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Spatiotemporal Gait Parameters and Walking Characteristics in Community-Dwelling Ambulatory Stroke Survivors

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Abstract

Background: Gait dysfunction is a major sequalae of stroke which negatively affect stroke survivors' walking and community re-integration. Understanding the impairments that determine their community functioning willassist in development of effective treatment strategies for them to overcome their disability.

Aim: The aim of the study was to explore thespatiotemporal gait parameters and walking characteristics in community-dwelling ambulatory stroke survivors and determined howthey differ across time of commencement of ambulation and duration of ambulation post-stroke.

Method: This study involved 164 (83males) community-dwelling ambulatory stroke survivors in Kano, Nigeria. The spatiotemporal gait parameters wereassessed along 12-meter distance walking path. Spatiotemporal symmetry was computed from the spatiotemporal parameters. Lower limb motor impairment, lower extremity function, and functional ambulation were assessed using Fugyl-Meyer assessment scale, Lower Extremity Functional scale, and Modified Emory functional ambulatory profile respectively. Their physical mobility was assessed using Modified Rivermead mobility index, walking confidence using ambulatory self-confidence questionnaire while Berg balance scale was used to measure balance. Functional mobility and walking endurance was assessed using the Time up and go test and 6-minute walk test respectively.Walking status was assessed with functional ambulatory category.

Results: The participants were aged30years and abovewith 61% above 50years. Most (59.8%) participants commenced ambulation within 1-month of stroke with 65.9% being independent in functional ambulation. Their spatiotemporal, mobility and balance parameters as well as spatiotemporal symmetry characteristics were severely affected and are significantly inversely related to their times of commencement of ambulation post-stroke.

Conclusion: Spatiotemporal gait parameters, mobility parametersand balance performances are severely abnormal in community-dwelling stroke survivors and negatively impact on their walking ability and community functioning.

Keywords: *Ambulation, Community-Dwelling, Spatiotemporal Gait,Stroke Survivors, Walking Characteristics*

Introduction

Ambulatory dysfunction occurs in a lot of stroke survivors resulting in difficulties in performing activities of daily living and mobility(1). This dysfunction is associated with deviations in EMG, spatiotemporal, kinematics, and kineticsvariables in stroke survivors(2). Human walking mediated by complex neural control mechanisms is usually not giving much concern [1].

After a stroke, the gait quality assessed with spatiotemporal symmetry worsen over the years[3]. This post stroke gait has been reported to come up with complex relationship among the spatiotemporal asymmetries, biomechanical parameters and sensory motor deficits [4]. It has been found that stroke relatedbalance and gait deficits have vital role in causing fall among stroke survivors [5]. Hence, stroke survivors with spatiotemporal asymmetric gait could be linked to more post-stroke falls[6]. The hemiplegic gait in stroke involves and depicts mechanical consequences of interactions among muscle weakness, spasticity,spastic activations, and abnormal synergistic activation[1]. Since mixture of deviations and compensatory motion dictated by residual functions characterized the post-stroke hemiplegic gait, it is important to identify and document the gait pattern of each stroke survivor[2].Altered spatiotemporal parameters such as low velocity, low cadence, short stride length, increased double support phases, and asymmetric single limb loading are typical characteristics of stroke survivors' gait [7]. Mobility recovery is a vital goal of rehabilitation for stroke survivors [8]. The development of effective gait training strategies will be aided through understanding the impairments which primarily determine the ability of stroke survivors to walk [9].

Hence this study is designed to determine the spatiotemporal parameters and walking characteristics and further determine how these parameters and characteristics differ across categories of time of walking onset post-stroke and categories of post-stroke duration of walking in stroke survivors.

