

Marked Corridor 20 Meters Brief Walking Aerobic Exercise Improves the Quality of Life and Functional Capability of Stroke Survivor Outpatients in Tertiary Hospitals in Osogbo, Nigeria

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| Abstract |

PURPOSE: The functional limitations in stroke survivors promote sedentary lifestyles and quality of life inadequacies, but there is increasing evidence that this could be minimized by physical exercise. Therefore, this study examined the effects of physical exercise on the quality of life (QoL) and functional capacity (ability to stand up from a sitting position) among stroke survivors drafted from two tertiary hospitals in Osogbo, Nigeria.

METHODS: A purposive sampling technique was used to select 21 registered right or left outpatient hemiplegic stroke survivors in a pre- and post-test experimental research design. The research questions were presented using descriptive statistics of frequency, percentage, mean and standard

deviation, while an Analysis of Variance (ANOVA) was used to test the study hypothesis at the .05 alpha level for significance.

RESULTS: Compared to the baseline (week 0), there were significant increases in the general quality of life, healthy well-being, physical exercise, pain perception, and environmental domains of QOL among the survivors in week four. Moreover, a significant increase was observed in these indices in week eight, compared to week four, except for the pain perception domain. Compared to the baseline, there was a significant decrease in the time it took the stroke survivors to stand up from a sitting position in week four. A significant decrease was observed in this index in week eight compared to week four.

CONCLUSION: Marked corridor 20 meters brief walking exercise for eight weeks significantly improved the quality of life and ability to stand up from a sitting position in stroke survivors in Osogbo, Nigeria.

Key Words: Exercise, Functional capacity, Stroke, Quality of life.

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I. Introduction

Stroke is a global health problem and the third largest killer in industrialized countries after heart disease and cancer. It is becoming prevalent in developing countries and is a major cause of physical disability in people over 60 years of age [1,2]. Stroke is characterized by an interruption of blood flow to the brain, resulting in the death of brain cells and a loss of function of the contralateral side to the affected hemisphere, and a range of focal neurological deficits that last longer than 24 hours [3].

The quality of life (QoL) is usually one of the indices often affected by the stroke survivors' condition due to the adjoining disabilities and ability to stand up from a sitting position. The QoL has been referred to as a current issue accepted to have two principal aspects: internal (certain personal traits and skills that enable a human being to take individual, autonomous actions), and external (the environmental conditions of the individual's life) [4]. The QoL generally has six domains: physical condition, mental condition, self-reliance, social relationships, environment, psychological, and religious beliefs [5]. The patient's perspective on the QoL is central in this definition, which encompasses a personal assessment of physical health status, e.g., the physical ability to stand up, psychological, social functions, mood, companionship, and recreational activities. The individual's perceptions are at the core of the conceptualization of QoL, and it is consequently subject-bound.

Exercise is considered one of the most important means to improve the QoL and achieve health and wellness [6]. It helps to improve health, maintain fitness, and is an important aspect of medical rehabilitation [7]. Aerobic exercise refers to the type of repetitive, structured physical activity that requires the body's metabolic system to use oxygen to produce energy. It improves the capacity of the cardiovascular system to uptake and transport oxygen, and

it is considered the cornerstone of endurance training, which is characterized by moderate energy expenditure over a prolonged period [8]. Adults should practice moderate aerobic physical activity for at least 150 minutes per week or 75 minutes of high-intensity exercise [9] to maintain and promote good health.

Many studies on exercise and health, including QoL, dwell more on apparently healthy individuals [10]. Moreover, there is a dearth of information on the effects of physical activity on stroke survivors in Nigeria or other areas of Africa, considering the myriads of environmental factors that play a vital role in the pathogenesis of disease conditions. Nevertheless, a previous study reported that eight weeks of twenty meters of walking aerobic exercise improved cardio-respiratory fitness and muscular strength of stroke survivor outpatients in tertiary hospitals in Osogbo, Nigeria [11]. Moreover, systematic reviews and meta-analyses provide evidence that aerobic exercise and resistive strength training are beneficial for improving the aerobic capacity, walking distance, muscle strength, and physical function of stroke survivors without necessarily increasing pain and increasing the muscle tone in the affected limbs [12,13]. In addition to physical therapy, other measures have been used to manage stroke patients, such as dietary supplements, drugs, and alternative therapy. The anti-apoptotic, anti-inflammatory, antioxidant, vascular, and neuroprotective effects of these interventions could be of value in managing stroke patients [14-17]. On the other hand, more is needed to examine the effects of physical activity on individuals with stroke.

