Assesment of body weight distribution on lower extremities of stroke survivors in quiet standing and while reaching for objects

Rufai Yusuf Ahmad*[1], Umar Bello[1], Jibril Sammani[1], Isa Muhammadu Tanko[2]
[1] Department of Physiotherapy, Bayero University, Kano, Kano State, Nigeria
[2] Department of Physiotherapy, General Hospital, Kumo, Gombe State, Nigeria

Abstract

Background: Majority of stroke survivors suffer problems of balance due to abnormal pattern of weight distribution on their lower extremities.

Objectives: The study was aimed to asses body weight distribution on the lower extremities of stroke survivors and healthy controls in quite stance and while reaching for an object.

Methods: forty two people with stroke (age 62.90± 7.70; 22 males) and forty two controls (age 39.30±13.73; 22 males) were asked to stand with each leg on a separate weighing scale and reach for three object placed 29.6 cm away from each other, one in the centre and two lateral to it on either side and 56 cm from the floor.

Results: People with stroke showed significant difference (P< 0.05) in weight distribution on the lower limbs in quite standing and all the reaching except for reaching to the affected side. In apparently healthy group, result showed significant difference (P< 0.05) in weight distribution on the lower limb in quite standing (Placing more weight on their right lower limb) and all the reaching tasks.

Conclusion: stroke survivors bear more weight on their unaffected side but those with right side affectation bore more weight on their affected side than those with left side affectation.

Key words: Stroke, weight distribution, lower limb, balance, quite stance

Introduction

Majority of stroke survivors suffer a number of neurological problems depending on the degree of cerebral affectation, which may include emotional, cognitive - sensory and motor impairments [1]. Impairments in motor function, makes them to adopt compensatory strategies during activities of daily living (ADL) as such they tend to put more of their weight towards the non affected side thereby unloading the affected side. This may lead to an unequal weight distribution on the lower extremities. Adequate body weight distribution in lower extremities is an important aspect of balance.

Forward trunk bending and reaching for objects is a frequent encounter in the activities of daily living. There is a need for postural stability which is an essential factor that gives proper balance and allows individuals to perform ADLs without falling [2]. In stroke patients improper body symmetry destabilizes the body segments making it difficult to attain balance which poses an individual to a high risk of falls [3]. Tsaklis et al., [4] and Genthon et al.[5] used electronic force pressure plat form to assess the weight bearing and stability in people with stroke and measured percentage weight on each leg of stroke patients respectively. This pressure platform is expensive and rare in circulation. However, bath room scale was used by Bahannon et al., [6] to assess weight bearing. None of these studies measured the pressure in each lower extremity of stroke survivors while reaching for an object.

It was hypothesized that there will be no significant difference in weight distribution in the lower extremities of stroke survivors and healthy individuals in quiet standing. Furthermore, there will be no significant difference in weight distribution in the lower extremities of stroke survivors and healthy individuals while reaching for an object at different points (towards the centre, towards the affected side and toward the unaffected side).

2. Methods:

2.1 Participants:

Participants with stroke were patients with a history of stroke at least six months, were able to understand and follow instructions, able to stand and walk with little or no support and capable of utilizing their upper extremities The healthy individuals had no musculoskeletal, neurological or cardiovascular conditions that will limit their participation in the study.

Participants with stroke were excluded if they had ataxia, severe spasticity, limb length discrepancy or with recent orthopedic conditions.

2. 2 Material and procedure:

Two weighing scales (CAMIRY ® Product) with a capacity of 120kg, with probable error of ± 1.2 digits in individual with weight <60kg and ± 2.0 digits in individual with weight >60kg were used. The scales were placed together to allow a distance of 20 cm between the feet (Pereira et al., 2010) while each foot rest in the centre of the scale, the scales were placed 79cm away from a table where three plastic cups placed 29.6cm away from each other on a table (one in the centre and the other lateral to it on either side) making a distance of 55cm from the floor.

The participant's body weight was assessed using a single weighting scale. The height of the participants was also measured and the body mass index (BM) was calculated. The participants were then asked to stand with each foot on a separate weighing scale as erect as possible, the researcher ensured a distance of 20cm between feet by drawing a line on each scale (the lines were 20cm away from each other). The researcher also made sure that the feet lie in the same angle (30^0 away from a midline), then the participants were instructed to reach for objects placed towards the right side, the centre, and left side. The weight applied on each lower limb was recorded in a proforma for both the stroke survivors and healthy individuals for all the reaching tasks performed.