Materials and Methods

This study purposefully recruited 164 community-dwelling ambulatory stroke survivors (without cognitive dysfunction) from four major tertiary hospitals in Kano, Nigeria. Those with gait disorders/ dysfunction before the stroke and those with severe/ limiting knee arthritis were excluded from the study. They were interviewed for their sociodemographics characteristics after which their spatiotemporal gait parameters and mobility parameters were clinically assessed. Their spatial variables including step length, step width/base of support (BOS), and stride length were measured in line with the method used previously [10]. During the measurement, a temporary ink was used to show the foot-print of the participants during ambulation, in order to obtain the foot print to measure the spatial gait parameters, an ink is placed on the posterior heel area of the feet of the participantsand they wereasked to walk through a 12-metre distance. The measurements were taken within the 10-metre measure with the walking through the first and last metre taken as acceleration and deceleration points. Participants were instructed to walk freely within the distance without being told what will be measured. This was done to disallowed trick movement that may affect the outcomes measured. The participants repeated each procedure for three times and the average best performance was documented as their measures.

The step length was measured as distances between heel contact of one foot to the following heel contact of the other foot while their Base of support was measured as the horizontal distance between two feet. Stride length was measured as distances between heel contact of one foot to the following heel contact of the same foot. In measuring temporal variables, stopwatch was used in measuring the parameters in seconds. Gait speed in meters per second was measured with 10-meter walking test, the gait speed was computed by dividing distance covered by the time taken to cover it. Cadence (steps per minute) was obtained as the number of steps covered per minute. Swing phase duration measured in seconds entails measuring period when a foot is not in contact with the ground during the swing phase of the gait cycle while stance phase duration measured in seconds entails measuring period when a foot is in contact with the ground during the stance phase of the gait cycle. The gait cycle duration was measured by combining periods of swing and stance phases duration and measured from first ground contact of a referenced lower extremity to the period when the same extremity contacts the ground again. Paretic initial double limb support time was measured as the period when both feet are on the ground firstly.

Participants' gait spatiotemporal symmetry characteristics/indices: gait asymmetry, symmetry ratio, symmetry index, and symmetry angle were derived from the primary spatiotemporal variables using the standardized recommended formulae[11]. The spatiotemporal symmetry characteristics were computed as follows

Gait asymmetry (GA): = |100 × [ln(Vparetic/Vnon-paretic)]|

Symmetry ratio (SR): = Vparetic/Vnon-paretic

Symmetry index: = [(Vparetic − Vnon-paretic)/0.5(Vparetic + Vnon-paretic)] ×100%

Symmetry angle: = [(45^0 − arctan (Vparetic/Vnon-paretic)) ×100%]/90

Where V in all the four symmetry equations above represent the spatiotemporal parameters including Step length, stride length, Swing time, stance time, intra-limb ratio, and initial double limb support time.

In addition to assessing gait spatiotemporal and symmetry parameters, walking characteristics were assessed by assessing the mobility variables (including lower extremity motor impairments, functional mobility, walking endurance, physical mobility, walking confidence, ambulation status, lower extremity function, and functional ambulation), and balance. The level of motor impairments in the lower extremities of the participants was measured with Fugyl-Meyer assessment scale which is highly recommended as a clinical and research tool[12]. Their functional mobility was measured using the Time up and go test (TUG)[13,14]. Walking endurance was measured using the 6-minute walk test [15]. Modified Rivermead mobility index was used in assessing physical mobility[16]while their walking confidence was measured using ambulatory self-confidence questionnaire[17]. Berg balance scale was used to measure balance [18].Their walking status was assessed with functional ambulatory category (FAC) [19]while the Lower Extremity Functional scale was used to measure the function of the lower extremity[20]. Modified Emory functional ambulatory profile was used to measure functional ambulation[21].

Data obtained was analysed using Statistical Package for Social Sciences (SPSS). Descriptive statistics of frequencies, percentages, mean, standard deviations, variance, and standard error was used to present the data on mobility and spatiotemporal parameters as well as spatiotemporal symmetry characteristics. Kruskal Wallis test was used to determine differences in spatiotemporal parameters and mobility parameters across categories of walking onset post-stroke and categories of post-stroke walking duration. Statistical significance was set at $p \leq 0.05$.

