed	242.781	0.198
Cadence	78.190	0.126
Productive activities		
Step length.	105.233	0.829
Stride length.	127.105	0.892
Natural gait speed	151.400	0.992
Maximum gait speed	154.080	0.920
Cadence	238.565	0.916
Community Function		
Step length.	238.565	0.916
Stride length.	325.058	0.612
Natural gait speed	436.444	0.552
Maximum gait speed	429.167	0.196
Cadence	139.361	0.078

DISCUSSION

Walking is not just the function of the human being for transfer from one place to the other; it serves the purpose of exploring the environment and functioning within the global ecosystem of the community. Stroke survivors are being discharged to the community with varied degrees of disability but with the expectation for community reintegration for improved quality of life and return to work. However, abnormality in gait patterns remains a major hindrance to effective community functioning and return to a productive lifestyle in stroke survivors after inpatient hospital discharge. This has in no small measure increased the burden of stroke on both the family and the community alike [6]. Hence, the importance of this study lies in the fact that it will make available the aspects of gait functions that need to attract more attention during the rehabilitation of stroke survivors to enhance independent functioning for effective community functioning and return to work and productivity. This study sought to investigate the association between gait function, functional independence, quality of life, and community reintegration in community-dwelling stroke survivors.

The wide age range of stroke survivors with some in their twenties shows the need for effective efforts at improving independent community and social functioning as most of them are still within their productive age and would be aspiring to return to a productive lifestyle. The importance of proper walking to being productive as well as socializing cannot be overemphasized. Although motor functional recovery and the recovery of skill function in stroke survivors is progressive and ongoing even after hospital discharge, the recovery of normal gait patterns is very important in their community reintegration and return to work. Hence, the positive relationship between gait parameters and functional independence shows that interaction with the environment in a community-dwelling stroke survivor is predicated on normal gait pattern and function. When there is an increase in gait function there will also be an improvement in the functional independence. Therefore, an independent walking ability is a prerequisite to performing most daily tasks and activities, and accomplishing a task either physically or socially cannot be achieved without attaining a minimum functional mobility in gait.

The positive relationship of gait function with quality of life indicates that interaction with the environment is important in quality of life and well-being. As the quality of life of an individual is expressed by the environment including the culture and belief system, no individual will be able to achieve a good quality of life without interaction with the environment which depends largely on not only walking but also the quality of the walking. Hence, it is not surprising that the quality of life of the participants depends on their efficiency and effectiveness of mobility [9]. In the contemporary working environment, effective and efficient mobility is an important asset. This is not only for community functioning or productivity, but it also ensures safety and wellness in the workplace and work environment. Even in a remote working environment, the importance of effective walking for exploration of the environment cannot be underestimated. Effective walking is therefore an important tool for community functioning and productivity. These outcomes show that an improvement in the gait function of stroke survivors will lead to improvement in their independent functioning, quality of life, community and social relationships, and productivity. Therefore, stroke survivors with severe gait disability will present with poor activities of daily living (ADL) and poor community re-integration [10]. Hence, lack of independence in gait affects the return to work for stroke survivors who were working before the stroke [11].

The association between gait function and independent functioning, quality of life, and productivity shows that an individual with distorted walking ability will not be as productive as an individual with a normal gait pattern and their quality of life will be poor. This will consequently increase the burden of stroke and stroke care. With an appropriate gait pattern, there would be an increase in the balance and the confidence to walk [12]. This will improve the quality of life and productive lifestyle.

CONCLUSION

Gait functional performance in community-dwelling stroke survivors is significantly lower than in age and sex-matched healthy individuals and it is significantly associated with low functional independence performance, low quality of life, poor community functioning, and lack of productivity in stroke survivors, Abnormal gait pattern is related to poor functional independence, poor quality of life and low productivity.

Disclosures

The authors declare that there is no conflict of interest

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