This study examined the effects of twenty meters of brief walking aerobic exercise for eight weeks on the QoL, healthy well-being, ability to perform activities of daily living, and relate well with the environment, functional capability, and pain perception among stroke survivors in Osogbo, Nigeria.

II. Methodology

1. Participants

A purposive sampling technique was adopted to recruit the study population, which was comprised of adult males and females who were right or left outpatients with hemiplegic stroke registered in two tertiary hospitals in Osogbo, Nigeria, *i.e.*, Ladoke Akintola University of Technology (LAUTECH) Teaching Hospital, Osogbo, Nigeria and Osun State Specialist Hospital, Osogbo, Nigeria. Thirteen participants were right or left hemiplegic stroke survivors recruited from the former, and eight from the latter.

2. Inclusion/exclusion criteria

The study participants included ambulant stroke survivors without or with walking aids; right or left hemiplegic stroke survivors aged 40 and 80 years with regular or a controlled blood pressure (with 110/70 and 140/90 mmHg); stroke survivors on medication and no more than three years on set.

The study participants were excluded for the following reasons: non-ambulant right or left hemiplegic stroke survivors with irregular or uncontrolled blood pressure (140/90 mmHg or higher) [18]; stroke survivors that had the crises more than three years ago; stroke survivors that were participating in any regular therapy or progressive exercise program similar to the one used in this research at the time of this study; stroke survivors that failed to provide informed consent to be included in the study.

3. Study design

This study adopted a one-group repeated measures pre-test and post-test experimental design. Twenty-meter walk aerobic exercise was used as an intervention to evaluate its effects on the QoL and functional capability of stroke survivors' outpatients in two tertiary hospitals in Osogbo, Nigeria. The participant data were obtained

on three different occasions. The first measurement was taken before the intervention, while the second and third measurements were obtained at the end of the fourth and eighth weeks of exercise therapy intervention, respectively.

4. Exercise protocol

The exercise intervention was designed in line with the American College of Sports Medicine [19] Frequency, Intensity, Type, Time and Progression (FITT & P) principle of exercise prescription for cerebrovascular (stroke) outpatients. For each exercise session, their heart rate and blood pressure (systolic and diastolic) were measured before and after the exercise to monitor and ensure participants conveniently tolerated the exercise load [19]. The exercise protocol was comprised of two- three days per week exercise sessions, ranging from 10 to 20 minutes duration per session for the eight weeks of intervention [20]. For each session, there was a warm-up of three minutes before the workout activity and a warm down of three mins after the workout. The type of exercise conducted included moderate-intensity aerobics, flexibility, and strength exercises. This was sub-divided into five minutes of exercise and three minutes of rest, approximately two times a week over eight weeks. Initially, the exercise was at the pace participants could tolerate (around 2.6metabolic equivalents (METs) to 3.4METs), but this was increased progressively as the participants adapted to the workload [19]. Motyl et al. [21], who studied the stroke survivors' response to 6-12 minutes of the walk test, also reported a test-retest sensitivity on a 20meters walk for patients, muscle strengthening, and increasing joint flexibility activities.

The flexibility exercises used were of three types. The first was a passive movement exercise in which the participants laid supine on a plinth. The joints in the affected side were flexed and extended passively by the researcher or the research assistants to the full range of motion allowed by the joints. All the joints in the upper limbs and lower

limbs (shoulder, elbow, wrist, intrinsic/ interphalangeal joints in the upper limb and hip, knee, ankle, and intrinsic joints of the foot in the lower limb) were treated for three sets of 10 repetitions each.