Results and Discussion

Results

The participants were aged 30 years and above. Larger percentage (54.9%) of the participants were within the age range of 51-71 years, the males were marginally (50.6%) more than females (49.4%) (Table 1). More (29.3%) of the participants had suffered stroke for between 3-6 months duration which equals to percentage of participants who suffered stroke for more than 12 months. More (39.6%) of the participants were discharged from inpatient hospital care within 24 hours of stroke onset. Most (59.8 %) of the participants commenced ambulation within the first one month of having a stroke while 29.3% of them had walked for between 1-3 months after stroke. Most (65.9%) participants were within functional ambulatory category of >4-≤6 (Table 1).

Table 2 contains the general description of mobility, spatiotemporal and balance parameters of the participants. The variabilities in mobility, spatiotemporal and balance parameters are shown in table 2. The spatiotemporal symmetry characteristics derived from the spatiotemporal parameters are also presented in table 3. In Spatial symmetry characteristics, stride length symmetry values including symmetry ratio, symmetry index, symmetry angle, and gait asymmetry were shown to be better than step length symmetry values (table 3). The result of the study revealed that gait temporal symmetry characteristics including stance time, swing time, and intralimb-ratio are in order of increasing gait asymmetry, symmetry index, and decreasing symmetry angle. In addition, double limb support time, stance time, swing time, and intralimb-ratio were found to be in order of increasing symmetry ratio (table 3).

The result of the study revealed that many of the spatiotemporal and mobility parameters significantly differ across categories of time of walking onset post-stroke (Table 4). Physical mobility, lower extremity function, walking confidence, balance, base of support, paretic swing phase duration, and paretic gait cycle duration significantly differ across categories of walking duration post-stroke (Table 5).

Table 1: Sociodemographic and clinical characteristics of the participants

Variables	**N**	**%**
Age categories (Years)		
30-50	64	39
51-71	90	54.9
72 and above	10	6.1
Duration of stroke (Months)		
≤ I	17	10.4
>1 to ≤ 3	36	22
>3 to ≤ 6	48	29.3
>6 to ≤1 2	15	9.1
>12	48	29.3
Onset of Walking post-stroke (months)		
≤ I	98	59.8
>1 to ≤ 3	44	26.8
>3 to ≤ 6	14	8.5
>6 to ≤12	7	4.3
>12	1	6
Duration of walking post-stroke (months)		
≤ I	24	14.6
>1 to ≤ 3	48	29.3
>3 to ≤ 6	35	21.3
>6 to ≤1 2	16	9.8
>12	41	25

***Cont...* Table 1: Sociodemographic and clinical characteristics of the participants**

Status of walking categories		
Dependent	56	34.1
Independent	108	65.9
Duration of hospitalization (days)		
≤ 1	65	39.6
>1 to ≤ 7	26	15.9
>7 to ≤ 14	39	23.8
>14 to ≤ 28	24	14.6
>28	10	6.1

N:Frequency %: percentage

Table 2: Description of mobility, spatiotemporal, and balance parameters of the participants

Variables	Mean±SD	SE	Variance
Ambulation			
Mobility parameters			
Walking endurance	141.88±77.90	6.08	6067.79
Ambulatory self-confidence	98.65±39.75	3.10	1580.19
Lower extremity function	34.55±17.66	1.38	311.98
Lower extremity motor impairment	23.88±7.41	0.58	54.86
Physical Mobility	35.33±6.30	0.49	39.68
Functional Ambulation	199.53±279.52	21.83	78128.95
Functional Mobility	44.8±64.16	5.01	4116.81
Gait spatiotemporal parameters			
Spatial variables			
Paretic stride length	65.40±23.24	1.81	539.92
Non-paretic stride length	60.89±22.65	1.77	513.12
Paretic step length	35.74±12.16	0.95	147.98
Non-paretic step length	32.26±12.22	0.95	149.21
Stride width/Base of support	20.38±05.79	0.45	33.56
Temporal variables			
Gait speed	0.43±0.27	0.02	0.072

Cont... Table 2: Description of mobility, spatiotemporal, and balance parameters of the participants

