PHYSICOCHEMICAL AND MICROBIAL ANALYSIS OF THE INDUSTRIAL WASTES IN A COPPER AND STEEL FACTORY IN NNEWI, ANAMBRA STATE NIGERIA

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ABSTRACT

Background: Waste from industrial processes in modern civilization contributes to water pollution, particularly contaminating groundwater through leaching and industrial effluents.

Aim of study: The aim of this study was to evaluate the toxicological and environmental impacts of a copper and steel factory wastes on the physicochemical and microbial qualities of the liquid effluent, water and soil around a copper and steel factory.

Methodology: A purposive sampling technique was employed for the study. The samples were grouped into 6 groups: 1 (soil samples from the factory), 2 (effluent discharge from factory), 3 (water sample from boreholes in the factory), 4 (water sample from borehole around the factory), 5 (soil sample from non-industrial site) and 6 (water sample from borehole, non-industrial site). Physicochemical properties (turbidity, electrical conductivity, pH, total hardness, total dissolved solids) and microbial analysis were determined using known standard methods. Analysis of the results was done using known standard methods and the results were statistically analyzed.

Results: The results showed that all physicochemical properties were within WHO permissible limit except turbidity levels in factory effluent and boreholes (P < 0.05), suggesting the samples from the factory may contain suspended and colloidal matter, and microorganisms. Microorganisms such as *E. coli, Streptococcus Spp., Coliform Spp*. and *Klebsiella spp*. were found in samples.

Conclusion: The industrial processes of the factory may have polluted the borehole water, thereby making it unsafe for both drinking and domestic use.

Key words: Physicochemical, microbial, industrial processes, copper, steel, pollution.

Introduction

Industrial pollution poses a threat to the health and wellbeing of millions of people and the global ecosystem[1]. Rapid growth of industrialization, urbanization and increase in human population around the globe has led to high demand for good quality water for domestic, recreational, industrial and other purposes[2].

The nature of industrial waste depends on the industrial processes from which it originates. Effluents from different industries are discharged into the adjoining environment and water bodies. The effluents discharged may have undergone some kind of treatment or not at all. Among the toxins and pollutants found in effluents are disease-causing microorganisms like bacteria and viruses, heavy metals, organic pollutants, and biodegradable organics. These contaminants have a serious impact on the ecosystem[3].

In developing countries including Nigeria, the reliance on groundwater over surface water for domestic use is very high. Industrial effluents and inorganic matters are the major sources of contamination of groundwater and other water sources[4]. The quality of groundwater in a given area can be determined by the physical and chemical properties of the water. The physical parameters that determine water quality include temperature, turbidity, colour, taste, and odour of water. As indicated by Peni and Listyani[5], the chemistry of the groundwater can be seen from the total dissolved solids (TDS), pH, and chemical composition. In terms of the chemical composition, the remarkable areas of attention are the acidity and the hardness.

The copper processing industries play an important role in manufacturing copper wires, copper burners, pesticides, ceramics, and cupric dyes for tanning industries. Effluents from metal finishing factories contains pollutants such as heavy metals, organic substances, cyanides, dissolved and suspended solids at levels which are harmful to the people. Steel industry effluents contain acidic waste, heavy metals, and organic contaminants, which significantly contribute to the contamination of water bodies. As a result of variations in the nature of raw materials, by-products, and the effectiveness of the operation system, polluted water discharged from steel production industries varied greatly in physicochemical indices and heavy metal concentrations.

Surface water contamination may lead to a high concentration of physicochemical elements that could upset the environment[6]. Industrial wastes have been reported to cause changes in ecosystem values, pH, conductivity, and trace metals. Biochemical processes in water systems have been shown to be influenced by physicochemical factors like temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), turbidity, and nutrient loads[1].

Calcium and magnesium make up most of what is known as water hardness. Technically, other multivalent cations (of valence greater than $^{+1}$) are considered part of the hardness.

Total Dissolved Solids and Turbidity levels are related to the presence of suspended organic materials which also promote the growth of microorganisms[7].

The pH value is a significant determinant of the quality of water that indicates the presence of alkali or acid in the samples of the water. It also affects chemical reactions, such as metal toxicity and solubility[8].

Electrical conductivity (E.C.) is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water[9]. The conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. Therefore, wastewater treatment is an essential requirement in today's society in order to decrease pollution and save natural resources.

The aim of this study was to evaluate the toxicological and environmental impacts of a copper and steel factory wastes on the physicochemical and microbial qualities of the liquid effluent, water and soil samples around a copper and steel factory in Nnewi, Anambra State Nigeria.

Materials and methods
Study Area:
This study was carried out in Nnewi Industrial area of Nnewi North LGA, Anambra State, Nigeria. The study area, Nnewi, lies between Longitudes 6° 91^{1} E and 6° 55^{1} E and Latitudes 6° 16^{1}N and 6° 10^{1} N.

Statistical analysis:

The data were presented as mean ± SD and the mean values of the test groups were compared with Control groups and WHO permissible limits by t-test and ANOVA using Statistical package for social sciences (SPSS) (Version 22) software. A $P<0.05$ was considered as significant.

