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Correlation between physical activity levels and clinical variables in stroke survivors

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Abstract

Increased levels of physical inactivity leads to increased disability level which results to decreased in balance status among stroke survivors. Balance problems are major co-morbidities stroke survivors are posed with. The current study was undertaken to investigate the relationship of physical activity profile and selected clinical variables of stroke survivors ; disability level, balance status and duration of stroke in selected tertiary hospitals in Anambra State, Nigeria. Sixty-eight (68) participants were recruited for this study of which 46 were males and 22 were were females. Physical activity level were measured using a 7-day International Physical Activity Questionnaire-short form (IPAQ-SF), Clinical variables like disability level were measured using Modified Rankin Scale, balance status were measured using Berg Balance Scale. Demographic data were collected which included weight, height, BMI and duration of stroke. The data was tabulated, analyzed statistically and discussed. It was found that physical activity level showed significant positive correlation in clinical variable like balance status, significant negative correlation was found between physical activity level and disability level, also between balance and disability level, non-significant negative correlation was found between physical activity level and duration of stroke incidence. In conclusion, physical activity showed a significant decrease in disability level and balance status. Developing strategies needed to promote and maintain physical activity in stroke survivors as well as potency of physical activity are important to decrease disability level and improve muscle strength adequate enough to maintain balance and good posture. Balance is greatly affected in sitting and high level of disability.

Keywords: Stroke Survivor; Physical activity; Disability; Balance level; Duration of Stroke

1 Introduction

Cerebro-vascular accident more popularly known as Stroke is an event with often devastating consequences. It is a leading cause of mortality and morbidity globally [1].The global stroke burden has been projected to likely increase from 38 million of disability-adjusted life years in 1990 to 61 million in 2020 [2, 3]. During the past years several epidemiological studies have revealed the associations of a number of factors relating with stroke.The evidence

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supporting benefits of physical activity (PA) on fitness, functioning, health and secondary prevention after stroke is compelling. However, many stroke survivors remain insufficiently active [4]. Early rehabilitation that includes Physical activity, early mobilization and increased amount of motor activity is hypothesized to be one of the most important factors contributing to the beneficial effect of comprehensive stroke unit treatment which has an effect on their clinical variables which include; their balance status, disability level, whereas too much bed rest is hypothesized to be harmful [5].

Other factors that causes stroke reocurrance includes but not limited to increased blood pressure, cigarette smoking and diabetes mellitus, which are widely accepted as being causal, while High Blood Pressure (HBP) ranks as a major risk factor for stroke and its reoccurance [6]. Although, With increasing sophistication in medical care of stroke incidents, there is a gradual increase in stroke survivors with stroke related morbidities, the health cost remains high [7]. Hence, preventive measures may be the better option given the high health cost of stroke management and the morbidities stroke survivors are faced with.

Preventive measures entails approaches to decrease risk factors thus decreasing the likelihood of stroke occurring in the first instance. This preventive measures includes Pharmacological and Non Pharmacological approaches. Physiotherapists are key players in the non- pharmacological approach of preventing stroke and its reoccurance. The non- pharmacological approaches for stroke control in hypertension as the main risk factor include weight reduction, dietary plan and regular physical activity (PA) [8].

Physical activity is defined as any bodily movement produced by skeletal muscle that results in energy expenditure above a basal level and is associated with balance status, reduced disability level, improved cardiovascular risk factors including reduced blood pressure [9]. (Booth *et al.,*2012). The risk of a first-ever stroke, ischemic or hemorrhagic, is associated with lower amounts of physical activity [10].

Risk modeling studies, based on data from primary prevention studies, have suggested that physical activity is likely to reduce the risk of recurrent stroke. It has been considered to be clinically relevant in the management of stroke, and Physical activity (PA) alone has been reported to offer reduction of up to 12mmHg in systolic Blood Pressure (BP) and 5mmHg reduction in diastolic BP [10]. Current evidence shows that a higher level of physical activity is associated with a decreased risk of stroke and has beneficial effects on stroke risk factors, and results in lesser stroke severity and a better long-term outcome following stroke.