The second type of exercise was flexibility exercise in which the participants stood erect. The two upper limbs were stretched, abducted, and adducted laterally and medially. The abduction was continued until both dorsal parts of the hand were made to touch each other and brought down to the lateral side of the body at the same time for 10 repetitions with a 1min rest for three sets. Finally, for the third exercise, the participants were asked to sit (long sitting). The upper limbs were raised parallel to the lower limb, and the hands were extended to touch the top of the toe and return to the original position for 10 repetitions, with a 1min rest, which was repeated for three sets. The process was repeated 10 times, and the participants were allowed a rest at 3min intervals between each set.

As such, the aerobic conditioning consisted of brisk walking on a 20 meters corridor for three repetitions. For this procedure, a free corridor that was not so busy with people (to avoid distractions) was marked from zero to 20meters. The participants' blood pressure and resting heart rate were taken and recorded. The participants were asked to walk at their pace up and down the corridor three times. The time taken for each walk was recorded. The participants were allowed to rest midway when they were tired. Those that did not complain of tiredness were asked to rest after the second trip time taken for aerobic walking.

For skeletal muscle strengthening, the exercises consisted of flexion and extension of the affected lower and upper limbs. These were implemented with body mass-imposed resistance and external resistance using a calibrated weight (sandbag) strapped to the wrist/ ankle of the affected upper /lower limb and lifted from the chest to the lateral side of the body in shoulder abduction or elbow extension for upper limbs. Each lower limb was raised from the plight or exercise mat up as much as they

could for hip flexion exercises done for 10 repetitions and three sets after which participants were asked to lie prone with the lower limb raised to the best ability of the participant's ability for hip extension in 10 repetitions for three sets. Knee flexion was done in high sitting, with the lower limbs flexed and extended at the knee joints with the calibrated weight tied to the ankle joint in 10 repetitions for three sets. Relaxation and elongation exercises were conducted before and after every session, including stretching to increase the flexibility of large muscle-joint groups (shoulder, elbow, hip joint, knee, and ankle). The weight loading started with 2kg, 4kg, 6kg, 8kg, and 10kg, respectively; the loading of the last four weeks was between 8kg and 10kg.

The timing for the aerobic walking exercise was five minutes with a three-minute rest interval. The walking exercise was conducted on a 20meter marked corridor, and it took an average of 15minutes for each participant. The walking exercise was repeated three times a week in the first five weeks and two times a week in the last three weeks.

The participants were treated on different days in the two centers, Tuesdays and Fridays, at LAUTECH Teaching Hospital, Osogbo, while those at State Specialist Hospital, Osogbo, were treated on Mondays and Thursdays. The participants were treated both in groups and individually. Table 6 lists the exercise program from week one through week eight. During the three times per week intervention, Saturday was chosen at LAUTECH Teaching Hospital, while Wednesday was the choice for State Specialist Hospital Osogbo.

1) Exercise intensity

The exercise intensity was determined by calculating the category of intensity for the individual participants using the formula of the American Heart Association (2008) [22], which categorized the exercise intensity into mild, moderate, and vigorous intensities:

- Low intensity was any exercise done at < 50% of the target heart rate (3.3METs);
- Moderate intensity was any exercise done at 50-70% of the target heart rate (4.0METs);
- Vigorous intensity is the exercise done at 70-85% of the target heart rate (8.0METs)

Moderate intensity was adopted for this study, considering the physical fitness level of the participants.

$$E_i = \text{HR}_{\text{rest}}/\text{HR}_{\text{max}} \times 100$$

where,

E_i = Exercise Intensity;

HR rest = Heart rate at rest

HR max = Heart rate maximum = 220 - age in years

HR max = 220-57 = 163 bpm. The mean age of the participants was 57years.

