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Effect of ambulatory mobility aid devices on cardiovascular parameters, walking speed, perceived exertion, and balance of older adult men in Enugu, Nigeria

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Abstract

Introduction: Ambulatory mobility aids are several devices the elderly may use in order to improve their walking pattern, balance, or safety while mobilizing independently.

Objectives: To assess the effect of ambulatory mobility aid devices on cardiovascular parameters, walking speed, perceived exertion, and balance of older adult men.

Methods: A sample of 156 old men was studied. Data were obtained through measurement of the participants' walking speed (distance covered/second), cardiovascular parameters (blood pressure), perceived exertion (difficulty or ease in breathing), and balance (ease in standing) after walking with and without the selected walking aid devices. Analysis was done to compare the effect of the walking aid devices on the selected dependent variables.

Results: Results showed ambulation with mobility aid devices resulted in increase in the heart rate and blood pressure with the greatest increase observed when walking with Zimmer frame. Ambulation with mobility aid devices resulted in decrease of the walking speed of the participants when compared to ambulation without devices. Perceived exertion of participants after using Zimmer frame and walking cane was within 4.06 ± 1.35 and 3.98 ± 1.26, respectively, as opposed to 3.08 ± 0.73 after ambulation without aid. Use of Zimmer frame provided enough balance for participants.

Conclusion: Ambulatory mobility devices caused difference in cardiovascular parameters when compared to ambulation at rest and without aid. It was recommended that selection of ambulatory mobility aid devices should depend on objective mobility assessments and periodical re-evaluation to ensure that it suits a person's functional requirements and physical capabilities.

Keywords

Ambulatory, mobility aid devices, cardiovascular parameters, walking speed, adult men

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Introduction

Aging can be defined as the process of becoming older or elderly. Most countries in the world have accepted the chronological age of 65 years as elderly or older person. However, like many westernized concepts, this does not adapt well to the situation in Africa where the definition of an elderly person associates with the ages of 50–65 years, depending on the setting, the region, and the country.[1] Regardless of the discrepancies in the classification of an elderly person in different parts of the world, there is a consensus that in humans, aging represents the accumulation of

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changes in an individual over time, encompassing physical, structural, psychological, and social changes mostly associated with human diseases.[1–5] These changes associated with old age make it difficult for normal functioning of the body parts and as such necessitate the use of aids by elderly persons to ameliorate the difficulties experienced. According to Cambridge Dictionary, an aid is a piece of equipment that helps one to do something.[6] The aids help the elderly gain more independence and are of different types depending on the form of difficulty experienced by such elderly persons. These aids include, but not limited to glasses, hearing aids, urinary inconsistence aids, braces, and mobility aids. However, most predominant aids utilized by a great percentage of elderly persons are the ambulatory mobility aids and these constitute the central focus of this study.

Ambulatory mobility aids or walking aids are sometimes referred to as ambulatory devices and are used interchangeably in the course of this study. Mobility aids are several devices elderly persons may be issued in order to improve their walking pattern, balance, or safety while mobilizing independently.[7] The ambulatory mobility aids can also be seen as devices designed to assist walking or otherwise improve the mobility of people with mobility impairment. They can also be a means of transferring weight from the upper limb to the ground, in cases where reducing weight bearing through the lower limb is desired.[7] Walking aids fall into multiple categories and include walking sticks (canes), sticks with three or four small feet, light alloy Zimmer frame "walkers," elbow crutches, and walking calipers.

The prescription of walking aids is ideally done by a physiotherapist after thorough assessment of gait, balance, cognition and the cardiovascular, musculoskeletal, and neurological systems of the patient. The assessment also takes into account any clinically significant co-morbidity and individual's day-to-day mobility requirements (e.g., community ambulation, navigating steps, or public transport).[7] The type of walking aid to be prescribed will depend on the needs of the individual.[8] Anyone who has a mobility issue, either temporary or long-term, can be prescribed a walking aid.