Results

Table 1 presents the result of physicochemical analysis of samples from factory sand and waste water, factory boreholes, neighborhood borehole and control samples. The results in Table 1 revealed that pH of group 1 was significantly higher than the WHO permissible limit (group 8) and control (group 5). The pH values of groups 2, 3 and 4 were within the WHO permissible limit (group 8) but significantly higher when compared with the control (group 6). The EC values of groups 2, 3 and 4 were significantly lower than the WHO permissible limit; values of groups 3 and 4 were also significantly lower than the control (group 6).

The TDS values of groups 2, 3 and 4 were significantly lower than WHO limit while values of groups 3 and 4 were also significantly lower when compared to the control (group 6). Also, the TH values of groups 2, 3 and 4, were significantly lower than WHO permissible limit; values of groups 3 and 4 were also significantly lower when compared to the control (group 6).

The values of turbidity in groups 2, 3 and 4 when compared to WHO permissible Limit was insignificant while groups 3 and 4 were significantly higher when compared to the control (group 6).

Table 2 presents the result of the physical characteristics of samples from factory sand and waste water, factory boreholes, neighborhood boreholes and control samples. The results in table 2 showed that the colour of groups 1 and 5 were brown, they were odorless but contained particles. Group 2 had a cloudy look, was odorless but contained visible particles. Groups 3, 4 and 6 were seen to be colorless, odorless and not containing particles.

The results of the microbial analysis on samples from factory sand and liquid effluent, factory boreholes, neighborhood boreholes and control samples are presented in Table 3. The results revealed that *Coliform specie* was seen in groups 1 and 5 suggesting their presence in both sand samples and sand control samples. E. coli was present in all groups except group 2, which is the effluent discharge from the factory.

The table also showed that in groups 2, 4 and 6, there was presence of *Klebsiella spp. Streptococci spp.* was seen in only group 4, while *Staph spp.* was not seen in any of the groups.

Table 1:   Results of Physicochemical Analysis of Samples from Factory Soil and Liquid Effluent, Factory Boreholes, Neighborhood Borehole and Control Samples.

Physicochemical properties	pH	Electrical Conductivity (uS).	Total Dissolved Solids(mg/L)	Total Hardness (mg/L)	Turbidity (NTU)
Factory Soil N=6	7.21±0.06	NA	NA	NA	NA
Factory Effluent N=6	6.60±0.11	41.4±4.9	20.65±2.46	15.00±0.63	5.00±0.00
Factory Boreholes N=6	7.00±0.00	37.95±11.34	16.50±1.64	17.00±0.06	5.35±0.05
Neighborhood Boreholes N=12	6.85±0.05	33.06±6.17	14.65±5.53	18.00±0.63	3.98±2.11
Soil Control N=6	6.93±0.00	NA	NA	NA	NA
Water Control N=6	6.52±0.00	64.34±7.12	40.36±0.00	41.58±0.09	1.67±0.00
WHO Sand Limit	6.0-9.5	NA	NA	NA	NA
WHO water Limit	6.5-8.5	1000	500	75.0	5.00

Values are presented as Mean ± SD, $P<0.05$.

NA: Not Applicable; for quantities that cannot be determined.

Table 2: Result of the Physical Characteristics of Samples from Factory Soil and Liquid Effluent, Factory Boreholes, Neighborhood Boreholes and Control Samples.

Groups	Sampling Sites	Colour	Odour	Presence Of Particles
1	A	Brown	Odourless	+++
	B	Brown	Odourless	+++
2	C	Cloudy	Odourless	+++
	D	Cloudy	Odourless	+
3	E	Colourless	Odourless	-
	F	Colourless	Odourless	-
	G	Colourless	Odourless	-
	H	Colourless	Odourless	-
4	I	Colourless	Odourless	-
	J	Colourless	Odourless	-
5	P	Brown	Odourless	+++
	Q	Brown	Odourless	+++
6	R	Colourless	Odourless	-
	S	Colourless	Odourless	-

Table 3: Result of Microbial Analysis on Samples from Factory Soil and Liquid Effluent, Factory Boreholes, Neighborhood Boreholes and Control Samples.

Groups	Sampling sites	*E. Coli spp.*	*Strept. spp.*	*Coliform spp.*	*Klebsiella spp.*	*Staph. spp.*
1	A	-	-	++	-	-
	B	+++	-	-	-	-
2	C	-	-	-	++	-
	D	-	-	-	+++	-
3	E	+++	-	-	-	-
	F	-	-	-	-	-
	G	++	++	-	-	-
	H	+++	+++	-	-	-
4	I	++	++	-	-	-
	J	-	-	-	++	-
	P	-	-	++	-	-
5	Q	++	-	-	-	-
	R	-	-	-	++	-
6	S	++	-	-	-	-

key **-:** Not seen, +: Scanty Growth, ++: Moderate Growth, +++: Heavy Growth

Discussion

The physicochemical and physical effects of the industrial wastes of a copper and steel factory was evaluated in this study. The presence of anions and cations such as sodium, calcium, sulphate, nitrate, phosphate, chloride and bicarbonate as well as physicochemical parameters such as electrical conductivity (EC), total dissolved solids (TDS), total hardness, pH, turbidity and selected common microorganisms in the liquid effluent, factory and neighborhood borehole water and soil samples from the factory were measured, recorded, analyzed and compared with the control samples and the WHO maximum permissible limits for water and soil.

In this study, all the cations and anions concentrations except phosphate concentration in all the borehole water, soil, and factory effluent samples were found to be significantly lower than the WHO set permissible limits. This result agrees with the previous findings in different parts of Nigeria like the West and South East Nigeria [15-22]. Phosphate, chloride and sulphate levels were higher in the factory soil samples and effluent discharge when compared to the control groups.