HR rest (RHR) = 82.9 = 83bpm

HRR = Δ MHR - RHR

HRR (heart rate reserved) = 163-83 = 81bpm

$$\begin{aligned} \text{For intensity} &= 0.4 \times \text{HRR} + \text{RHR} \text{ --- } 0.5 \times \text{HRR} + \\ &\quad \text{RHR (low intensity - Moderate intensity)} \\ &= 0.4 \times 81 + 83 \text{ -- } 0.5 \times 81 + 83 \\ &= 115.4 \text{ bpm -- } 124 \text{ bpm} \end{aligned}$$

Therefore, all the participants were allowed to exercise between 115.4bpm to 124 bpm for safety reasons.

5. Ethical concerns and informed consent

Before commencing the study, ethical clearance for the approval of the research protocol was sought and obtained from the University of Ilorin Ethical Review Committee. The ethical number: UERC/ASN/2018/1198 was assigned for the study.

The participants and their caregivers were informed about the procedures, benefits, and discomfort of the study through several interactive sessions that were organized at different times in the two hospitals where they were

recruited. The participants willingly completed and signed an informed consent form to participate in the study. The baseline information on health history, medical clearance for exercise, duration of stroke, and medication use, as indicated in the inclusion and exclusion criteria, were obtained to screen the participants.

6. Measurement of QoL

The short form of the World Health Organization Quality of Life questionnaire instrument (WHOQOL - BREF) was used [23]. The questionnaire had two sections. Section A focused on the demographic data; section B focused on the QoL indices under aerobic exercise and life, the activity of daily living, pain perception, health and wellness, environment, and psychological well-being of the participants.

Before data collection, experts in the Department of Linguistics, University of Ilorin, assisted in translating the questionnaire to the Yoruba language. After administration, it was translated back to the English language. The questionnaire contained 22 questions providing information on several factors of the QoL. This included the following: the physical domain, relating to pain or discomfort, energy or fatigue, sleep, rest, mobility, daily activities, medicine dependency, and job performance; the Psychological Domain, which is related to feelings, learning, memory and attention, self-esteem, aspect, spirituality, religiousness, and positive or negative thinking; the Social Domain, concerning personal relationships, social support, and sexuality; the Environmental Domain, which is related to physical security, home environment, financial security, opportunity for information assessment, event participation and activities undertaken during their spare time. The questions under each domain were rated on a rating scale of 1 - 4 for each sub-variable. The scores were then recorded in line with the WHO coding system provided along the WHOQOL.

Table 1. Demographic Characteristics of the Stroke Survivor Outpatients Recruited from Two Hospitals in Osogbo, Nigeria

Variable		Frequency	Percentage (%)
Gender	Male	12	57.10
	Female	9	42.90
<u>Total</u>		<u>21</u>	<u>100.00</u>
Occupation	Retiree	3	14.30
	Civil servant	1	4.80
	Self employed	11	52.40
<u>Total</u>		<u>21</u>	<u>100.00</u>
Affected side	Right side	13	61.90
	Left side	8	38.10
<u>Total</u>		<u>21</u>	<u>100.00</u>

7. Measurement of functional ability (ability to stand up from a sitting position)

The objective was to measure how long it took the participants to perform the task of daily living. A stopwatch was set to zero, while the participants were asked to sit in a relaxed position on a wooden chair. The researcher then informed the participants to prepare, and the stopwatch was started when the participants were instructed to stand upright from the chair. When in the full upright posture, the stopwatch was stopped, and the time it took the participants to stand erect was recorded to the nearest 0.1 seconds. [24]

8. Statistical analysis

The data collected from this study were analyzed using the Statistical Package for the Social Sciences (version 16.0). Both descriptive (mean, standard deviation, frequency, percentage, minimum and maximum values) and inferential statistics were used to present the results. The differences between the mean values of the QoL and the ability to stand up from a sitting position were tested by repeated measures analysis of variance, followed by a Bonferroni post - hoc test for multiple comparisons. Statistical significant differences were considered at $p < .05$.

III. Results

1. Demographic characteristics of stroke survivors outpatients recruited from two hospitals in Osogbo, Nigeria

Table 1 shows that 57.1% of the stroke survivors were male. Furthermore, 14.3% were retirees, 4.8% were C/S, 52.4% were self-employed, and 4.8% were traders. Approximately 61.9% of the participants had right-sided hemiplegia, while 38.1% had left-sided hemiplegia. The physical and physiological characteristics of the stroke survivors were documented in previous studies [11].