However, despite the diverse categories of people likely to be prescribed the use of walking aids, elderly individuals make up a greater percentage of walking aid beneficiaries with latest studies revealing that the use of ambulatory mobility aid devices such as canes is on the rise for elderly people.[9] As the number of elderly people continues to rise, the demand for walking aids is expected to increase twofolds by 2050. This is because elderly people represent the fastest growing age group and approximately two-thirds live with high blood pressure and lower muscle mass, accepting the chronological age of 65 years and above as the definition for elderly.[10] Studies[11,12] have reported that high blood pressure is a risk factor for cardiovascular diseases and death in elderly people, while a lower muscle mass has been associated with increased risk of mobility loss in older population, especially males. Therefore, the maintenance of mobility is thought to be fundamental to active aging, allowing older adult men to continue to lead dynamic and independent lives.[13] Walking aids are usually prescribed routinely by physiotherapists during rehabilitation to elderly patients to compensate for balance and mobility deficits,[7] protect against falls,[14] and increase activity and participation in patients with mobility limitations[15] with the aim of increasing the patients' base of support, increasing gait, preventing falls, improving balance, functional independence, and improving ambulation.

Because elderly individuals comprise a large part of the population using walking aids, the effect of using these aids on important indicators of their overall health and function is of major concern. These indicators include balance, which is the ability to distribute body weight in a way that lets one stand or move without falling[16]; walking speed, which is the walking capacity and preparedness for safe community mobility,[17] and perceived exertion which connotes a strenuous or costly effort, resulting in generation of force, initiation of motion, or in the performance of work. Lastly, cardiovascular parameters such as heart rate (HR) and blood pressure used in monitoring the supply of blood throughout the body by the cardiovascular system.[18]

Against this back drop, this study was therefore designed to determine the effect of ambulatory mobility aid devices on walking speed, balance, perceived exertion, and cardiovascular parameters of elderly adult men. One omnibus hypothesis meant to compare the changes that take place in the selected cardiovascular parameters, perceived exertion, walking speed, and balance of participants at rest, and after walking with and without ambulatory mobility aid devices is therefore postulated for verification.

Empirical framework

Researchers have investigated the effects of ambulatory mobility aid devices on cardiovascular parameters, walking speed, perceived exertion, and balance overtime. For example, a study[19] compared the effect of different walking aids on selected cardiovascular parameters, energy cost, and walking speed among elderly patients with knee osteoarthritis in Nigeria. Participants' systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate were measured before and after ambulation. The results showed that SBP, DBP, pulse rate, and walking speed were significantly different ($p < 0.05$). Walking speed with cane ambulation ($0.55 \pm 0.11\,\mathrm{m.sec^{-1}}$) was significantly higher than for Zimmer's frame ($0.40 \pm 0.1\,\mathrm{m.sec^{-1}}$). The study concluded that Zimmer frame ambulation elicited comparatively high blood pressure and pulse rate while cane ambulation was accompanied by relatively high walking speed.

Another study[20] examined the effects of walking with aids on walking speed and selected cardiovascular parameters in apparently healthy elderly individuals in Nigeria.

The results of the study that SBP (139 ± 16.62 mmHg), DBP (80 ± 9.57 mmHg), and HR (75.51 ± 9.54 beats/min) after walking with Zimmer frame ambulation were higher than with cane (133 ± 18.97 mmHg; 79 ± 8.59 mmHg; 75.37 ± 10.28 beats/min), and tripod (130 ± 16.59 mmHg; 77 ± 9.13 mmHg; 74.63 ± 9.92 beats/min) ambulation, respectively. Walking speed (0.58 ± 0.21 m/s) with a cane was significantly faster ($p = 0.001$) than Zimmer with frame (0.31 ± 0.12 m/s), and tripod (0.50 ± 0.19 m/s). The study concluded that walking Zimmer with frame ambulation elicited a higher blood pressure, a higher HR, and a slower WS than cane and tripod ambulation, respectively.

In Italy, another study[21] examined the impact of different types of walking aids on the physiological energy cost during gait for elderly individuals with several pathologies and dependent on a technical aid for walking. The study concluded that there were very little studies on the evaluation of physiological energy cost produced during gait with a walker. A study[20] reported that the characteristics of their population did not allow them to conduct their test without a technical aid.

The previous studies[19,20] conducted in Nigeria, though used elderly individuals, they included both apparently healthy adults and those with knee osteoarthritis who were not housed in an old people's home. On the other hand, this study employed only apparently healthy elderly adults who were housed in two old people's homes, and age (65 years and above) was the most common characteristic among the populations.

A close observation of the studies that used Nigerian elderly population reviewed above could show that they are similar with this study, however, with one striking difference. This difference is the inclusion of perceived exertion and balance of the elderly adult men in the present study, which the earlier studies did not investigate.