Cadence	53.84±22.75	1.78	517.47
Paretic Swing phase duration	0.82±0.55	0.04	0.31
Non-paretic swing phase duration	0.72±0.46	0.04	0.20
Paretic Stance phase duration	0.95±0.73	0.06	0.54
Non-paretic stance phase duration	1.03±0.69	0.05	0.48
Paretic Gait cycle duration	1.77±1.1	0.86	1.20
Non-paretic Gait cycle duration	1.75±1.0	0.78	1.00
Paretic Initial double limb support time	0.56±0.55	0.43	0.30
Non-paretic Initial double limb support time	0.61±0.63	0.49	0.40
Balance	40.78±11.43	0.89	130.61

SD: Standard deviation; SE: Standard error

Table 3: Description of Spatiotemporal symmetry characteristics of the participants

Variables	Mean±SD	SE	Variance
Gait spatiotemporal symmetry characteristics			
Spatial symmetry characteristics			
Stride length gait asymmetry	11.25±9.64	0.75	92.85
Step length gait asymmetry	18.1±12.03	0.94	144.64
Stride length symmetry index	11.19±9.34	0.73	87.27
Step length symmetry index	18.74±15.11	1.18	228.41
Stride length symmetry ratio	1.12±0.13	0.01	0.02
Step length symmetry ratio	1.22±0.21	0.02	0.05
Stride length symmetry angle	48.98±0.94	0.07	0.88
Step length symmetry angle	49.07±0.39	0.03	0.15
Temporal symmetry characteristics			
Swing time gait asymmetry	24.5±20.5	1.60	419.58
Stance time gait asymmetry	17.84±17.06	1.33	191.16
Intra-limb ratio gait asymmetry	35.33±28.85	2.25	832.32
Swing time symmetry index	23.84±19.46	1.52	378.58
Stance time symmetry index	21.58±53.34	4.16	2844.81
Intra-limb ratio symmetry index	34.38±26.54	2.07	704.47
Swing time symmetry ratio	1.29±0.32	0.02	0.10
Stance time symmetry ratio	1.20±0.21	0.02	0.05
Intra-limb ratio symmetry ratio	1.53±0.97	0.08	0.94

Cont... Table 3: Description of Spatiotemporal symmetry characteristics of the participants

Double limb support time symmetry ratio	1.16±0.35	0.03	0.12
Swing time symmetry angle	49.11±0.13	0.01	0.02
Stance time symmetry angle	49.19±0.13	0.01	0.02
Intra-limb ratio symmetry angle	49.09±0.15	0.01	0.02

SD: Standard deviation; SE: Standard error

Table 4: Comparison of mobility, spatiotemporal, and balance parameters across post-stroke walking onset categories

Variable	≤ I month (v) (n=65) Median (IQR)	>1 - ≤ 3 months (w) (n=65) Median (IQR)	>3 - ≤ 6 months (x) (n=65) Median (IQR)	>6 months (y) (n=65) Median (IQR)	H-value	p-value	Post-hoc
ML PRM.							
WEN	155.59(104.43)	96.00(129.79)	88.90(54.11)	97.85(108.61)	17.97	<0.001*	v, &w, v &x
LEMI.	28.00(10.25)	19.50(12.25)	19.00(13)	21(11.25)	21.83	<0.001*	v, &w, v &x
PML.	39(08)	38(11.25)	37.5(06)	38.5(6.75)	02.23	0.527	
FMB	20(16.63)	35(49.44)	37.56(35.51)	41.31(66.08)	25.40	<0.001*	v, &w, v &x
LEF	35.5(28.25)	34(31.75)	30.5(17)	35(28.25)	01.77	0.623	
FAMB	80.26(50.38)	153.15(308.89)	162.06(212.59)	165.97(394.40)	23.67	<0.001*	v, &w, v &x
ASC	100.5(52.25)	95.5(58.50)	93.5(51)	94.5(69)	03.58	0.310	
Balance	43.5(12.25)	41.5(19.75)	40.5(14.75)	44(27.25)	04.98	0.174	
GSPTV.							
PSTRL	72(34.5)	56(34)	48(29)	50(24.5)	11.80	0.008*	v &x
PSTPL	36(15)	32(20)	32.5(12)	36.5(16.75)	04.30	0.231	
BOS	19(05)	20(06)	22(10.5)	18.5(20.25)	02.60	0.457	
Gait speed	0.46(0.31)	0.29(0.37)	0.27(0.19)	0.27(0.30)	23.33	<0.001*	v, &w, v &x
Cadence	52(30.25)	43.5(31)	39(39.5)	45(44)	12.64	0.005*	v &w
PSWPD	0.60(0.46)	0.94(0.74)	1.28(1.26)	0.63(1.02)	08.80	0.044*	
PSTPD	0.79(0.41)	01.00(0.69)	1.01(0.76)	1.03(1.14)	11.78	0.008*	v &x
PGCD	1.45(0.73)	01.97(1.09)	2.47(1.70)	1.75(2.07)	15.35	0.002*	v, &w, v &x
PIDLS	0.30(0.31)	0.75(0.64)	0.83(0.57)	0.40(0.72)	26.69	<0.001*	v, &w, v &x

