

Lung Function Abnormalities and its Associated Factors Among Stroke Survivors in Two Tertiary Hospitals in Southwest Nigeria.

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ABSTRACT

Background: Stroke is a medical condition with significant influence on daily life activities among its survivors who have residual motor deficit. The motor deficit could affect respiratory muscles and this can contribute to a reduction in ventilatory function. The study aimed to assess the spirometric abnormalities in stroke survivors and to explore its relationship with the degree of disability, the stroke type and the affected brain hemisphere.

Methods: It was a cross-sectional study among stroke survivors with brain CT scan confirmed stroke. The participants had spirometry done and interpreted based on the ATS/ERS criteria using MIR Intermedical Spirolab spirometer produced by Intermedical Limited UK.

Results: One hundred stroke survivors with a modified Rankin scale (mRS) range of 0–3 and with no underlying respiratory disease were involved in the study. The participants had a mean age of 64.5±8.6 years and 82% of them had ischaemic stroke. Restrictive ventilatory pattern (seen in 43%) was the most common spirometric pattern observed among the participants. No significant relationship was observed between the spirometric pattern and the type of stroke ($p=0.432$). There was a significant relationship between the mRS score and the spirometric measurements (FVC z-score and FEV1 z-score); $p<0.001$ and $p=0.003$, respectively. Respiratory symptoms occurred in 13% of the participants and those with respiratory symptoms had a significantly shorter duration since diagnosis of stroke compared to those without respiratory symptoms ($p=0.032$).

Conclusion: Restrictive ventilatory pattern is common among stroke survivors and their lung function reduces with increasing degree of disability.

Key words: Forced Vital Capacity, Forced Expiratory Volume, Stroke, Spirometry, Respiratory Muscles

1. INTRODUCTION

Stroke can be defined as a fast-developing clinical signs of neurological dysfunction attributable to focal infarction in the brain, retina or spinal cord, or a focal blood collection inside the brain tissue, ventricles or the subarachnoid space that cannot be attributed to trauma¹. It can be divided into two broad types including haemorrhagic and ischemic stroke with about 87% of strokes being ischemic and 13% being haemorrhagic².

Stroke is a very common cause of long-standing disability and mortality worldwide and it is of major public health concern³. It is the second leading cause of death and disability worldwide⁴. About 15 million people all over the world develop a stroke annually out of which five million die and another five million end up being permanently functionally limited (with facioparesis, hemiparesis or hemiplegia)⁴. The incidence of stroke varies from country to country and this variation has been suggested to be due to the genetic make – up of each individual and factors in the environment such as inadequate healthcare services particularly in poor countries. Although the incidence, mortality and disability – adjusted life – years (DALYs) of stroke has decreased in rich countries, the prevalence of stroke continues to increase globally as a result of expanding population and aging as well as the

increased prevalence of modifiable risk factors of stroke, particularly in low – and middle – income countries⁴.

Stroke frequently results in hemiplegia, abnormalities in posture, muscle tone and motor control with resultant impairment of voluntary motor function. Lung function can be affected by diseases outside the respiratory system such as Diabetes Mellitus, Sickle cell disease and stroke^{5,6,7}. Stroke can have numerous effects on the respiratory system including a reduction in ventilatory function and a heightened risk of hypoxia, impaired cough reflex with a resultant heightened risk of respiratory infections and sleep-disordered breathing among others. These respiratory disorders can be due to the weakening of the muscles of respiration and movement of the chest wall, loss of muscular collaboration within the chest, and disturbances in control of the trunk posture, which can indirectly add to a reduction in ventilatory function and a heightened risk of hypoxia^{3,8}. The effect of stroke on the respiratory system depends on the magnitude and degree of injury to areas of the brain involved in the control of respiration including the areas responsible for the control of the neuromuscular component of the respiratory system^{9,10}. Patients with stroke can have dysfunction of the diaphragm and accessory muscles of respiration, particularly on the weak side of the body, and this can result in asymmetrical movement of the chest, changes in the respiratory mechanism, and as a result, to a reduced efficiency of lung ventilation^{11,12}.