Methods

Participants and setting

Between the months of August and September 2022, we carried out this study that adopted the One-Shot-Case experimental research design. This design was used in order to ascertain the effect of ambulatory mobility aid devices on the cardiovascular parameters, walking speed, perceived exertion, and balance of 156 out of 257 elderly men housed in Blue Torch Home Care Limited, Trans-Ekulu, Enugu State, and Little Sisters of the Poor Home located at Amah Street, Uwani, Enugu. These men were within the ages of 65 years and above. The study utilized the Taro Yamane formula in determining the sample size of the study.[22]

The Taro Yamane formula is given as: $n = n = \frac{N}{1 + N(e)^2}$

Where;

n = desired sample size

N = the entire population

e = level of significance of limit of tolerable error assumed to be 5% or 0.05

1 = unit constant figure

The desired participants for this study were included based on four criteria. These criteria included that the older adult men must be 65 years and above, they must not rely on walking aids (assistive devices) for ambulation and support, they must be willing and available to participate in the study and they must be healthy and fit enough to undergo some examination.

Participants in this study were screened out based on certain criteria. These criteria included participants who rely on walking aids (assistive devices) for ambulation, those who were below the age of 65 years, participants who were not oriented or were psychologically impaired, those who did not understand English language, and those who were not healthy and fit enough to undergo some examination.

Variables

Outcome variables included measurement results of cardiovascular parameters (blood pressure and HR) and perceived exertion. They also included results of balance and walking speed. Explanatory variables included two walking aids. These included walking cane and Zimmer frame.

Instruments for data collection

Six instruments were used in obtaining data for the purpose of this study. These instruments included sphygmomanometer, stethoscope, Borg CR-10 Scales,[23] Berg balance scale,[24] walking canes, and Zimmer frame.

Ethical Consideration

The data collected for the purpose of the study were in line with known research ethical declaration.[25,26] Ethical approval for this study was obtained from University of Nigeria, Nsukka (Enugu Campus) Medical School Research Ethics Committee (UNTH/CSA/329). Written informed consent was obtained from all subjects before the study.

Procedure for data collection

The desired participants in this study were recruited from the location using homogenous purposive sampling technique. Consenting older adult men in two homes for the elderly participated in the study.

Selected older adults who participated in this experimental study served as their own controls with the use of no ambulatory mobility aid devices as the comparison. Participants' SBP, DBP and pulse rate, perceived exertion, balance, and walking speed were measured at rest and after ambulation without ambulatory mobility aid devices. Each participant performed a 6-min walk test using each of the two selected ambulatory mobility aid devices on three separate days. The researchers demonstrated

Table 1. Demographic characteristics and baseline cardiovascular parameters, perceived exertion and balance of participants at rest.

Variables	Frequency	Percentage
Age (years)		
65–66	114	73.1
67 and above	42	26.9
Total	156	100.0
Married status		
Married	139	89.1
Widowed	13	8.3
Never married	4	1.6
Total	156	100.0
Baseline	**Range**	**Mean ± SD**
Systolic blood pressure, mmHg	98–188	138 ± 22.16
Diastolic blood pressure, mmHg	56–144	85 ± 13.66
Pulse rate, b/min	64–107	80.71 ± 9.40
Perceived exertion	2–4	2.68 ± 0.54
Walking speed, m/s	0.28–0.98	0.95 ± 1.15
Balance	54–60	57.48 ± 1.50

Source: Field survey 2021 (SPSS Computation).

the correct use of different ambulatory mobility aid devices to the participants before walking. For maximal strength, balance and to protect against falls, the walking aids were adjusted to match the measurement of each participant before walking. The participants were advised to wear their normal comfortable footwear throughout the study. Postambulation SBP, DBP, pulse rate, perceived exertion, balance, and walking speed of the participants were determined for each of the selected ambulatory mobility aid devices.

Statistical analysis

Data were analyzed using percentages, mean, standard deviation, and repeated measures analysis of variance (ANOVA). Percentages, mean, and standard deviation were used to describe the data. ANOVA was used to compare the impact of the ambulatory mobility aid devices on all the selected variables at $p < 0.05$ level of significance. All data analysis was run using IBM Statistical Package for Social Sciences (IBM SPSS) software version 25.