IQR: Interquartile range; ML PRM.: Mobility parameters WEN: Walking endurance, LEMI: Lower extremity motor impairment; FAMB:

Functional ambulation, PML: Physical mobility; FMB: Functional mobility; LEF: Lower extremity function, ASC: Walking confidence;

PSTRL: Paretic stride, length; PSTPL: Paretic step length; BOS: Base of support PSWPD: Paretic swing phase duration, PSTPD: Paretic stance phase duration; PGCD: Paretic gait cycle duration; PIDLS: Paretic initial double limb support time

Table 5: Comparison of mobility, spatiotemporal, and balance parameters across post-stroke walking duration categories

	Ambulatory duration post-stoke in months							
Variable	**≤ I(V) (n=65) Median (IQR)**	**>1 - ≤ 3(W) (n=65) Median (IQR)**	**>3 - ≤ 6(X) (n=65) Median (IQR)**	**>6 - ≤12(Y) (n=65) Median (IQR)**	**>12(Z) (n=65) Median (IQR)**	**H- value**	**P-value**	**Post-hoc**
ML PRM.								
WEN	127.50(111.00)	130.95(144.76)	180.00(139.70)	117.36(120.00)	120.00(91.10)	2.07	0.722	
LEMI.	29.00(12.00)	25.50(12.00)	26.00(10.00)	24.00(13.00)	20.00(15.00)	5.33	0.255	
PML.	39.00(08.00)	36.50(16.00)	39.00(16.00)	40.00(01.00)	39.00(04.00)	11.29	0.023*	X&Y
FMB	22.67(27.13)	20.25(23.61)	20.00(24.14)	24.91(43.45)	26.00(29.00)	4.49	0.344	
LEF	26.00(24.00)	30.00(27.00)	30.00(27.00)	36.00(26.00)	40.00(25.00)	11.56	0.021*	V&Z, X&Z, W&Z
FAMB	93.35(88.89)	90.00(154.55)	79.06(100.01)	94.31(181.18)	120.54(119.02)	4.69	0.321	
ASC	87.50(46.00)	90.50(49.00)	94.00(61.00)	109.00(56.00)	114.00(49.00)	12.20	0.016*	W &Z
Balance	41.00(13.00)	40.50(18.00)	41.00(15.00)	51.00(10.00)	46.00(10.00)	10.31	0.036*	W &Z, W&Y, V&Y
GSPTV.								
PSTRL	62.50(43.00)	62.50(37.00)	66.00(34.00)	75.00(41.00)	65.00(34.00)	2.05	0.726	
PSTPL	32.50(24.80)	32.00(19.80)	34.50(11.00)	38.00(16.00)	36.00(18.00)	3.07	0.546	
BOS	18.00(04.50)	19.00(04.00)	19.00(05.00)	22.00(08.80)	20.00(09.00)	9.82	0.043*	V&Y
Gait speed	0.39(0.28)	0.40(0.44)	0.50(0.41)	0.36(0.37)	0.36(0.25)	2.94	0.569	
Cadence	50.00(28.00)	49.00(32.00)	53.00(32.00)	51.00(34.00)	48.00(31.00)	1.36	0.851	
PSWPD	0.50(0.32)	0.60(0.48)	0.64(0.58)	1.20(1.47)	0.96(0.83)	15.20	0.004*	V&Z, V&Y
PSTPD	0.75(0.36)	0.80(0.52)	0.79(0.50)	1.00(0.58)	0.99(0.79)	2.80	0.592	
PGCD	1.36(0.66)	1.57(0.77)	1.47(0.92)	2.15(2.13)	1.85(1.30)	9.64	0.047*	V&Z, V&Y, X&Y
PIDLS	0.34(0.36)	0.37(0.43)	0.28(0.62)	0.86(0.62)	0.40(0.65)	8.36	0.079	