This could be as a result of the additives such as stabilizers and plasticers used by the factory in their processes. Sodium causes scale formation and corrosion in boilers while in human excess sodium ion causes hypertension, congenial diseases, kidney and nervous disorders [23].

Phosphates in the environment, food or water are not toxic to people or animals unless they are present in very high concentration or amount. High levels of phosphate are deleterious to animals and humans on consumption. It can cause increase in plasma phosphorus level and decrease in serum calcium. The resulting hypocalcaemia stimulates secretion of parathyroid hormone, which in turn increases the rate of bone resorption [24]. High nitrate concentration has been linked to methemoglobinemia and formation of carcinogenic and mutagenic nitrous amine in gastrointestinal tracts of human being [25]. Chloride, phosphate and sulphate anions are acidic and when ingested in high concentrations, change the acid-base equilibrium, creating more acidic conditions, a process that can lead to acidosis [15].

Results of the physicochemical analysis of samples in this study showed that the neighborhood borehole water and factory effluent and water were slightly acidic and neutral respectively but fell within the WHO set permissible limit for industrial and agricultural water. This slight acidity can be attributed to the significantly lower number of cations and anions found in the samples. However, the pH of the factory soil sample is slightly basic and can be attributed to the rich organic and inorganic matters found in it. Although pH usually has no direct impact on water consumers, it is one of the most

important water quality parameters that should be carefully monitored to avoid leaching of metals in the water, sour taste and skin irritations. The pH affects the solubility of most metals in water and is an important factor affecting the productivity of aquatic ecosystems[26].

Electrical conductivity, Total dissolved solid and Total hardness are all interrelated as an increase in the total concentration of dissolved ions in the water will cause an increase in the aforementioned parameters within the samples. Ekenta *et al*.[27] stated that electrical conductivity (EC) reflects the total concentration of soluble salts in water.

Total Dissolved Solids (TDS) comprise mainly of inorganic salts and some small number of organic substances that are dissolved in water and affect water quality [28-29], while total hardness is dictated by the amount of minerals such as calcium and magnesium deposited in the water. In this study, the EC, TDS, and TH in either the factory effluent or water samples were significantly lower than the WHO set permissible limits. These results agree with the findings of [27, 30-31] but disagree with the findings of Dessie *et al*.[32], who found higher values of EC, TDS, TH in industrial waste water due to differences in quantity and nature of chemicals used. Turbidity is the reduction of transparency of water due to the presence of particulate matters such as clay, silt, organic matter, or microscopic organisms. The result of this study indicates that there is high turbidity in all the effluent and water samples of the factory.

This shows pollution and possibility of bacterial growth [33]. It is in line with the result of the physical characteristics of the samples. Borehole water samples are colourless, odourless and has no particles while the effluent discharge are cloudy, odourless and has moderate particles. The FAO[34] reported that elevated colour concentration might suggest coloured organic substances and the presence of metals such as Fe, Mn and Cu.

Results from the microbial analysis of soil, water and effluent discharge samples showed the presence of varying growth ratio of pathogenic organisms such as *E. coli spp.*, *Streptococcus spp., Coliform spp.,* and *Klebsiella spp.*, in the different samples while *Staphylococcus spp.* was not detected in all the samples.

These pathogenic organisms should not be found in drinking and industrial water but are usually present in surface water, soil and faeces of humans and animals. Though not all coliform bacteria can cause illness in humans, the presence of any microbe is a possible health concern. The result is in line with the findings of Akoji [35] who reported 25% *Enterobacter aerogenes*, 40% *E. coli* and 35% of different coliforms in borehole water in Abuja and Sojobi [17] who found *Enterobacter aerogenes* and *E. coli* in borehole water in North Central of Nigeria.

Conclusion:
The results from this study showed that the industrial wastes from the factory may have polluted the borehole water, thereby making it unsafe for both drinking and domestic use.

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BARRIERS TO INFECTION PREVENTION AND CONTROL PRACTICE AGAINST COVID-19: A SURVEY OF HEALTHCARE WORKERS IN NIGERIA

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ABSTRACT

Background/aim of the study

Following the COVID-19 pandemic which was declared a public health emergency all over the world, healthcare workers in Nigeria are still faced with many types of barriers to infection prevention and control practices. The study assessed the barriers to compliance with Infection Prevention and Control (IPC) practices among Healthcare Workers (HCWs) in Nigeria during the early phase of COVID-19.

Methods

A cross-sectional descriptive design using a non-probability purposive sampling technique was used to select seventy-eight (78) HCWs working in different healthcare facilities in Nigeria involving medical and allied health professionals such as nurses/midwives, physiotherapists, radiographers, pharmacists, orthotist, prosthetist, orthopaedic technologists, and public health professionals.

Results

The findings of the study revealed 78 HCWs participated in this study comprising 44(56.4%) medical doctors, 4(4.1%) Nurses, 17(21.8%) Physiotherapists, 5(6.4%) Laboratory scientists, and 8(10.4%) others. Thirty-nine (50.0%) of the participants found overcrowding/understaffing as one of the major barriers to IPC, 37(47.4%) indicated less commitment of HCWs to the IPC policies and 35(44.9%) indicated lack of water as the major barrier to IPC practice. Limitation of personal protective equipment such as face masks was seen as a barrier to compliance in 17(21.8%) of participants and the unavailability of alcohol-based hand rubs was seen as a barrier by 33(42.3%) of participants.