Results

Demographic characteristics and baseline cardiovascular parameters, perceived exertion and balance of participants at rest

One hundred and fifty-six ($n = 156$) participants were involved in this experimental study. The mean age of the participants in the study was 65.2 ± 0.64 years. One hundred and fourteen (73.1%) were within the ages of 65–66 years, and 42 (26.9%) of the participants were within the age range of 67 years and above. Furthermore, majority (139 or 89.1%) were married, 13 (8.3%) were widowed, and a negligible number 4 (1.6%) belonged to never married.

Baseline cardiovascular parameters of perceived exertion and balance of the participants as measured before participation in the study illustrate that at rest, the SBP and DBP ranged between 98 and 188 mmHg, and 56 and 114 mmHg with a mean of 138 ± 22.16 mmHg and 85 ± 13.66 mmHg, respectively. The pulse rate of the participants measured at rest ranged between 64 and 107 beats/min with a mean of 81 ± 9.40. The perceived exertion of the respondents ranged between 2 and 4 with a mean of 2.68 ± 0.54. The balance of the participants measured at rest ranged between 54 and 60 with a mean of 57.48 ± 1.50 (Table 1).

Cardiovascular parameters, perceived exertion, walking speed, and balance of participants with and without mobility aid devices

Cardiovascular parameters, perceived exertion, walking speed, and balance of the participants as measured after they have ambulated without walking aid devices prove that after ambulation without mobility aid devices, the SBP and DBP ranged between 94 and 181 mmHg, and 50 and 180 mmHg with a mean of 138 ± 21.06 mmHg and 83 ± 15.21 mmHg, respectively. The pulse rate of the participants measured after ambulation without mobility aid devices ranged between 61 and 113 beats/min with a mean of 79.62 ± 11.03. The perceived exertion of the respondents ranged between two and four with a mean of 3.08 ± 0.73. The walking speed of the participants ranged between 0.27 and 0.97 m/s with a mean of 0.93 ± 1.13. The balance of the participants measured after ambulation without mobility aid devices ranged between 43 and 60 with a mean of 55.42 ± 3.98.

Cardiovascular parameters, perceived exertion, walking speed, and balance of the participants as measured after they have ambulated with a Zimmer frame explain that after ambulation with a Zimmer frame, the SBP and DBP of the participants ranged between 112 and 198 mmHg, and 62 and 127 mmHg with a mean of 140 ± 19.95 mmHg and 86 ± 23.28 mmHg, respectively. The pulse rate of the participants measured after ambulation with a Zimmer frame ranged between 59 and 115 beats/min with a mean of 80.74 ± 12.43. The perceived exertion of the respondents ranged between 2 and 7 with a mean of 4.06 ± 1.35. The walking speed of the respondents ranged between 0.23 and 1.13 m/s with a mean of 0.70 ± 0.20. The balance of the participants measured after ambulation with a Zimmer frame ranged between 41 and 58 with a mean of 49.62 ± 4.53.

Cardiovascular parameters including perceived exertion, walking speed, and balance of the participants as measured after they have ambulated with a cane confirm that after ambulation with a cane, the SBP and DBP of the participants ranged between 99 and 187 mmHg, and 59 and 107 mmHg with a mean of 135 ± 20.20 mmHg and 84 ± 15.99 mmHg, respectively. The pulse rate of the participants measured after ambulation with a cane ranged between 59 and 115 beats/min with a mean of 79.62 ± 11.03. The perceived exertion of the respondents

Table 2. Cardiovascular parameters, perceived exertion, walking speed, and balance of participants with and without mobility aid devices.

Variables	Without aid	Zimmer frame	Cane
Systolic blood pressure, mmHg	138 ± 21.06	140 ± 19.95	135 ± 20.20
Diastolic blood pressure, mmHg	83 ± 15.21	86 ± 23.28	84 ± 15.99
Pulse rate, b/min	79.62 ± 11.03	80.74 ± 12.43	79.86 ± 10.57
Perceived exertion	3.08 ± 0.73	4.06 ± 1.35	3.98 ± 1.26
Walking speed, m/s	0.93 ± 1.13	0.70 ± 0.20	0.71 ± 0.21
Balance	55.42 ± 3.98	49.62 ± 4.53	50.25 ± 5.08

Table 3. Comparison of the changes in selected cardiovascular parameters, perceived exertion, walking speed, and balance of participants at rest and after walking with and without ambulatory mobility aid devices.