3.3 Data Analysis:

The date collected from the patients was summarized using descriptive statistic of mean, standard deviation, frequency and percentages. Independent t- test was used to compare the mean weight distribution between the two groups. All statistical analysis was performed using statistical package for social science (SPSS) Version 16 at probability level of 0.05.

Results

A total of 84 participants took part in the study, 42 stroke survivors (stroke group) and 42 apparently healthy individuals (Healthy group). The mean age of the stroke group was 62.90± 7.70 age; age range of 48-75 years. The mean age of the healthy group was 39.38± 13.73; age range of 22-72 years. The mean weight of participants in healthy and stroke groups were 57.33±6.21 and 66.38± 10.97 respectively.

Both the stroke and healthy groups consisted of 22(52%) males and 20(48%) females. Thirty (71%) participants in the stroke group were right hand dominant, and 28(67%) of the participants in the healthy group were also right hand dominant. In the stroke group, most of the participants 25(60%) had the lesion in their right cerebral hemisphere. Table 1, shows the demographic characteristic of the participants.

Table 1: Demographic characteristic of the participants

Variables	Group	M±SD	n(%)
Age	**Stroke**	62.90± 7.70	42
	Healthy	39.38± 13.73	42
Gender	**Stroke**		
	Male		22(52)
	Female		20(48)
	Healthy		
	Male		22(52)
	Female		20(48)
Weight	**Stroke**	66.38±10.97	42
	Healthy	57.33±6.21	42
DH	**Stroke**		
	Right		30(71)
	Left		12(29)
	Healthy		
	Right		28(67)
	Left		14(33)
SOL	**Stroke**		
	Right		25(60)
	Left		17(40)

M±SD=mean and standard deviation; n=frequency, DH=Dominant Hand, SOL= side of lesion; n= (%)

The mean weight distribution between the two lower extremities of the stroke group were significant ($P<0.05$) when compared while in quiet stance, reaching to the centre and reaching to the unaffected side. However, there was no significant difference in weight distribution between the two limbs when the participants were reaching to the affected side ($P>0.05$). This is presented in table 2.

Table 2: Mean weight distribution on lower extremities of stroke survivors.

Activities	Lower Limb	n	Mean ±SD	t	p-value
QST	Unaffected	42	38.85±6.71	8.372	0.000*
	Affected		42	27.61±5.53	
RTC	Unaffected	42	37.09±7.48	5.685	0.000*
	Affected	42	29.00±5.40		
RTNA	Unaffected	42	44.14±10.48	11.569	0.000*
	Affected	42	23.61±4.71		
RTAF	Unaffected	42	32.11±8.96	-1.151	0.253
	Affected	42	34.14±7.02		

KEY ; t= t value p = probability level, M±SD=mean and standard deviation, *= Significance at p<0.05, QST = Quite stance, RTC = Reaching to the centre , RTNA = Reaching to the unaffected side, RTAF= reaching to the affected side, n=frequency.

The mean weight distribution between the lower extremities of the apparently healthy group were compared while in quiet stance, reaching to the centre and reaching to the left and to the right lower limbs; the results were significant (P<0.05). This is presented in table 3.

Table 3: Mean weight distribution between lower extremities of apparently healthy individuals.

Activities	Lower Limb	n	Mean ±SD	t	p-value
QST	Right LL	42	30.19±3.52	2.240	0.028*
	Left LL	42	28.00±5.26		
RTC	Right LL	42	27.28±3.38	-5.143	0.000*
	Left LL	42	31.76±4.51		
RTRT	Right LL	42	35.28±3.96	12.44	0.000*
	Left LL	42	23.04±4.99		
RTLT	Right LL	42	20.76±5.51	-10.68	0.000*
	Left LL	42	38.14±8.98		

KEY ; t= t value p = probability level, SD= Standard Deviation, *= Significance at p<0.05, QST = Quite stance, RTC = Reaching to the centre , RTRT = Reaching to the right, RTLT= Reaching to the affected side, LL=Lower Limb.