2. Effects of exercise on the general QoL and its different domains among stroke survivors in Osogbo, Nigeria

Compared to the baseline (week 0), there were significant increases in the general QoL of stroke survivors in week four ($p < .05$) (Fig. 1). Moreover, this index was significantly higher in week eight than in week four ($p < .05$). A significant increase was recorded in the healthy well-being domain of QoL in week four, compared to week zero, among the stroke survivors ($p < .05$) (Fig. 2). Moreover, this index was significantly higher in week eight than in week four ($p < .05$). Compared to the baseline (week 0), there were significant increases in the physical exercise dom

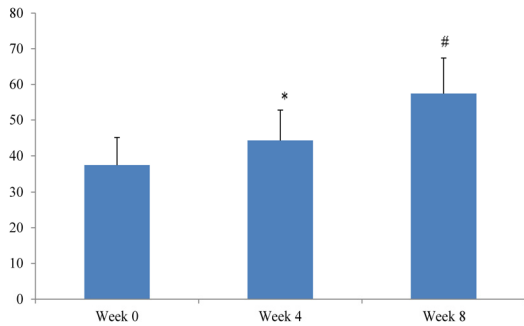


Fig. 1. Effects of exercise on the general QoL of stroke survivors in Osogbo, Nigeria. The values are expressed as the mean \pm SD. * $p < .05$ is significant at week zero vs. week four; # $p < .05$ is significant at week four vs. week eight.

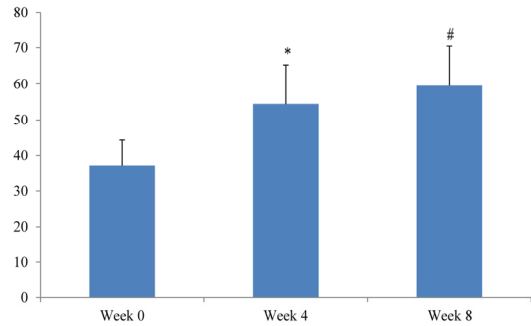


Fig. 3. Effects of exercise on the ability to perform activities of daily living (physical exercise domain) of the QoL of stroke survivors in Osogbo, Nigeria. The values are expressed as the mean \pm SD. * $p < .05$ is significant at week zero vs. week four; # $p < .05$ is significant at week four vs. week eight.

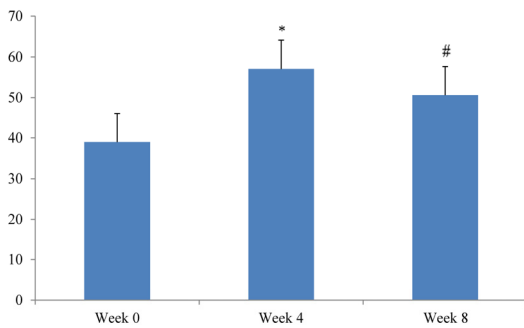


Fig. 2. Effects of exercise on healthy well-being domain of the QoL of stroke survivors in Osogbo, Nigeria. The values are expressed as the mean \pm SD. * $p < .05$ is significant at week zero vs. week four; # $p < .05$ is significant at week four vs. week eight.

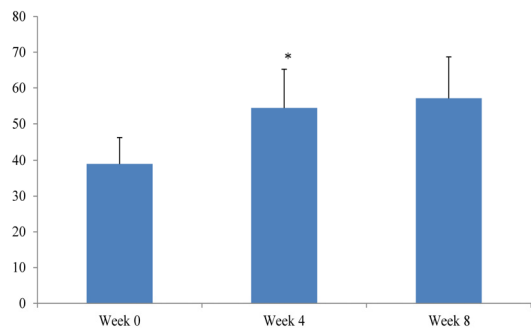


Fig. 4. Effects of exercise on the pain perception domain of the QoL of stroke survivors in Osogbo, Nigeria. The values are expressed as the mean \pm SD. * $p < .05$ is significant at week zero vs. week four.

ain of the QoL among the stroke survivors in week four ($p < .05$) (Fig. 3). Moreover, this index was significantly higher in week eight than in week four ($p < .01$).