However, increased levels of physical inactivity have negative impacts on health systems, the environment, economic development, community well-being and quality of life which results to increased disability level in Stroke Survivors, hence this study investigated the relationship of physical activity profile on selected clinical variables of stroke survivors by examining the relationship between physical activity (PA) level, disability level and balances status of stroke survivors.

Nevertheless, balance problems is a major co-morbidities stroke survivors are posed with, the restoration of balance is considered a key aspect of stroke rehabilitation because balance is believed to be an essential precursor of the restoration of independence in activities of daily living (ADLs), functional mobility, and prevention of falls among Stroke survivors [11]. The use of measurement tool that will cover a wide range of abilities, in doing so, the validity of International Physical activity Questionnaire- Short Form (IPAQ-SF), Modified Rankin Score(MRS) and Berg Balance Scale (BBS) was assessed [12].

International Physical activity Questionnaire- Short Form (IPAQ-SF) is a 9-item questionnaire that records activity of four intensity level; vigorous, moderate, walking and sitting.

The Modified Rankin Scale (MRS) is a single item, global outcomes rating scale for stroke survivors. It is used to categorize level of functional independence with reference to pre-stroke activities rather than on observed performance of a specific task [13]. MRS assessments can be used to describe impairment, activity, participation, and quality of life [12].

The Berg balance scale is used to objectively determine a patient's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14 item list [14]. It does not include the assessment of gait.The Berg Balance Score (BBS) is the best-known balance measurement tool, originally designed to measure balance in older individual, but the issue of balance is something common among communities with neurological deficit including stroke,the items evaluate the ability to maintain static positions of increasing difficulty by decreasing the base of support progressing to dynamic activities of varying difficulty.

2 Material and methods

This study was an analytical cross-sectional survey in which the participants were stroke survivors who were receiving treatment from the out-patient Physiotherapy departments of Nnamdi Azikiwe University Teaching Hospital (NAUTH), Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH), Onitsha General Hospital in Anambra State. The participants were consecutively recruited from Physiotherapy out-patient departments of selected health facilities. The health facilities was selected using convenience sampling technique.The study instrument was a 7-day International Physical activity Questionnaire-short form (IPAQ-SF) to assess Physical activity level.The IPAQ-SF is a 9-item questionnaire that records activity of four intensity level; vigorous, moderate, walking and sitting. The IPAQ-SF was reported to have acceptable measurement properties for monitoring population levels of PA among us18 to 65 years old adults in diverse settings. It has a test-retest reliability and criterion validity of r= 0.8 and r=0.3 respectively.

Modified Rankin Scale was used to assess the degree of disability in patients who have had a stroke towards Physical activity (PA). Modified Rankin Scale (MRS) is an ordinal scale that consists of 7 grades ranging from 0 (no symptoms) to 6 (death) measuring the degree of disability or dependence in everyday life [15]. Berg balance scale was used to assess patient's ability (or inability) to safely balance during a series of predetermined tasks. Berg Balance Scale is used to objectively determine a patient's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14 item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function and takes approximately 20 minutes to complete [14].

Automatic blood pressure monitor: Blood pressure (mm/Hg) was measured with an automatic blood pressure monitor. After the initial 5 minutes rest, the participant was placed in a relaxed sitting position with the arm supported on the table at the heart level [16]. The cuff of the automatic monitor was wrapped around the upper arm just above the cubital fossa and the on-button of the monitor was pressed. After a short while, the blood pressure of the participant was displayed and it was recorded.

Stadiometer: The heights of the participants was measured using the stadiometer (SECA model). To assess height, the participants was asked to stand backing the stadiometer, barefooted and their heels was positioned against the vertical calibrated stand with their scapula, buttocks and heels resting against the wall. The female participants will be asked to remove their hair-wear. The readings was taken by the researcher standing in front of the participants and the zero mark was checked after every reading for accuracy. While the weight will be obtained using the weighing scale. The participants was asked to stand barefooted on weighing scale looking straight while the researcher read the weight. The readings was taken by the researcher standing in front of the subjects and the zero mark was checked after every reading for accuracy.

Bio-data of the study participants that has had stroke was obtained.