Conclusion

Several factors were identified as constituting varying degrees and levels of barriers to IPC practices following COVID-19 in Nigeria. There is a need for the government, policymakers, the leadership of private healthcare facilities, and Healthcare workers to establish an innovative, effective, and efficient system to address barriers to IPC practices which will help to reduce the risk and spread of COVID-19 in healthcare settings.

Keywords: *COVID-19. Infection Prevention and Control, Barriers, Healthcare Workers, Nigeria*

INTRODUCTION

In January 2020, the World Health Organization (WHO) declared the novel coronavirus also named SARS-CoV-2 a Public Health Emergency of International Concern globally[1]. The virus was first isolated in December 2019 in Wuhan China and causes human illness and diseases[2]. Coronavirus disease (COVID-19) spreads from human to human through an infected droplet and it can also be transmitted through faecal-oral and direct contact[3, 4]. Worldwide, the advent of covid-19 has brought negative consequences to the population's health, education, economy, and other areas of life[5]. In addition, among the general population, Healthcare workers (HCWs) are more vulnerable to the risk of SARS-CoV-2 and also its onward transmission among fellow HCWs and patients[6]. The health of the HCWs is germane to the delivery of quality healthcare during covid-19[7,8]. Covid-19 brought about overwhelming use healthcare facilities in both developed and developing worlds, and Nigeria was not exempted; with the attending implication of physical and psychological stress, difficulties in triage decisions, and even the pain that comes with losing patients[9,10,11]. The workplace has been revealed to be a pivotal place in the spread of Covid-19 infection among HCWs and patients which necessitated the introduction of Infection prevention and control guidelines to combat SARS-CoV-2 by reducing its risk and preventing its spread[12].

Around 40% of HCW infections worldwide are caused by work exposure[13]. HCWs in Nigeria were faced with challenges of diverse nature during the early phase of covid-19 pandemic[14]. IPC practices during HCWs' interaction with patients are crucial to preventing and also reducing its covid-19 spread[12]. In the work of Ilesanmi et al.,[6] on the increased Covid-19 infection among HCWs, it was observed that several factors contributed to the

spread of SARS-CoV-2 among HCWS and patients such as inadequate management support for healthcare facilities, lack of Personal Protective Equipment (PPE) provision, and lastly an inadequate understanding of IPC measures for Covid-19. Similarly, Mohamad et al.[12] in a study conducted on IPC practice among HCWs in Malaysia, reported that compliance status differed among professions, work categories, and years of practice. It was also reported that ensuring adequate training among HCWs is pivotal to reducing the risk and preventing the spread of covid-19 infection.

Since the early stages of the pandemic, the available prevention recommendations for preventing COVID-19 transmission have stayed unchanged[15]. The IPC practice guidelines include physical and social distancing, hand hygiene, use of medical masks. good indoor ventilation and the usage of PPE were generally promoted as means to combat the spread of covid-19 infection during the pandemic[15,16]. Despite the presence of guidelines, HCWs are still not immune to SARS-CoV-2[12].

The aim of this study was to explore the barriers to compliance with IPC practices among HCWs in Nigeria during covid-19.

MATERIALS AND METHODS

This study adopted a cross-sectional descriptive design using a non-probability purposive sampling technique to select seventy-eight (78) healthcare workers which includes medical doctors, nurses and midwives, physiotherapists, radiologists, laboratory scientists, and others.

Study tool and data collection

Data were collected through an online survey Google form. The link was shared through a snowball method via various WhatsApp groups to which Healthcare workers belong to. The questionnaire "IPC practices following covid-19 and barriers to compliance with the IPC practices among Healthcare workers" by Jamie[17] was adapted and used. Section 1 collected participants' socio-demographic data and their practice of handwashing before and during the period of COVID-19 as well as the availability of guidelines or protocols for caring for patients with COVID-19. Section 2 described the barriers experienced by the HCWs in their compliance with IPC practices such as Hand hygiene, face mask use, and physical and social distancing.

Section 2 consists of 15 questions informing on if there is lack of water, if sinks are inconveniently located/there is lack of sinks, if there's lack of soap and water, if the HCWs are too busy/there is insufficient time, if there is understaffing/overcrowding, if there is lack of knowledge about guidelines/protocols, if there is no place to wash hands, if hand washing agents cause irritation and dryness, if there is low risk of acquiring infection from patients, forgetfulness from HCWs and if HCWs are less committed to the policies. Other questions on barriers to IPC practices are if the patient need takes priority, always wearing gloves and unavailability of alcohol-based hand rubs. Respondent's consent was also taken to participate in the survey. The study was done completely confidential and voluntary. The responses of study participants were treated confidentially and anonymously.

Data analysis

Data were downloaded from the Google Form data collection platform, via Microsoft Excel and summarized using frequency counts and percentages.