IQR: Interquartile range; ML PRM.: Mobility parameters, WEN: Walking endurance, LEMI: Lower extremity motor impairment; PML: Physical mobility; FMB: Functional mobility; LEF: Lower extremity function, FAMB: Functional ambulation, ASC: Walking confidence; PSTRL: Paretic stride length; PSTPL: Paretic step length; BOS: Base of support; PSWPD: Paretic swing phase duration, PSTPD: Paretic stance phase duration; PGCD: Paretic gait cycle duration; PIDLS: Paretic initial double limb support time

Discussion

The study evaluated spatiotemporal gait parameters and walking characteristics in community-dwelling ambulatory stroke survivors and determine how they differ across time of commencement of ambulation and duration of ambulation post-stroke. It is interesting to note that the stride length and step length of the paretic limb are longer than the non-paretic. This may be due to trick and compensatory strategies used during ambulation in hemiparetic stroke survivors. This corroborates the opinion of previous authors that longer paretic step length is associated with greater compensatory mechanisms of non-paretic limb propulsion as well as dependence on abnormal plexor and extensor synergy [22]. However, the results that the stride length symmetry values were better than the step length symmetry values may not be unconnected with the fact that stride length is attained with a complete gait cycle which entails series of coordinated activities and involve a full complement of all neuromuscular biomechanism during a gait cycle in contrast to the step length that only involve some biomechanism during a gait cycle.

The study has shown that in terms of temporal symmetry ratio, data of the study participants revealed that in order of increasing asymmetry; that double limb support time, stance time, swing time, and intralimb ratio symmetry ratios were found to be asymmetric and outside normal symmetry ratio range of (0.1-1.1) as reported by Alexander *et al*, (2009)[23]. This shows that the asymmetry observed in temporal parameters of gait in stroke survivors is due to the loss of neuromuscular synergy in the affected limb.

The fact that the obtained values of temporal symmetry ratio which were higher than the normal range, and that of the non-paretic stance phase being higher than paretic stance phase duration is of clinical relevance. It points to the fact that, to attain symmetry in gait of stroke survivors, rehabilitation experts should focus on the temporal parameters symmetry for improved walking performance and walking proficiency. It has been similarly reported by Alexander *et al*, (2009)[23] that increased non-paretic limb weight bearing duration with reduced paretic limb stance phase duration indicate temporal symmetry ratio higher than 1.1 during ambulation. It could therefore be deduced that walking with more even distribution in stance phase duration between paretic and non-paretic lower extremities may be ensued when better temporal symmetry ratios that are within normal range. Hence, to avoid usual falls due to loss of balance during walking in stroke survivors, more emphasis and attention should be focused on the concept of gait symmetry post-stroke. A previous study by Zhang *et al*, (2018)[24] had observed that gait asymmetry is one among the typical resulting impairments due to hemiparesis. Since spatiotemporal gait asymmetry is common post-stroke resulting in instability and injury during ambulation [25], efforts should be directed at providing clear understanding of their characteristics and extent as well as how they can be focused on during rehabilitation for better clinical outcomes for independent community functioning in stroke survivors.