Ethical approval was sought and obtained from committee of the selected hospitals before commencing the study.The informed consent of each of the prospective respondents was obtained. Following permission from the various heads of the outpatient department, information was obtained on the following variables: Age, blood pressure, gender, duration of stroke incident, height and weight. In addition, Physical activity levels in Stroke survivors was assessed using international physical activity questionnaire short form (IPAQ-SF), while disability levels was assessed using the Modified Rankin Scale(MRS) and finally the balance status of stroke survivors was assessed using Berg Balance Score(BBS).

Modified Rankin Scale (MRS) is an ordinal scale that consists of 7 grades ranging from 0 (no symptoms) to 6 (death) measuring the degree of disability or dependence in everyday life.

Berg Balance Scale is used to objectively determine a patient's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14 item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function and takes approximately 20 minutes to complete [12].

Physical activity (PA) level: PA level of participants was assessed using 7-day international physical activity questionnaire short form (IPAQ-SF). The IPAQ-SF is a 9-item questionnaire that records activity of four intensity level; vigorous, moderate, walking and sitting. The IPAQ-SF was reported to have acceptable measurement properties for monitoring population levels of PA among us18 to 65 years old adults in diverse settings. It has a test-retest reliability and criterion validity of r= 0.8 and r=0.3 respectively [15]. The IPAQ-SF was scored by rating PA level as multiples of

metabolic equivalent (METs). Expressed as MET-min per week: Vigorous (8 METs), moderate (4 METs), Walking (3.3 METs). For instance, walking activities are rated as a product of average minutes, number of days and 3.3 METs.

Continuous score (Short form):

Expressed as MET- min per week: MET * minutes of activity * event per week.

A sample size of 68 has a 95% power of detecting an effect size of 0.4 at an alpha level of 0.05.

The data was summarized using descriptive mean and standard deviation as well as frequency and proportion. Data was explored for normality using kolmogorov-smirnov test. Correlation between physical activity levels and clinical variables of stroke survivors was done. Level of significance for all calculations was set at $p< 0.05$.

3 Results and discussion

Participants in this study were stroke survivors who were receiving treatment from the out-patient Physiotherapy departments of Nnamdi Azikiwe University Teaching Hospital (NAUTH), Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH), Onitsha General Hospital in Anambra State. Sixty eight (68) participants comprising of forty-six (46) male and twenty- two (22) female with a mean age of 25.43±4.66 years participated in this study.The average selected clinical variables were; height (157.6±11.121), weight (55.63±4.450), body mass index (BMI) (22.916±4.0687), duration of stroke (16.07±13.248), disability level (3.72±1.314), balance level (27.88±14.293) and physical activity level (33211.53±42062.872),Table 1.

Table 1 Average distribution of participant's age,height, weight, Body Mass Index (BMI), dration of stroke, level of disability, balance level and physical activity levels

Variables	N	Minimum	Maximum	Mean±STD
Height (M)	68	124	186	157.06±11.121
Weight (Kg)	68	45	70	55.63± 4.458
Duration of Stroke	68	1	48	16.07±13.248
Berg Balance Scale	68	6	56	27.88±14.293
Modified Rankin Score	68	1	5	3.72±1.314
IPAQ (METs)	68	0	139398	33211.53±42062.87
BMI	68	15.7	35.8	22.918±4.0687
Age	68	45	78	58.59±6.752
Valid N (listwise)	68			

The relationship between the t-value and the p-value may be use to define the hypothesis and also to determine the relationship between the mean of two variables. In Table 2, t-value was found to be higher in duration of stroke (for both male and female) and disability level (for both male and female), with corresponding significant p-value. This could mean significant relationship in mean values P- value for other parameter were found to be higher which depicts non significance relationship.

In Table 3, 26 (37.1%) of the participants are bounded to wheelchair, 22 (31.4%) walk with assistance while 20 (28.6%) are independent. The term, wheelchair bound, walking with assistance and independent is a measure of balance status using berg balance scale.

Level of disability, is measured with modified rankin scale which uses 5-point scale to score disability level. 8(11.4%) show No significant disability despite symptoms; able to carry out all usual duties and activities, 5 (7.1%) Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance, 7 (10%) Moderate disability; requiring some help, but able to walk without assistance, 26 (37.1%) Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance, and 22 (31.4%) showed Severe disability; bedridden, incontinent and requiring constant nursing care and attention.