Variables	Without aid	Zimmer frame	Cane	*F* value	*p* Value
Systolic blood pressure, mmHg	138 ± 21.06	140 ± 19.95	135 ± 20.20	110.234*	0.000
Diastolic blood pressure, mmHg	83 ± 15.21	86 ± 23.28	84 ± 15.99	46.986*	0.000
Pulse rate, b/min	79.62 ± 11.03	80.74 ± 12.43	79.86 ± 10.57	49.651*	0.000
Perceived exertion	3.08 ± 0.73	4.06 ± 1.35	3.98 ± 1.26	7.586*	0.000
Walking speed, m/s	0.93 ± 1.13	0.70 ± 0.20	0.71 ± 0.21	2.276*	0.021
Balance	55.42 ± 3.98	49.62 ± 4.53	50.25 ± 5.08	8.563*	0.003

*$p < 0.05$.
Source: Field survey 2021 (SPSS Computation).

ranged between 2 and 7 with a mean of 3.98 ± 1.26. The walking speed of the respondents ranged between 0.27 and 0.40 m/s with a mean of 0.71 ± 0.21. The balance of the participants measured after ambulation with a cane ranged between 43 and 58 with a mean of 50.25 ± 5.08 (Table 2).

Comparison of the changes in selected cardiovascular parameters, perceived exertion, walking speed, and balance of participants at rest and after walking with and without ambulatory mobility aid devices

Comparison of the changes in the selected cardiovascular parameters, perceived exertion, walking speed, and balance of participants after operating without and with the selected ambulatory mobility aid devices prove that there is a statistically significant difference in selected cardiovascular parameters. The same trend is also observed with regard to perceived exertion, walking speed, and balance, respectively (Table 3).

Discussion

Ambulatory mobility aid devices and cardiovascular parameters

From the findings of the study, it was observed that ambulation with ambulatory mobility aid devices (cane and Zimmer frame) resulted in an increase in the selected cardiovascular parameters (SBP, DBP, PR) with the greatest increase observed when walking with Zimmer frame (SBP = 140 ± 9.95, DBP = 86 ± 23.28, PR = 80.74 ± 12.43) as opposed to walking with cane and without aid devices. This increase could be attributed to the fact that Zimmer frame distributes the participants' weight from the legs to the arms, taking away the weight from the legs, which of course, could eliminate any pain and stress caused through body weight from the legs to the arms, thereby placing more stress on the cardiovascular parameters. This allows the individual to walk for lesser periods as a result of an increase in the feeling of tiredness because the Zimmer frame has a very rigid structure, lacks wheels that provide smooth maneuverability. These findings tend to be in line with those of a previous study[20] which indicated that walking frame ambulation elicited a higher blood pressure and a higher HR when compared with a tripod and cane walking aids. The findings of this study are also in harmony with those of a study[27–30] that reported ambulation with a standard walker required a 212% more oxygen per meter compared with unassisted ambulation and a 104% more oxygen per meter compared with a wheeled walker in older adults. They also reported that ambulation with a standard walker elicited 200% and 98% higher HR per meter as compared with unassisted and ambulation with a wheeled walker, respectively. They concluded that the decision to prescribe any ambulatory mobility aid device may be clinically important with patients who have impaired cardiorespiratory systems.

Ambulatory mobility aid devices and walking speed

The results of this study showed that ambulation with ambulatory mobility aid devices resulted in a decrease of the

walking speed of the participants when compared with ambulation without ambulatory mobility aid devices. This decrease could be as a result of the fact that numerous factors contribute to walking speed. Some of the factors include neural control, muscle strength, and energy level. Since the participants were not habitual users of the ambulatory mobility aid devices, their muscle strength and neural control may not have been acquainted with the mobility aid devices which resulted in a decrease in gait speed, a reliable measure of fall prevention, and survival. This scenario might have been different if the participants were given some time to adapt to the use of the mobility aid devices. Also, from the findings, it was discovered that Zimmer frame accounted for the greatest decrease in the walking speed of the participants when compared with walking without ambulatory mobility aid devices and walking with cane. This could be likened to the fact that unlike cane which normally entails constant swinging, Zimmer frame requires the participant to lift it with each movement which might be time-consuming as well as energy-consuming. This finding corroborates the findings that walking with the three different aids by the elderly promoted reduction in walking speed when compared with walking with no aid.[20] It was noted that one of the reasons for this was that the participants did not use the walking aids habitually, and it was their first experience walking with these aids which also could be the case in this study.