Table 4 shows the mean weight distribution between the two lower extremities in stroke survivors having right side affectation and those with left side affectation. In stroke survivors with right side affectation, the result revealed significant difference in quite standing, reaching to the centre, reaching to unaffected and affected side. While in those with left side affectation, the result revealed significant difference in quite standing, reaching to centre and reaching to the unaffected side but no significant difference while reaching to the affected side in stroke survivors with left side affectation.

Table 4: Mean weight distribution between lower extremities of stroke survivors with right side affectation and those with left side affectation.

Side of affectation	Task	Lower Limb	M±S	p-value
RIGHT SIDE	QST	Right	28.78±4.97	0.000*
		Left	39.85±6.78	
	RTC	Right	31.07±5.18	0.031*
		Left	37.21±8.63	
	RTN	Right	26.14±4.41	0.000*
		Left	43.57±11.42	
	RTA	Right	36.57±6.86	0.027*
		Left	32.21±10.57	
LEFT SIDE	QST	Right	38.35±6.75	0.000*
		Left	27.03±5.78	
	RTC	Right	37.03±7.01	0.000*
		Left	27.96±5.29	
	RTN	Right	44.42±10.19	0.000*
		Left	22.35±4.39	
	RTA	Right	32.07±8.26	0.675
		Left	32.92±6.90	

M±SD= Mean and standard Deviation, P=* Significant, QST= quite stance, RTC= Reaching to the centre, RTN – Reaching to unaffected side, RTA = Reaching to the affected side.

Discussion

This study was carried out to assess the body weight distribution in the lower extremities of stroke survivors in quit stance and while reaching to objects placed at the centre, and towards the affected and unaffected sides. The results of this study revealed significant difference in weight distribution between affected and unaffected lower limbs in the stroke group during quite stance. They tend to bear more weight on their unaffected side of the body. This is in line with the findings of Pereira et al.[7] that stroke survivors placed about 54% of their body on the unaffected side.

The results of this study showed significant difference in weight distribution of the lower limbs of stroke survivors while reaching to the centre and to the unaffected side with the participants bearing more weight on the unaffected lower limbs. This may be attributed to the fear of losing balance and probably fall. However, Cheng et al.[3] reported that there was no relationship between weight bearing symmetry and falls. The result showed no significant difference in weight distribution between lower limbs while reaching to the affected side, indicating that the individuals did not transfer much weight on this side compared to when they reached towards the unaffected side. This might be as a result of poor muscle strength on the affected side.

The result of weight distribution on lower extremities in apparently healthy participants showed that there was a significant difference in the weight bearing between the two limbs in quite standing, while reaching to the centre, reaching to the right, and reaching to the left side. These

findings can be explained by the finding of Karski and Karski [8] that about 80-90% of people stand on the right leg because of abduction contracture or restricted adduction and the fact that the right hip is stronger, more stable and consequently easier for standing.

The results also revealed significant difference in weight distribution on lower limb of stroke survivors with right affectation in quite standing, reaching to the centre and reaching to the unaffected but showed no significant difference while reaching to the affected side. This means that stroke survivors bear more weight on their affected lower limb when reaching out to the affected side. Even though there was no significant difference, the results showed slight weight bearing on right affected lower limb while reaching than in stroke patients with left lower limb paresis. This finding is in line with the findings of Geurt et al. [9] which showed that patients with the right brain hemispheric stroke (i.e. with left side affectation) had some more problems during voluntary weight shifting.

Based on the analyzed result it is clearly shown that stroke survivors bore more weight on their unaffected lower limb. Although apparently healthy individuals do not have a uniform weight distribution, they show significant difference in weight distribution while reaching towards objects. Whereas stroke survivors do not have this difference in weight distribution similar to that of healthy individuals while reaching towards the affected side. It is also seen that stroke survivors with right side affectation can bear more weight on their affected side compared to stroke survivors with left side affectation.

Conclusion

On the findings of the study, it can be concluded that stroke survivors bear more weight in their affected lower extremity in quite standing and while reaching forward for object towards the centre, towards the unaffected side and a little more weight on the affected side. As well stroke patients with right side of the body affectation bear more weight on the affected - than those with left side affectation.

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Corresponding author:

*Rufai Yusuf Ahmad

Department of Physiotherapy,

Bayero University, Kano.

Email: ryahmad.pth@buk.edu.ng.