These respiratory complications are responsible for varying degrees of lung function abnormalities. In diseases of the central nervous system including stroke, respiratory function usually shows restrictive defects, which are due mainly to the changes in the chest wall or the abdomen¹³. In a study by Jung K. et al., it was observed that patients with stroke had a restrictive ventilatory pattern with lower spirometric values compared to age- and sex-matched controls¹⁴. In another study by Kimura et al., it was observed that stroke patients with dysphagia and those without dysphagia had lower vital capacities compared to healthy controls¹⁵. In yet another study by Lista-Paz et al. it was observed that the main lung volumes (VC, IC, IRV, PEF, FVC and FEV1) were clearly lower in chronic stroke patients compared to healthy age- and sex-matched controls in addition to being lower than their reference values (VC, IC, ERV, FEV1, FVC), and these results were suggestive of a restrictive ventilatory defect in these patients¹⁶. A low VC was also reported by Annoni et al. in hemiplegic patients and this was more obvious in patients with a greater degree of motor impairment and this result is consistent with a restrictive pattern¹⁷.

Spirometry is a reasonably easy and cheap lung function test that is easily accessible and it has a reasonably high sensitivity in identifying pulmonary function abnormalities. Although it measures several physiologic parameters, the most relevant clinical parameters are forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and FEV1/FVC% (ratio of FEV1 to FVC expressed as a percentage).

Stroke is a chronic medical condition and a very common cause of disability worldwide. Although the incidence of stroke has reduced in high income countries, the burden of stroke continues to be on the rise in low – and middle – income countries. Stroke has a significant impact on quality of life of its survivors particularly in those with residual motor deficit³. The quality of life of these patients is impacted by the occurrence of respiratory problems or impairment together with the consequent implication for the manage-

ment and rehabilitation of these category of patients¹⁸. Most measures and treatment focuses on other aspects paying little attention to respiratory impairment in these patients¹⁸. Although the neurological impairments that occur as a result of stroke have been well-studied and documented, the extent of respiratory impairment following stroke and the consequent implications for patient outcomes remains less well understood¹⁸. There is therefore a compelling need to further investigate the influence of stroke on lung function and with the improved knowledge a case can be made for the inclusion of lung function assessment and more valuable rehabilitation strategies as part of the care of stroke survivors, ultimately resulting in better patient care and an all-encompassing understanding of health challenges in stroke survivors. This study therefore aims to assess the spirometric abnormalities in stroke survivors and to explore its relationship with the degree of disability, the type of stroke and the affected brain hemisphere.

2. MATERIALS AND METHODS

The study was a hospital-based, cross-sectional study carried out at the adult Neurology clinics of Bowen University Teaching Hospital (BUTH), Ogbomoso, Nigeria and Osun State University (UNIOSUN) Teaching Hospital (UTH), Osogbo, Nigeria. The Neurology clinics of BUTH and UTH have a population of about 48 and 95 patients respectively with stroke. The clinics hold weekly with an average clinic attendance of six and fourteen patients respectively with stroke per clinic. Included in the study were those with clinical and imaging confirmation of stroke with brain CT scan and those with Modified Rankin score (mRS)¹⁹, between 0 to 4. Excluded were those with a stroke duration of less than 30 days, those with subarachnoid haemorrhage, stroke patients with receptive aphasia or cognitive impairment, stroke patients who were unable to make a tight seal with their lips on the mouthpiece of the spirometer on account of facial nerve palsy, those who have chronic respiratory disease and or clinical heart failure and those with previous musculoskeletal disorders. Ethical approval was obtained

Table 1: Sociodemographic Characteristics of the Participants

Variables	Frequency n = 100	Percentage (%)
Mean Age (in years) ± SD	64.5 ± 8.6	
Mean Duration Since Stroke Diagnosis	43.7±34.1	
Gender		
Male	58	58.0
Female	42	42.0
History of Current Tobacco Smoking		
Yes	5	5
No	95	95
Diabetes Mellitus	12	12
Stroke Type		
Ischaemic	82	82
Haemorrhagic	18	18
Affected Brain Hemisphere		
Right	47	47
Left	53	53
Functional Outcome After Stroke (mRS)		
0	39	39
1	23	23
2	20	20
3	18	18
Respiratory Symptoms		
Cough	13	13
Sputum Production	3	3