RESULTS

A total of seventy-eight healthcare workers from different disciplines in different healthcare centres were recruited into the study. The majority of the respondents 47 (60.3%) were women, and the majority (85.9%) of the respondents were between the ages of 25 and 34. A total of fifty-three respondents (69.2%) had between one to five years of practice and a total of 17 (21.8%) had between six to ten years of practice. Most of the respondents work in government and private hospitals with an equal percentage of 37 (47.4%) respondents while 4 (5.1%) of respondents work for non-governmental organizations (NGOs). Most of the respondents 44 (56.4%) were medical doctors, 17 (21.8%) were physiotherapists, and 4 (5.1%) were nurses. Majority of the respondents (46.2%) worked in the Federal Capital Territory. All the respondents indicated they practice hand washing during the period of covid-19 while 65 (83.3%) respondents surveyed said that hand washing is a component of the organizational culture before the advent of covid-19. During the period of covid-19, a total of 61 (78.2%) of respondents indicated the presence of a covid-19 guideline or protocol. See Table 1

Barriers to compliance with Infection, prevention and control practices following covid-19 among healthcare workers.
Thirty-five (44.9%) respondents indicated that lack of water hindered them from practicing hand hygiene. Twenty-three (29.5%) respondents showed that the location of sinks, as well as the lack of sinks, hindered the practice of hand hygiene. Twenty-nine (37.2%) respondents indicated a lack of soap and water as barriers to practicing hand hygiene. Fifty-three (67.9%) respondents indicated that they don't allow being too busy or having insufficient time to hinder them from practicing hand hygiene. Half of the respondents indicated either understaffing or overcrowding hindered them from practicing hand hygiene. Thirty-three (42.3%) indicated the unavailability of alcohol-based hand rubs as a barrier to practicing hand hygiene.

government/hospital policies. See Table 2

Regarding the covid-19 guideline or protocol, 59 (75.6%) respondents indicated that a lack of knowledge about the guidelines did not hinder them from practicing hand hygiene. Hand washing agents could sometimes cause irritation and dryness but 47 (60.2%) of respondents showed that it did not hinder them from carrying out hand hygiene.

Sometimes healthcare workers could prioritize patient health over their own personal safety but 52 (66.7%) respondents showed that hand hygiene took priority over patient's needs. Also, 24 (30.7%) respondents indicated they always wore gloves following the advent of covid-19. Furthermore, 14 (17.9%) respondents indicated that because of the low risk of acquiring infection from patients, they did not practice hand hygiene; 19 (24.4%) respondents attributed not practicing hand hygiene to forgetfulness; 9 (11.5%) respondents indicated that unavailability of places to wash their hands hindered the practice of hand hygiene; 17 (21.8%) respondents indicated the absence of a medical mask hinders them from examining or making contact with patients; 37 (47.4%) respondents attributed barriers to IPC practices to less commitment of healthcare workers to

Table 1: Socio-demographic characteristics of the respondents

	Variable	Frequency	Percent
Gender	Male	31	39.7
	Female	47	60.3
	< 25	3	3.8
	25 – 34	67	85.9
Age (years)	35 – 44	7	9.0
	45 +	1	1.3
	< 1	3	3.8
Years of practice	1 – 5	54	69.2
	6 – 10	17	21.8
	>10	4	5.1
	Medical Doctors	44	56.4%
	Nurses/midwives	4	4.1%
Profession	Physiotherapists	17	21.8%
	Laboratory scientists	5	6.4%
	Radiographers	1	1.3%
	Orthotist	2	2.6%
	Pharmacist	2	2.6%
	Ortho technologist	1	1.3%
	Public Health	1	1.3%
	Prosthetist	1	1.3%
Area of Practice	Private Hospital	37	47.4
	Government Hospital	37	47.4
	Non-Governmental	4	5.1
Do you practice hand washing during covid-19	Yes	78	100
	No	0	0
Do you have a guideline or Protocol for caring for patient with covid-19	Yes	61	78.2
	No	17	21.8
Do you practice hand Washing in your facility before the advent of covid-19	Yes	65	83.3
	No	13	16.7

Table 2: Barriers to compliance with Infection Prevention and Control practices (Hand hygiene, Face mask use, and Physical/social distancing) following the Covid-19 outbreak among Health Care Workers in Nigeria

	Frequency	Percent
1. Lack of water	35	44.9
2. Sinks are inconveniently located/lack of sinks	23	29.5
3. Lack of soap and water	29	37.2
4. Too busy/insufficient time	25	32.1
5. Understaffing/overcrowding	39	50.0
6. Unavailability of alcohol-based hand rubs	33	42.3
7. Lack of knowledge about guidelines/ protocols	18	24.4
8. Hand washing agents cause irritation and dryness	31	41.7
9. Patient needs take priority	26	33.3
10. Always wearing gloves	24	30.7
11. Low risk of acquiring infection from patients	14	17.9
12. Forgetfulness	19	24.4
13. No place to wash hands	9	11.5
14. Not wearing mask while examine or contact with the patient	17	21.8
15. Less commitment of health care workers to the policies	37	47.4

DISCUSSION

Infection Prevention and Control (IPC) practice is a key element in preventing the spread of COVID-19 and HCWs have been proven to be an important conduit for the transmission of SARS-CoV-2. This study assessed the barriers to IPC practices among Nigerian during the early phase of the COVID-19 pandemic. Hand hygiene is one of the important protocols recommended by WHO to combat the spread of COVID-19 infection among HCWs and between HCWs and patients. This study revealed that some HCWs were not practicing hand washing in their workplace before the advent of the COVID-19 pandemic but, the practice changed during COVID-19 when all HCWs are now adherents of handwashing. This may be due to the pandemic nature of COVID-19 which naturally required strict adherence. The WHO recommended "Five Moments of hand hygiene" which was crucial in combatting the spread of COVID-19[18]. Nigeria Centre for Disease Control (NCDC) recommended good hand hygiene as part of the efforts to halt the spread of COVID-19, especially at the point of care which refers to where three elements come together: the patient, the healthcare worker, and the care or treatment involving contact with the patient or their surrounding[19].