Table 2 Descriptive mean distribution of variables; height, weight, BMI, duration of stroke, balance level, level of disability and physical activity level in relation to gender

Variable	Gender	N	Mean	Std. Deviation	T-value	P-value
Height (M)	Male	46	157.76	±10.669	.750	.456
	Female	22	155.59	±12.137	.717	.478
Weight (Kg)	Male	46	55.67	±4.527	.110	.912
	Female	22	55.55	±4.416	.111	.912
Duration of Stroke	Male	46	18.37	±14.251	2.120	.038
	Female	22	11.27	±9.437	2.439	.018
Berg Balance Scale	Male	46	25.70	±13.353	-1.857	.068
	Female	22	32.45	±15.405	-1.765	.086
Modified Rankin Score	Male	46	3.96	±1.173	2.202	.031
	Female	22	3.23	±1.478	2.029	.050
IPAQ (METs)	Male	46	27162.44	±35868.401	-1.741	.086
	Female	22	45859.61	±51383.282	-1.537	.134
BMI	Male	46	22.674	±3.7070	-.712	.479
	Female	22	23.427	±4.7923	-.650	.520

Table 3 A Frequency distribution of berg balance scale, level of disability score

Variable	Frequency	Percent (%)
Wheel chair bound	26	37.1
Walking with assistance	22	31.4
Independent	20	28.6
N	68	100

3.1.1 Level of disability scoring of modified Rankin scale

Table 4 Frequency distribution for Level of disability scoring of modified Rankin scale

Level of disability score Modified rankin score	Frequency	Percent (%)
No significant disability despite symptoms; able to carry out all usual duties and activities	8	11.4
Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance	5	7.1
Moderate disability; requiring some help, but able to walk without assistance	7	10.0
Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance	26	37.1
Severe disability; bedridden, incontinent and requiring constant nursing care and attention	22	31.4
N	68	100

Majority of the participant showed Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance (37.1%). Similarly, some showed severe disability; bedridden, incontinent and requiring constant nursing care and attention (31.4%). 10% of the study participant showed Moderate disability; requiring some help, but able to walk without assistance; 7.1% of them had Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance while 11.4% of them showed No significant disability despite symptoms; able to carry out all usual duties and activities. [Table 4]

Statistically significant positive correlation was found between physical activity level and balance level. Significant negative correlation was found between physical activity level and disability level, also between balance and disability level. Not significant negative correlation was found between physical activity level and duration of stroke incidence.[Table 5].

Table 5 Correlation between physical activity level (IPAQ-METs), duration of stroke, level of disability, balance level

		Duration of stroke	**Balance status**	**Disability level**	**IPAQ (METs)**
Duration of Stroke	R	1.000	-0.181	.220	-0.061
	p-value	.	0.140	0.071	0.618
Balance status (Berg balance)	r	-0.181	1.000	-0.929**	0.730**
	p-value	0.140	.	0.000	0.000
Disability level (Modified Rankin Scale)	R	0.220	-0.929**	1.000	-0.735**
	p-value	0.071	0.000		0.000
IPAQ (METs)	R	-0.061	0.730**	-0.735**	1.000
	p-value	.618	.000	.000	.

3.2 Test for Hypothesis

3.2.1 Hypothesis 1

Statement: There would be no significant correlation between Physical activity (PA) level and disability level of stroke survivors receiving treatment in selected hospitals in Anambra State.

Test statistics: Pearson's correlation

Alpha level: 0.05

Correlation coefficient: -0.735

p-value: 0.000

Judgement: Since the p-value was lesser than 0.05, the hypothesis was thereby **rejected.**

3.2.2 Hypothesis 2

There would be no significant correlation between Physical activity (PA) level and relationship and balances status of stroke survivors receiving treatment in selected hospitals in Anambra State.

Test statistics: Pearson's correlation

Alpha level: 0.05

Correlation coefficient: 0.730

p-value: <0.000

Judgement: Since the p-value was less than 0.05, the hypothesis was thereby **rejected**.

3.2.3 Hypothesis 3

Statement: There would be no significant association between disability levels and balance status of stroke survivors receiving treatment in selected hospitals in Anambra State.