Ambulatory mobility aid devices and perceived exertion

The findings of this study indicated that ambulation with ambulatory mobility aid devices increased the perceived exertion of older adults. The findings indicated that the perceived exertion of participants after using Zimmer frame and walking cane were within 4.06 ± 1.35 and 3.98 ± 1.26, respectively, as opposed to 3.08 ± 0.73 after ambulation without aid. According to the Borg CR-10 Scales,[23] the mean rate indicates a somewhat heavy exertion which implied that the exertion of the participants increased after using the Zimmer frame and cane mobility aids. This may be possible probably due to the required repeated efforts for lifting the Zimmer frame and cane. These findings were in line with the findings from the study,[21] where they compared two types of walkers with regard to energy cost produced during gait in weakened elderly individuals over the age of 65 years who were admitted in geriatrics care. Their study discovered that the use of a fixed walker led to a major increase in gait phase coordinated index (PCI) of the participants. The findings of this study also correspond to the findings of a study which concluded that the strength and metabolic demands of using a cane or walker assistive device could be excessive even though clinical and biomechanical evaluations of canes and walkers have confirmed that these devices can improve balance and mobility.[7]

Ambulatory mobility aid devices and balance

From the results of this study, the use of Zimmer frame provided enough balance for participants when compared to a cane. This is possible due to the fact that the structure of the Zimmer frame, with its legs extending to four separate areas, means that there is a larger area of support, which could ensure that the participants are balanced from all sides. This study confirms the findings of a previous study when the findings were synthesized by considering their relation to basic biomechanical principles.[7] Some biomechanical findings appear to support the clinical view that canes and walkers can improve balance and mobility for older adults and people with other clinical conditions.

Limitations of the study

Based on the findings of the study, it could be recommended, first that when an ambulatory mobility aid device is prescribed for an older adult patient, the cardiorespiratory limitations of the patient should be considered. Any of the ambulatory mobility aid devices to be prescribed should be well fitted within the range of the patient's cardiorespiratory reserve. Second, if an ambulatory mobility aid device is to be prescribed for an older adult with a compromised cardiorespiratory system, choosing a device that would afford the patient ample distance and duration for the effort without compromising other factors should be considered. Third, in older adults with compromised cardiovascular parameters, Zimmer frame should be avoided, if possible, for these patients, even when a frame is needed for other reasons. A cane should be a suitable substitute. Fourth, a Zimmer frame should be prescribed for an older adult patient if the patient is at a risk of falling and lacks ability to maintain balance. However, the cardiovascular system should be taken into consideration to avoid compromising the health of the patient. Lastly, the selection of any ambulatory mobility aid device should depend on objective mobility assessments and periodical re-evaluation to ensure that it suits a patient's functional requirements and physical capabilities.

Conclusion

Ambulatory mobility aid devices caused differences in cardiovascular parameters, walking speed, perceived exertion, and balance when compared with ambulation at rest and without aid. Zimmer frame brought about greater increase in the levels of the selected cardiovascular parameters (SBP, DBP, and pulse rate) and perceived exertion, reduced walking speed when compared with a cane. However, Zimmer frame appeared to be more effective in providing enough balance for users as opposed to a cane.

Authors' note

This manuscript was prepared with the single idea of determining the effects of ambulatory mobility aid devices on cardiovascular

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Author contributions

Uchechukwu A Ezugwu: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Supervision; Visualization; Writing—original draft; Writing—review and editing. Barbra M Eze: Data curation; Formal analysis; Investigation; Methodology; Supervision; Visualization; Writing—original draft; Writing—review and editing. Rita N Ojide: Formal analysis; Writing—original draft; Investigation; Writing—review and editing. Deborah N Alegu: Formal analysis; Writing—original draft; Investigation; Writing—review and editing. Patricia C Ngwakwe: Formal analysis; Writing—original draft; Investigation; Writing—review and editing. Nwamaka A Elom: Formal analysis; Writing—original draft; Supervision; Writing—review and editing. Christian I Ogah: Formal analysis; Writing—original draft; Investigation; Writing—review and editing. Ignatius O Nwimo: Data curation; Writing—original draft; Formal analysis; Methodology; Supervision; Writing—review and editing.

Declaration of conflicting interests

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Ethics approval

Ethical approval for this study was obtained from University of Nigeria, Nsukka (Enugu Campus) Medical School Research Ethics Committee (UNTH/CSA/329).

Informed consent

Written informed consent was obtained from all subjects before the study.

Trial registration

Not applicable.

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