Less commitment of HCWs to IPC practices has been identified in several studies as a critical barrier to IPC following COVID-19[20,21,22]. This is also in tandem with the result of our study where close to half of the respondents identified less commitment to IPC practices as a vital hindrance to preventing the spread of COVID-19. This identified barrier might be a result of misconceptions about COVID-19 and, as a result, responsible for their less-than-satisfactory behaviour and attitude.

Shortage of water and hand-cleaning solutions were part of the major factors identified in the literature as reasons why HCWs fail in their practice of IPC[22]. This is also similar to our study where close to half of the respondents identified lack of water, lack of soap and water, unavailability of alcohol-based hand rubs, and no place to wash hands as major barriers to IPC practice.

The reason can be that some of the Healthcare facilities in Nigeria have poor water supply and for those that have water supply, it is grossly inadequate to cater to the HCWs and the patients within the facilities. Adequate provision of water, soap, and hand cleaning solutions (alcohol rub or hand sanitizer) in the health facility is pivotal in IPC.

From our study, understaffing and overcrowding were identified as the main barriers to IPC practices among Nigerian HCWs. In a study done by Lowe et al.,[23] across eight conflict-affected countries (Lebanon, Central African Republic, South Sudan, Yemen, Nigeria, Mali, Afghanistan, and the Democratic Republic of the Congo), it was observed that shortages of HCWs were a vital hindrance to IPC practice in the identified countries. Conflict always leads to movement within and between a region and this doesn't exempt HCWs thereby leading to the reduction in the number of available HCWs in healthcare facilities. Several studies revealed overcrowding as a perceived barrier to IPC practice among HCWs[24,25,26]. The COVID-19 pandemic made healthcare facilities overcrowded because of the large number of patients suffering from symptoms associated with COVID-19. This made already overstretched healthcare facilities and HCWs find themselves in situations where IPC practices became difficult to carry out effectively and efficiently.

Lack of knowledge, inadequate training of staff, and shortage of trained staff have been identified as important barriers to IPC practice[22,23,27].

This is in tandem with the outcome of our study where some of the respondents identified a lack of knowledge about COVID-19 guidelines/protocols as a barrier to their IPC practice. Educating HCWs on every aspect of COVID-19 will go a long way to preventing the spread of COVID-19 among the HCWs and also between HCWS and patients. In the work of Mersha et al.,[22], negligence and ignorance were identified as one of the major contributing barriers to effective IPC practice. This is similar to findings in our study where negligence and ignorance were seen to play a pivotal role where some of the respondents failed to wear a face mask while in contact with the patient, and some also saw their perceived low risk of acquiring infection from patients as a point not to practice IPC and nonchalant attitude of forgetfulness was another barrier identified.

Work overload has been shown to be an important barrier to IPC practice among HCWs[28]. The findings in our study identified being too busy or insufficient time as a hindrance in IPC practice. This can be explained by the fact that HCWs became the major focal point during COVID-19 with everyone that felt unwell from any form of ailment visiting the hospital even from sickness they could ordinarily attend to at home. This led to an increased workload among the HCWs.

The main limitation of this work is the lack of presentation of all Healthcare workers in Nigeria which affected the generalization of our results. Further studies can be done focussing on each state in Nigeria is recommended. In summary, we found that at the early phase of the COVID-19 pandemic, HCWs in Nigeria were able to identify certain types of barriers to their IPC practices and the pandemic provided an opportunity to strengthen important aspects of IPC practices especially hand hygiene and HCWs' attitudinal commitment to policies that have been previously overlooked.

CONCLUSION

This study showed an overview of barriers to compliance with IPC practices in Nigeria among healthcare workers following COVID-19. Healthcare workers in Nigeria are still faced with many types of barriers in IPC practices which cut across government and private healthcare facilities. Understaffing/overcrowding, lack of water and soap, and less commitment of healthcare workers to the IPC policies were topmost among the barriers. For effective implementation of IPC practice in healthcare facilities, the barriers should be given prompt and adequate attention both at the level of the policymakers, the leadership, and also among the healthcare workers

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KNOWLEDGE AND ATTITUDE ON THE ROLE OF PHYSIOTHERAPY IN THE INTENSIVE CARE UNIT AMONG OTHER HEALTH CARE PROFESSIONALS IN SOUTH EAST, NIGERIA

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ABSTRACT

Background: The Intensive Care Unit (ICU) is designed to ensure that continous and comprehensive care is delivered to patients by highly trained staff and should include both clinically oriented and design based multi- professional team members.

Aim: This study set in South East Nigerian States, was therefore aimed to determine the knowledge and attitude of the role of physiotherapy in the ICU among other HCPs in South East Nigeria; and the influence of selected socio-demographic profile of the participants on the constructs.

Methods: A cross-sectional survey involving Sixty (60) conveniently sampled HCPs working in the ICU who consented and participated. The participants' socio-demographic variables were obtained and a questionnaire was used to evaluate the knowledge and attitude of the role of physiotherapy in ICU among other HCPs in south east Nigeria. The obtained data were summarized using descriptive statistics of frequency, percentages, mean, and standard deviation, while inferential statistics of Mann Whitney U test, Kruskal Wallis test, and Spearman-rank correlation were used to analyze data with the alpha set at <0.05.