Relative to the baseline (week zero), there were significant increases in the pain perception domain of QoL among stroke survivors in week four ($p < .05$) (Fig. 4). On the other hand, there was no significant elevation in this domain in week eight, compared to week four ($p < .05$). A significant increase was noted in the environmental domain of the QoL among the stroke survivors in week four than in week zero ($p < .05$) (Fig. 5). Moreover, there

was a significant increase in this domain in week eight than in week four ($p < .05$).

3. Effects of exercise on functional ability (ability to stand up from a sitting position) of stroke survivors in Osogbo, Nigeria

Compared to the baseline (week 0), there were significant decreases in the time it took for the stroke survivors to stand up in week four ($p < .05$) (Fig. 6). Moreover, a further significant decrease was observed in this index in week eight than in week four ($p < .05$).

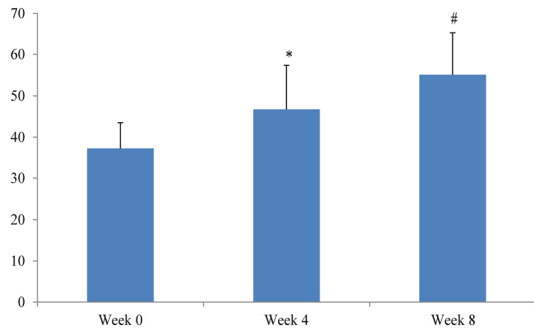


Fig. 5. Effects of exercise on the ability to relate well with the environment (environmental domain of the QoL) of stroke survivors in Osogbo, Nigeria.

The values are expressed as the mean \pm SD.

* $p < .05$ is significant at week zero vs. week four; # $p < .05$ is significant at week four vs. week eight.

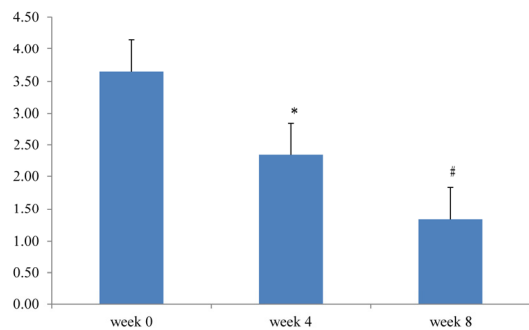


Fig. 6. Effects of exercise on the functional ability (ability to stand up from a sitting position) of stroke survivors in Osogbo, Nigeria.

The values are expressed as the mean \pm SD.

* $p < .05$ is significant at week zero vs. week four; # $p < .05$ is significant at week four vs. week eight.

IV. Discussion

This study examined the effect of exercise on the QoL of stroke survivors. The specific objectives set for this study were as follows: to investigate the extent to which aerobic exercises would improve the QoL of stroke survivors; determine the effect of exercises on the functional capacity of stroke survivors; determine if additional health benefits were associated with regular and regularized exercises in

stroke survivors; determine if exercise improved the cardiovascular parameters (blood pressure and heart rate) of stroke survivors. The result revealed significant differences in most of these parameters.

This study showed that there were more male stroke survivors than females in Osogbo, Osun State. This finding agrees with many studies, which indicate that men have a higher risk of stroke than women [25]. The majority of the participants were self-employed. This study contradicts Ojo and Mohamed [26], who reported that retirees are at a higher risk of cardiovascular diseases than those self-employed.

The majority of the participants were right hemiplegic who had weakness on the right side (left hemispheric CVA). This disagrees with a study that found that left-sided strokes were more frequent than right-sided strokes [27]. These differences may be due to different study populations. Hence, the dominant type of hemiplegia could be race-specific. The result also showed that most participants were on regular medication; only a few were not for various reasons. Therefore, the researcher should counsel all the participants to comply with their doctor's prescription before they are allowed to participate in the study because it is part of the inclusion criteria.