Table 2: Lung Function of the Study Participants

Variables	Frequency n = 100	Percentage (%)
Spirometric Pattern (Based on Z-Scores)		
Normal (>-1.65)	15	15
Mild Restriction (-1.65 to -2.50)	10	10
Moderate Restriction (-2.51 to -4.00)	17	17
Severe Restriction (<-4.00)	16	16
Mild Obstruction (-1.65 to -2.50)	33	33
Mixed	9	9
Spirometric Measurements		
	Mean ± SD	
FVC z-score	-1.298 ± 1.84	
FEV1 z-score	-1.471 ± 1.19	
FEV1/FVC z-score	-0.151 ± 2.08	

from the Research Ethics Committee of Bowen University Teaching Hospital Ogbomoso with approval number BUTH/REC-126.

Given that the entire population of stroke patients in both centres was not more than 10,000, the sample size for the study was calculated using the formula:

$$n = n/1 + (n/N) \text{ with } n = Z^2pq / d^2. \text{ }^{20}$$

The minimum sample size was determined to be 90, at 95 per cent confidence level using a prevalence of 81.6%, obtained from a previous study²¹. Although 90 was the calculated sample size, a total of 100 participants (31 from BUTH and 69 from UTH) were randomly selected for the study (to improve the power of the study) on each clinic day until the sample size was achieved over a one year period (November 2022 to October 2023).

Socio-demographic information and clinical history of the study participants were collected with the aid of a structured interviewer-administered questionnaire after obtaining consent. Stroke-related history including the type and brain hemisphere involved in the stroke (as documented in the brain imaging report which was retrieved from the patients' file) was noted. The degree of disability after stroke was assessed using the modified Rankin scale (mRS).¹⁹ The mRS is the most common outcome measure that assesses the degree of disability or dependence in performing the activities of daily living in stroke survivors. It is also the most common functional outcome measure in contemporary stroke research¹⁹. The mRS is a six-point disability scale with possible scores ranging from 0 to 5. Scores were obtained by interview method as shown below;

- 0 = No symptom at all
- 1 = No significant disability despite symptoms; able to carry out all usual duties and activities
- 2 = Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance.
- 3 = Moderate disability; requiring some help, but able to walk without assistance
- 4 = Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance.
- 5 = Severe disability; bedridden, incontinent and requiring constant nursing care and attention.

Although the mRS is a reliable tool, it is limited by the fact that interpretation of categories may be subjective and it has a limited ability to detect small changes in disability.

The height and weight were measured using a standard weighing

Table 3: Relationship Between Lung Functions and Stroke Types

Variables	Stroke Type		Test Statistics	P – value
	Ischaemic n (%)	Haemor- rhagic n (%)		
Spirometric Pattern				
Normal	11 (73.3)	4 (26.7)	χ ² = 2.750	0.432
Restriction	35 (81.4)	8 (18.6)		
Obstruction	27 (81.8)	6 (18.2)		
Mixed	9 (100.0)	0 (0.0)		
Spirometric Measurements				
FVC z-score	-0.952 (3.2)	-0.966 (4.1)	U = 632.000	0.341
Median (IQR)				
FEV1 z-score	-1.313 (2.5)	-1.226 (1.6)	U = 624.000	0.306
Median (IQR)				
FEV1/FVC z-score	-0.538 (2.3)	1.653 (5.5)	U = 660.000	0.484
Median (IQR)				

IQR = Interquartile range

scale with an integrated height meter after ensuring slight dressing (extra clothing such as caps, headgear, wristwatches and footwear were removed). The participants had their respiratory and cardiovascular systems examined in addition to a general physical examination in order to exclude those who had abnormalities in their respiratory, cardiovascular and musculoskeletal systems that can affect pulmonary function. A thorough but quick neurological examination was carried out on all the patients recruited for the study to document any focal neurological signs.