Results: The majority of the participants (66.6%) had an acceptable level of knowledge, while all the participants (100%) had a positive attitude. No significant correlation was found between knowledge and attitude (rho=0.026, P=0.844). Age had a significant influence on attitude (P =0.003), but not on knowledge (P = 0.208). Gender did not significantly influence knowledge (P= 0.127) and attitude (P =0.208). Educational qualification had no significant influence on knowledge (P=0.212) and attitude (P =0.05). Profession significantly influenced attitude (P =0.04) but not knowledge (P =0.383). The clinical experience had a significant influence on attitude (P <0.0001) but not on knowledge (P=0.594).

Conclusion: Health Care Professionals working in ICU had an acceptable level of knowledge and a positive attitude regarding physiotherapy involvement in the ICU.

Keywords: *Knowledge, Attitude, Role of Physiotherapy, Intensive Care Unit, Health Care Professionals*

Introduction

Physiotherapy is a health care profession that provides treatment to individuals to develop maintain and restore maximum movement and functional ability throughout a person's life span [1,2]. The physiotherapist must understand the cultural, psychological, and social factors that affect the patients to provide effective treatment [3]. Medical history review and physical examination begin the assessment of a patient's condition and it applies to all patients irrespective of age and context [4]. Physiotherapy has many specialties such as cardiopulmonary, geriatrics, neurology, orthopedics, and pediatrics, to name a few [2].

An Intensive Care Unit (ICU) is an isolated confined ward in the hospital where the most critically ill patients are located together and managed using specialized personnel and equipments [5]. The treatment of the patient in the ICU requires expensive equipments such as advanced monitors, mechanical ventilators, pacemakers, and defibrillators [6,7]. Patients admitted to the ICU are critically ill patients are defined as those with life-threatening health problems who need to receive critical medical interventions and complex care [8]. These patients are known to have a serious health problem that requires a high level of support, which could be in the form of respiratory support or the support of two or more organ systems, including cardiovascular, respiratory, renal, metabolic, or cerebral function [9]. Critically ill patients frequently suffer long-term physical and psychological complications.

They are on long-term mechanical ventilation and as a result, 25% display significant muscle weakness, and approximately 90% of long-term ICU survivors will have ongoing muscle weakness. Prolonged stays in the intensive care unit are also associated with impaired quality of life, functional decline, and increased morbidity, mortality, cost of care, and length of hospital stay [10].

Physiotherapy has been accepted as an integral component in the management of patients who require intensive care; and physiotherapists play a unique role as a part of the ICU team [11]. Physiotherapists are elemental team representatives of the clinical healthcare team, and they need to understand other practitioners' roles and communicate effectively to provide high-quality, coordinated patient care [12]. The aim of physiotherapy in the ICU is to enhance function, reduce the length of stay, and improve the quality of life of critically ill patients, including those receiving mechanical ventilation [13]. Muscle weakness, joint stiffness, impaired functional exercise capacity, physical inactivity, and respiratory conditions such as retained airway secretions, atelectasis, and respiratory muscle weakness are physical reconditioning and associated problems of a critically ill patient which requires physiotherapy interventions [14].

Interdisciplinary teamwork is an essential component of holistic care since team members' skills, experience, and knowledge are pooled together to produce the best outcomes [15]. Each of the members in the Intensive Care Unit (ICU) team plays a unique role according to the patient's needs. In the current demanding healthcare environment, inter-professional team practice is being promoted as a comprehensive means of providing cost-effective healthcare [16].

Literature suggests that professional specialization has led to fragmentation between professions, which are likely to result in healthcare team members being unable to look at the problems of patients as a whole team [17]. A small number of studies have highlighted a part of the attitudes and perceptions that may underlie inter-professional relationships and their effect on teamwork and the effectiveness of management in critical care [17,18]. Communication is being identified as of particular interest because of the complex socio-technical tendency of the ICU environment. Interpersonal factors have been reported as the main causes of stress in high-dependency areas whereas poor communication is reported as the cause of errors [18].

Knowledge is defined as the capacity to acquire, retain and use information through experience, comprehension, discernment, and skill [19]. Knowledge is vital in generating appropriate actions by providing the background for articulating possible courses of action which will yield the intended result [20]. The greatest challenge facing physiotherapists is creating awareness among the masses and other healthcare providers about the role of physiotherapy in health care delivery [21]. Just as poor awareness about a profession can lead to misconceptions about it, good awareness can enhance its appreciation and use. Thus good awareness of the role of physiotherapy in the health care delivery system may influence adequate use of it [22]. For this study, knowledge refers to the understanding and awareness of HCPs regarding physiotherapy management in the ICU.

Attitudes are learned evaluations concepts associated with the people think, feel, and behave [23]. The quality of one's attitude is judged from the observable, evaluative responses that are made[24]. Attitude is defined as a mental position relative to a way of thinking or being, and it can imply positive or negative behaviour [22]. For this study, an attitude refers to the positive and negative behaviour of HCPs in Anambra state toward physiotherapists working in the ICU as well as toward physiotherapy services in general in the ICU.