Test statistics: Pearson's correlation

Alpha level: 0.05

Correlation coefficient: -0.929

p-value: <0.000

Judgement: Since the p-value was less than 0.05, the hypothesis was thereby **rejected**.

3.2.4 Hypothesis 4

Statement: There would be no significant correlation between Physical activity (PA) level and duration of stroke incident in stroke survivors receiving treatment in selected hospitals in Anambra State

Test statistics: Pearson's correlation

Alpha level: 0.05

Correlation coefficient: -0.061

p-value: 0.618

Judgement: Since the p-value was greater than 0.05, the hypothesis was thereby **accepted**.

3.2.5 Hypothesis 5

Statement: There would be no normal distribution between Physical activity (PA) level, balance status and disability level in stroke survivors receiving treatment in selected hospitals in Anambra State

Test statistics: Kolmogorov-smirnov

Alpha level: 0.05

p-value: 0.000

Judgement: Since the p-value was lesser than 0.05, the data **will not be normally distributed**

The relationship between physical activity and stroke is complex and of utmost interest to clinicians, therapists, and epidemiologists. The main aim of this study was to investigate the relationship of physical activity profile and selected clinical variables :disability level, balance status and duration of stroke in selected tertiary hospital. The result of this study showed that majority of the participants was males. This is in agreement with the study of Quinn *et al*., [13], who also reported majority of male stroke survivors in their study, this could be that males are more predisposed to stroke than females.

Table 6 The kolmogorov-smirnov test for Normality

	Kolmogorov-Smirnov		
	Statistic	**df**	**p-value**
Berg Balance Scale	0.208	46	0.000
	0.277	22	0.000
IPAQ (METs)	0.308	46	0.000
	0.357	22	0.000
Modified Rankin Score	0.276	46	0.000
	0.290	22	0.000
p- Value is significant at p≤0.005.			

According to the findings of this study, disability level increases drastically with decrease in physical activities, this finding is similar to a related study by Saunders *et al*., [17], who found out that increase in physical activity (including exercise) after stroke is viable for improving fitness and other associated post stroke functional problems. The reason for the increase in disability level in high-functioning stroke survivors maybe due to decrease in physical activity profile including walking. Thus, this finding should motivate the professional body and Nigeria physiotherapists as individuals to augment their efforts in developing strategies needed to promote and maintain physical activity in stroke survivors. Physical activity level was also found to influence the balance status of stroke survivors, as the balance status in a stroke survivor decreases directly, the level of physical activities decreases.

The result further showed that as the level of disability increases in a stroke survivor, balance is hugely distorted, and vice verse. This finding is reported by Teasell *et al*., [18], who found the relationship between balance and disability to be inverse as balance is greatly affected in sitting, walking, transfer and in high level of disability such as premorbid disability, mobility disability, in activities of daily living etc. Reason for this maybe because most stroke survivors had limited sitting balance which maybe because they were disabled. Thus, this finding should encourage stroke survivors with sitting ability and balance. Physical activity level is also independent on the duration of stroke. This finding is similar to a related study by Gallanagh *et al*., [19], who found out that Physical inactivity among stroke survivors within a longer duration was implicated one of the 5 key risk factors which account for more than 80% of the global burden of stroke reoccurrence, disabilities, residual impairments such as reduced mobility, poor balance, and decreased muscle strength making physical activity more challenging and a sedentary lifestyle more likely. Thus, this finding should encourage physical activity which has increasing evidence based in the primary and secondary prevention of stroke, decreased stroke duration and in stroke rehabilitation.

4 Conclusion

The result of this study suggests a relationship between physical activity levels, disability level; balance status and duration of stroke in a stroke survivor. Physical activity is associated with a better quality of life and promotes improvement in function in a stroke patient. This study does imply that stroke patients, should be encouraged to be more physically active, in order to gain the health benefits that physical activity can contribute to balance improvement and reduces disability level Further, the implications could be generalized globally, to encourage stroke patients around the world to be more active.

Compliance with ethical standards

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Disclosure of conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statement of ethical approval

The study was approved by the institution's Health Research Ethical Committee (HREC) at the Nnamdi Azikiwe University (NAU/FHST/2021/MRH44).

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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