2.1 Lung Function Assessment

Spirometry was done for the participants based on the American Thoracic Society / European Respiratory Society guidelines²² using a MIR Intermedical Spirolab spirometer manufactured by Inter-medical (UK). Each subject was asked to perform the manoeuvre up to a maximum of eight times with at least 30 seconds of rest between manoeuvres and the best of the three spirometers that satisfied the established acceptability and repeatability criteria was chosen automatically by the device for measurement of the FVC, FEV1, and FEV1/FVC% with each spirometric measurement being stated as both absolute and percentage predicted values. Acceptable blows were free of artefacts or coughs, had sharp take-offs and had an exhalation duration of > 6 seconds or a plateau in the volume-time curve. The results were interpreted using the Global Lung Function Initiative (GLI)-2012 multi-ethnic spirometric reference and were classified as follows;²³

- Normal if FEV1/FVC ≥ LLN, with FVC ≥ LLN;
- Obstructive if FEV1/FVC < LLN, with FVC ≥ LLN;
- Restrictive if FEV1/FVC ≥ LLN, with FVC < LLN and;
- Mixed if FEV1/FVC < LLN, with FVC < LLN.

All study participants with abnormal spirometry results were referred to the Pulmonology clinic for further evaluation. The lower limit of normal (LLN) for each individual corresponds to a z-score of -1.645.

2.2 Data Management and Analysis

The data obtained were analyzed using SPSS version 25.0 (SPSS Chicago Inc., IL, U.S.A). The participants' age, height, ethnicity, FVC and FEV1 measurements were uploaded into the Global Lung Initiative (GLI-2012) online calculator to determine the lower limit of normal (LLN) acceptable range for spirometry results using the

Table 4: Relationship Between Spirometric Measurements of the Study Participants and the Affected Brain Hemisphere

Variables	Affected Brain Hemisphere		Mann-Whitney U test	P – value
	Right	Left		
FVC z-score Median (IQR)	-0.529 (3.9)	-0.966 (2.0)	U = 1243.500	0.989
FEV1 z-score Median (IQR)	-1.328 (2.5)	-1.010 (1.5)	U = 953.000	0.043
FEV1 / FVC z-score Median (IQR)	-0.704 (2.1)	-0.497 (5.0)	U = 924.500	0.027

prediction reference equations for African Americans. This was used to categorize the different types of spirometric patterns (normal, restrictive, obstructive and mixed abnormalities)^{24,25}. Categorical variables were summarized using frequency distribution tables and pie charts while continuous variables were presented using mean and standard deviation (SD). The relationship between different categories of data was determined using Chi-square tests. Non-parametric tests (Mann-Whitney U and Kruskal-Wallis tests) were used to compare spirometric measurements (continuous variables) across categorical groups. A p-value of ≤ 0.05 was considered significant.

2.3 Data Availability Statement:

The data that support the findings of this study is available at <https://zenodo.org/records/14059595>.

3. RESULT

A total of 125 stroke survivors were assessed for the study. Of these, 25 did not meet the inclusion criteria and they were excluded from the study. The reasons for exclusion include inability to make a tight seal with the lips on the mouth piece of the spirometer on account of facial nerve palsy, unacceptable spirogram and a prior diagnosis of chronic obstructive pulmonary disease. Although our inclusion criteria included a mRS score of 0 to 4, no eligible participant with a mRS score of 4 was able to perform an acceptable spirometry. Therefore, the participants had mRS score range of 0 to 3.

3.1 Sociodemographic Characteristics of the Participants

The participants had a mean age of 64.5±8.6 years, a mean BMI of 28.8±4.6 and a mean duration since diagnosis of stroke of 43.7±34.1 months with 58% of them being males. All the participants had hypertension, 82% of them had an ischaemic stroke, 53% had left-sided hemispheric stroke and 39% had a mRS score of 0. (Table 1)

3.2 Lung Function of the Study Participants

The study participants had a mean FVC z-score, FEV1 z-score and FEV1/FV z-score of -1.298±1.84, -1.471±1.19 and -0.151±2.08 respectively (table 2). Eighty-five per cent (85%) of the study par-

Stroke

There was no significant relationship between the spirometric patterns of the participants and the type of stroke; $\chi^2=2.750$, $p=0.432$. There was also no significant relationship between the spirometric measurements (FVC z-score, FEV1 z-score, FEV1/FVC z-score) and the stroke type; U=632.000, $p=0.0341$; U=624.000,