The results showed that a few of the participants had a normal BMI. The majority were in the higher BMI categories. Studies have shown that people with a higher BMI are liable to have hypertension and stroke, which agrees with the reports of Kurth et al. and Rost et al. [28, 29] that people with a higher BMI are predisposed to hypertension and cardiovascular diseases (CVD).

There was no significant difference in the QoL of stroke survivors before and after the exercise intervention. The results revealed a significant difference in the participants' QoL. The actual effect was that during the eight-week exercise intervention, the QoL of the participant improved. This suggests that exercise has a positive effect on the QoL of stroke survivors, and it improves the overall QoL

of stroke survivors [10]. Therefore, the main hypothesis was rejected because there was a significant difference in the QoL of stroke survivors before and after the exercise interventions. Involving stroke victims in regulated exercises, such as 20 meters walking and flexibility exercises, helped improve the overall QoL of this population. This also revealed the effects of aerobic exercises on the QoL of stroke survivors. The aerobic exercises definitely improved the QoL of stroke survivors because of the improvement of most of their physiological variables and functional ability.

The study showed that the eight-week exercise intervention improved the well-being of the participants. Therefore, stroke survivors might benefit from exercise intervention for eight weeks. Moreover, carefully planned exercise could promote and increase their well-being. Bottomley [30] reported that the general and healthy well-being of individuals who are elderly and stroke survivors could benefit from exercise because augmentation with various forms of exercise is beneficial. The participants also contributed by their responses that activities in the form of exercise improve the living conditions (self-satisfaction) and well-being of stroke survivors.

The participants reported significant improvements in the ADL tasks, such as using the toilet unaided, wearing clothes, eating, and bathing, which was difficult prior to the exercise intervention. This implies that exercise is important for improving the ADL of stroke survivors when they are well structured and properly supervised, as in the study of Kwakkel et al. [31], who reported that exercise improves the stride speed and other aspects of ADL when started as early as six months after the stroke and sustained for approximately 20 minutes per session. The activity of daily living (ADL) should be the primary objective of any rehabilitative exercise intervention program.

The functional ability is one involving the upper and lower limbs. This study showed that the participants improved their functional ability significantly after exercise

intervention. Specifically, they spent a shorter time sitting down and standing up. This corroborated the study of Bocalini et al. and Kanai et al. [32,33] in that exercise improves the general and the areas of difficulty for stroke survivors. Such activities are carried out using the major muscles for specific body functions of stroke survivors suggesting that exercise therapists need to develop exercise programs that will improve the functional ability of stroke survivors. In this study, there was improvement in the pain perception of the stroke survivors after the eight-week exercise intervention. Generally, stroke patients lose a sensation of feelings on the affected part due to the paralysis and numbness but only experience pain in the shoulder and affected hip joints. On the other hand, the participants reported that the pain felt before exercise reduced and improved their physical performance culminating in an improved QOL. Therefore, this study contributed to the findings that exercise positively affects the pain perception (PP QoL) of stroke survivors. Hoffman [34] reported that aerobic exercise caused an acute improvement in mood and a reduced perception of pain from a painful stimulus. There is a need to explore this angle of an intervention by combining both qualitative and quantitative studies for the intervention because pain perception is key to the recovery and prevention of recurring stroke.

The results from the study revealed significant improvement in the participants' ability to relate well with the environment domain of QoL after an eight-week exercise intervention program. This concurs with Balasubramanian et al. [35] in that engaging in aerobic exercise motivates the elderly with stroke to relate better with their environment.

Exercise is, therefore, a major intervention medium that might be useful for improving the functional capacity and QoL of stroke victims. Nevertheless, the number of stroke survivors is one of the limitations of this study. Moreover, the study captured registered stroke survivors from two main tertiary health institutions in Osogbo, Nigeria. These

limitations could have some implications when attempting to generalize the results presented in this study.

V. Conclusion

Marked corridor 20 meters brief walking exercise for eight weeks improved the quality of life and ability to stand up from a sitting position in stroke survivors in Osogbo, Nigeria.

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