The results of this study show significant difference in the walking endurance, lower extremity motor impairment, functional mobility, and functional ambulation across different categories of time of commencement of walking post-stroke. Notably, the differences were also significant in paretic stride length, gait speed, cadence, paretic stance phase duration, paretic gait cycle duration, and paretic initial double limb support time across categories of walking onset post-stroke. Most importantly, in most cases those who began walking within 1-month post-stroke had better parameters than those who commenced walking later. Although it may be assumed that those who commenced walking earlier post-stroke may have recovered motor function faster than those who commenced walking later, this cannot be associated with their severity of stroke at onset as it was difficult to retrospectively assess this even when their hospital record was explored. However, our assumption that they may have recovered motor function faster can be substantiated by the fact that they had lower limb motor function and ambulatory parameters better than the others who returned to walking later. The trends in the result of this study have shown that better outcomes in the parameters decreases in order of increasing categories of time of commencement of walking with those who commenced walking at above 3 months to as late as 6 months post-stroke having poorer outcomes in many of the parameters.This shows that the earlier the stroke survivors commence ambulation, the earlier their gait rehabilitation will commence and their prospect of improvement in their mobility and spatiotemporal gait parameters. This gives credence to early ambulation of stroke survivors to expedite functional recovery for community re-integration and possible return to work. This will reduce redundancy in stroke survivors and subsequently reduce the burden of cares on the informal caregivers. This supports the findings of Cumming *et al*, (2011)[26] that improvement in recovery of function and return to independent walking is accelerated with earlier and intensive post-stroke mobilization.It also agrees with that of Coleman *et al*, (2017)[27]that commencement of rehabilitation in the first two weeks post-stroke may result in improved outcomes. An earlier study had reported relative faster clinical improvement during three months post-stroke and continue thereafter slowly at 3-6 months post-stroke [28].

The result of this study shows that Physical mobility, lower extremity function, walking confidence and balance differ significantly across categories of walking duration post-stroke.Lower extremity function and walking confidence of those who have been walking for more than a year was better than those that have been walking for not up to a year. While Physical mobility and balance are better in participants who have been walking for more than six months but not more than a year. Therefore, the decreased physical mobility and balance in those who have been walking for not up to six months may not be unconnected with the fact that those group were just returning to walking after the onset of stroke and they may not have regained their confidence in walking and their balance still remains unstable

It is also worthy of note that the base of support, paretic swing phase duration, and paretic gait cycle duration were better in stroke survivors who had walking duration of at least six months than those who had been walking for less than six months. Consequently, there are better spatiotemporal and mobility gait parameters in those who had walking duration up to a yearpost-stroke, except for lower extremity function and walking confidence which extend beyond one year. It could be deduced from the findings that the mobility and spatiotemporal parameters are better with longer walking duration of greater than six months up to a year and even beyond. This is in tandem with the assertion that improvement and recovery in function post-stroke occur in the first 6 months and can continue beyond [28–30].This shows that the more and the longer a stroke survivor walks; the more they gain proficiency in walking and get better in several parameters and components required for normal walking function.

Conclusion

Spatiotemporal gait parameters and mobility parameters are severely abnormal in community-dwelling stroke survivors. Mobility and spatiotemporal parameters are better in stroke survivors who commenced walking as early as one month of stroke than those who commenced walking later and that the later the commencement of walking in stroke survivors, the more likelihood of having abnormal gait parameters. The earlier the commencement of walking and longer walking duration in stroke survivors, the more likelihood of recovering the mobility and spatiotemporal gait parameters/symmetry.

Conflict of Interest: None

Ethical Clearance: Ethical approval for the study was sought and obtained from the Health Research and Ethics Committees of College of Medicine of the University of Lagos, Aminu Kano Teaching Hospital and Kano State Ministry of Health. Participants consented to participate in the study before they were included in the study.

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