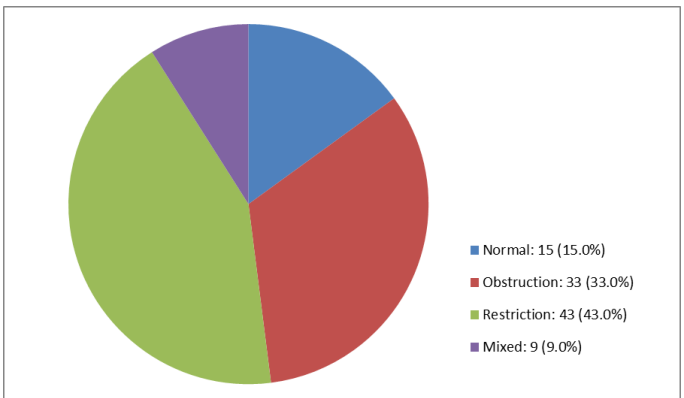


Figure 1: Pattern of Lung Function Findings of the Study Participants

$p=0.306$; and U=660.000, $p=0.484$ respectively (table 3).

3.4 Relationship Between Spirometric Measurements of the Study Participants and the Affected Brain Hemisphere

There was a statistically significant relationship between the FEV1 z-score and the affected brain hemisphere (U=953.000, $p=0.043$). A statistically significant relationship was also observed between FEV1/FVC z-score and the affected brain hemisphere (U=924.500, $p=0.027$). No significant relationship was observed between FVC z-score and the affected brain hemisphere (U=1243.5, $p=0.989$). (Table 4).

3.5 Relationship Between Spirometric Measurements of the Study Participants and the Modified Rankin Scale Score

There was a statistically significant relationship between the functional outcome following stroke (as determined by the mRS score) and the FVC z-score; $\chi^2=30.579$, $p<0.001$. Similarly, there was also a statistically significant relationship between the mRS score and the FEV1 z-score; $\chi^2=13.808$, $p=0.003$ (table 5).

Table 5: Relationship Between Spirometric Measurements of the Study Participants and the Modified Rankin Scale

Variables	Modified Rankin Scale				Kruskal – Wallis test	P – value
	0	1	2	3		
FVC z-score Median (IQR)	0.05 (2.1)	-1.31 (2.2)	-2.13 (3.9)	-2.776 (2.2)	H = 30.579	<0.001
FEV1 z-score Median (IQR)	-0.86 (0.7)	-1.72 (1.6)	-1.78 (2.6)	-3.00 (2.5)	H= 13.808	0.003
FEV1/FVC z-score Median (IQR)	-1.60 (2.5)	0.50 (2.1)	-0.59 (1.3)	0.336 (5.3)	H= 7.322	0.062

ticipants had abnormal spirometry and a breakdown of this reveals that 43% had restrictive pattern abnormality, 33% had obstructive pattern while 9% had a mixed ventilatory pattern (obstructive and restrictive). (Figure 1). There was no relationship between restrictive ventilatory pattern and DM ($\chi^2=1.308$, $p=0.253$). There was also no relationship between restrictive ventilatory pattern and obesity ($\chi^2<0.001$, $p=0.986$).

3.3 Relationship Between Lung Function and the Type of

3.6 Relationship Between the Presence of Respiratory Symptoms and the Duration Since Diagnosis of Stroke

Mann-Whitney U test indicated that stroke survivors with respiratory symptoms had a significantly shorter duration since diagnosis of stroke (median=12 months) than those without respiratory symptoms (median=48 months); U=357.500, $p=0.032$. There was also no relationship between tobacco smoking and the presence of respiratory symptoms ($X^2=0.768$, $p=0.375$)

4. DISCUSSION

A Key findings in this study revealed that abnormal spirometric pattern was observed in 85% of the participants consisting of 43% with restrictive pattern, 33% with obstructive pattern and nine per cent (9%) with mixed pattern. The study found a significant relationship between FEV1 and the affected brain hemisphere. There was also a significant relationship between FEV1/FVC and the affected brain hemisphere. The study also revealed a statistically significant relationship between the mRS score of the participants and the spirometric measurements (FEV1 and FVC). Respiratory symptoms also showed a statistically significant relationship with the duration since diagnosis of stroke. The study found no association between spirometric measurements and the stroke type.

The study revealed that 82% of the study participants had ischaemic stroke. This is not unexpected as it has been previously documented that 87% of strokes are ischaemic². The study also revealed that 53% of the study population had left-sided hemispheric stroke while 47% had right-sided hemispheric stroke. This finding is similar to those of earlier studies which also reported a higher percentage of left hemispheric stroke as compared to right hemispheric stroke. For instance, in the study by Fink et al., it was also reported that 53% of their study participants had left-sided hemispheric stroke while 47% had right-sided hemispheric stroke.²⁶ Similarly, Foerch et al. reported that 56% of their study participants had left-sided hemispheric stroke while 44% had right-sided hemispheric stroke.²⁷ The reason for this seemingly higher frequency of stroke involving the left side of the brain is unknown and it would have to be evaluated through further research.

The most common spirometric pattern observed in this study is the restrictive ventilatory pattern which was seen in 43% of the study participants. Restrictive ventilatory defect has been consistently reported earlier in previous studies. In a study by Jung et al, all of the study participants (100%) had a restrictive ventilatory defect.¹⁴ A much higher percentage of restrictive ventilatory defect in this study may be due to the fact all the study participants has stroke less than 4 weeks as the time they were being assessed. This is unlike the index study which consisted of chronic stroke patients who were all assessed over 4 week following the diagnosis of stroke. Similarly, in studies by Lista-Paz et al and Annoni et al, the study participants also had spirometry results suggestive of restrictive ventilatory pattern.^{16,17} In patients with stroke, respiratory function usually shows restrictive defects and these have been attributed mainly to the chest wall and abdominal changes which may occur as a result of weakening of the respiratory muscles.^{13,18} In patients with stroke, the diaphragm and intercostal muscles on the weak side are less effective in their respiratory functions as compared to the healthy side.^{11,12} Chest wall movement has also been observed to be reduced on the weak side compared with the strong side in patients with stroke.²⁸ These have been observed to be associated with a 10% and 15% reduction in FVC and FEV1 respectively in stroke patients when compared to healthy individuals.²⁹ Other factors which may be responsible for restrictive ventilatory pattern are obesity and diabetes mellitus (DM). However, in this study there no was significant relationship between restrictive ventilatory pattern and obesity. Similarly, the study found no significant relationship between restrictive ventilatory pattern and DM. This finding may be due to the small number (12) of study participants with DM. Although the overall spirometric measurement in this study was suggestive of a restrictive pattern, as many

as 33% of the study participants had obstructive pattern. Although a predominantly obstructive pattern was reported in stroke survivors by Ezeugwu et al,¹⁸ the specific reason for this finding is unknown. However, this may be due to some cofounders such as the use of biomass fuel for cooking which is particularly common in a developing country like Nigeria. The use of biomass fuel for cooking particularly in poorly ventilated kitchens is a major predisposing factor for the development of chronic obstructive pulmonary disease.³⁰ It is also possible that the study by Ezugwu had more tobacco smokers and this may be responsible for the finding of obstructive ventilatory defect. Tobacco smoking is an established risk factor for chronic obstructive pulmonary disease.

The study also showed a significant relationship between FEV1 and FEV1/FVC on one hand and the affected brain hemisphere. Participants with right hemispheric stroke had a significantly lower FEV1 and FEV1/FVC than those with left hemispheric stroke. The reason for this finding is not understood and further research will be necessary to unravel the reason for this finding. The study found no relationship between FVC and the affected brain hemisphere as there was no significant difference in FVC of those with right hemispheric as compared to those with left hemispheric stroke. This finding is similar to those of Ezeugwu et al. and Khedr et al. who also found no significant difference in the FVC of stroke survivors with right or left hemispheric stroke.^{18,32}

The study revealed no significant relationship between the type of stroke and the spirometric measurements as there was no significant difference between the FEV1, FVC and FEV1/FVC of the study participants with haemorrhagic stroke as compared to those with ischaemic stroke. This finding is consistent with the study by Machado et al, who also found no significant difference between spirometric measurements (FVC, FEV1 and FEV1/FVC) of the participants with ischaemic stroke and those of the participants with haemorrhagic stroke.³¹ These findings indicate that lung function decline in stroke survivors may not be related to the type and of stroke.

It was observed in this study that there was a statistically significant relationship between the FVC and FEV1 of the study participants and their degree of disability as assessed using the mRS. It was observed that the study participants with a better (lower) mRS score had a higher FVC and FEV1 and this was statistically significant. The finding of the index study is similar to that of Khedr et al who also observed that pulmonary function was significantly related to the degree of disability³². This is not unexpected since it has been observed that in patients with stroke, the abdominal diaphragm and intercostal muscles on the paretic side are less effective in their respiratory functions as compared to the healthy side.^{11,12} It is only logical that the more the respiratory muscle weakness (which corresponds to the degree of disability), the less effective the respiratory muscles will be in their functions and the more the reduction in spirometric measurements (FEV1 and FVC). Furthermore, studies in older individuals have highlighted a link between reduced respiratory muscle strength and skeletal muscle atrophy and weakness.³³ This implies that stroke patients undergoing rehabilitation should have their respiratory muscle strength monitored as a reduction in respiratory muscle strength may lead to limitation of their daily activities.

It was also observed in our study that 13% of the study participants had cough while only three per cent (3%) had sputum production. These symptoms were not related to any period of the

year. This low occurrence of respiratory symptoms among the study participants may be due to the fact that the participants are all chronic stroke survivors with the majority of them having had stroke for over a year. It was also observed that the period between the diagnosis of stroke and the time the participants were recruited into the study was significantly shorter among those with respiratory symptoms as compared to those without respiratory symptoms. Respiratory symptoms may be more common in the acute phase of stroke on account of aspiration which may lead to an increased risk of stroke-associated pneumonia (SAP). As defined by a consensus, the terminology SAP is a depiction of a range of diseases of the lower respiratory tract that occurs within 7 days following the onset of stroke.³⁴ Although all the participants in this study were not in the acute phase of stroke, it is possible that the few who had respiratory symptoms had residual symptoms carried forward from the acute phase. Furthermore, the restrictive pattern was relatively more common among the study participants and this may not be associated with any symptom, particularly in the early stages. In addition, the study found no relationship between tobacco smoking and the presence of respiratory symptoms

4.1 Conclusion

In conclusion, the prevalence of abnormal spirometric pattern is high among stroke survivors with most of them being more likely to have restrictive pattern abnormality. Lung function was also observed to reduce with increasing degree of disability. In addition, although respiratory symptoms were found to be uncommon among stroke survivors, the frequency decreased with increasing duration since the diagnosis of stroke.

Our limitations were our inability to assess respiratory muscle strength and the non-exclusion of the few tobacco smokers and those who cook with biomass fuel which may serve as cofounders. In addition, the exclusion of participants with more severe impairments may limit the generalizability of the findings to all stroke survivors.

We recommend that lung function assessment should be included in the care of stroke survivors and adequate attention should be paid to respiratory care among stroke survivors.

Areas of future research should include assessing respiratory muscle strength and respiratory muscle ultrasonography.

Author Contributions

Dr A.O. Odeyemi: Conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, supervision, validation, writing – original draft, writing – review and editing.

Prof O.O. Adewole: Conceptualization, project administration, resources, supervision, validation, writing – original draft, writing – review and editing.

Dr A. Adebowale: Data curation, formal analysis, methodology, project administration, resources, supervision, validation, writing – original draft, writing – review and editing.

Dr A.G. Adeyeye: Funding acquisition, investigation, resources, validation, writing – review and editing.

Dr T.A. Bamikefa: Funding acquisition, investigation, resources, validation, writing – review and editing.

Dr O.A. Ala: Funding acquisition, investigation, resources, validation, writing – review and editing.

Dr A.O. Yusuf: Funding acquisition, investigation, resources, validation, writing – review and editing.

Dr O. Olayemi: Funding acquisition, investigation, resources, validation, writing – review and editing.

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