The presence of active teamwork between HCPs within the ICU team from various disciplines may improve efficiency, functional outcomes, and the cost of care for patients [25]. The multidisciplinary relationship plays a major role in effective patient care so the provision of effective and efficient health services needs communication and coordination between practitioners [15]. The awareness of every member's role in the multidisciplinary environment of ICUs is important and any lack of knowledge among HCPs may influence the referral process and the delivery of patient care [26]. The awareness of the importance of the role of a physiotherapist in the ICU may therefore influence the patient care process [27]. In the ICU the physiotherapist as a rehabilitation expert is involved in assessing, treating, and managing critically ill patients who have a variety of neurological, respiratory, cardiac, medical, and surgical conditions. The aim of physiotherapy in the ICU is to enhance function, reduce the length of stay, and improve the quality of life of critically ill patients, including those receiving mechanical ventilation [27].

The primary physiotherapy interventions provided to critically ill patients are focused on physical reconditioning and associated problems. These typically include muscle weakness, joint stiffness, impaired functional exercise capacity, physical inactivity, and respiratory conditions such as retained airway secretions, atelectasis, and respiratory muscle weakness [11].

The knowledge and attitude of every healthcare profession towards other healthcare professions may affect the delivery of patient care [28]. The study was aimed to determine the knowledge, attitude of other HCPs working in the ICU on the role of physiotherapy in the ICU, and the influence of socio-demographic variables on the knowledge and attitude.

Method

Study participants

Sixty (60) Health Care Professionals (HCP) working in the intensive care unit consented to the study. Those who were eligible for inclusion were HCPs working in any of the ICU sub-categories such as Coronary ICU, High dependency unit, Medical ICU, Surgical ICU, Neurological ICU, and Pediatric ICU at the time of the study, the participants were registered HCPs at their regulatory bodies and HCPs that were eligible for inclusion were employed for at least six months in the intensive care units before the time of their selection in selected Hospitals in South East, Nigeria which included Federal Medical Center Owerri Imo State, Federal Medical Center Umuahia Abia State, Federal University Teaching Hospital Abakiliki Ebonyi State, Nnamdi Azikiwe University Teaching Hospital Nnewi, Anambra State, and the University of Nigeria Teaching Hospital Enugu Enugu State.

A priori power analysis was performed using G*Power 3.1.9.7 software, based on alpha level of 0.05, power of 0.8, effect size of 0.4 and degree of freedom of 5. The minimum calculated sample size was 58 but 60 participants were recruited for the study. The study was hence fully powered.

The study protocol was approved by the Ethics Committee of Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State. An approval was obtained from the management of the selected hospitals in South East Nigeria. The participants were given a detailed explanation of the study protocol and its objectives. Those who volunteered to participate signed a written informed consent before being recruited for the study.

Procedure

An adapted questionnaire that focused on the knowledge and Attitude of other HCPs was self-administered to all the participants. The questionnaire was modified from a questionnaire developed by Jones [27] on perception of medical staff on intensive care physiotherapy in the past 6 months in United Kingdom, Australia, Canada, South Africa, and Hong Kong. Content validity was done through review by a physiotherapists and the relevant HCPs working in one of the selected hospitals' intensive care unit. The questionnaire was modified based on the outcome of the review. It was pilot-tested at one of the intensive care units and changes made based on the feedback from the pilot participants. It is a 35-item questionnaire divided into three sections. The first section collects data on participants' socio-demographics, the second section collects data on knowledge and the third section gathers information on attitude. The scoring of participants' knowlegde ranged from 1 = "True", 2 = "False" and 3 = "I don't know" A total score of knowledge questions was = 14. The scoring of participants' attitudes ranged from 1 = "Disagree", 2 = "Neutral‖ and 3 = "Agree", from a total score of attitude =36 an average of greater than 70% was determined to be acceptable by the researchers.

Data Analysis

A post-hoc power analysis performed using G*Power 3.1.9.7 software revealed that the study was sufficiently powered (0.85) at alpha level of 0.05, sample size of 60, effect size of 0.4 and degree of freedom of 5. Descriptive statistics of mean, standard deviation, proportion as well as frequencies were used to summarize the data. Inferential statistics of Mann-Whitney U tests Kruskal Wallis tests and Spearman's correlation test order were used in testing the hypothesis with the alpha set at <0.05.

Results

The majority of the participants were females (56.3%) and were currently married (55%). About one-half of them (51.7%) fell within the age range of 20- 29 years with the majority (98.7%) attending the tertiary institution. A large number of them were nurses (45%), had 1-5 years of clinical experience (48.3%), worked in a general medical ICU setting (43.3%), and had less than 1-3 years of work experience in the ICU(80%) (Table 1).

The majority (66.6%) had an acceptable level of knowledge on the role of physiotherapy management in the ICU. However, their mean knowledge score was 10.4 ± 2.05.(Table 2). All the participants (100%) had a positive attitude regarding the role of physiotherapy in the ICU. However, their mean attitude score was 32 ± 2.4 (Table 2).

Age had a significant influence on knowledge (K=10.714, P<0.05), with the age range of 50-59 years having the highest mean rank (49.25). However, no significant influence was found between profession and knowledge (K=5.227, P=0.383), sex and knowledge (U=358.500, P= 0.208), clinical experience, and knowledge (K=1.902, P=0.593) (Table 3). Moreso, Age had a significant influence on attitude (K=14.228, P<0.05), with the age range of 40-49 years having the highest mean rank (50.57). Profession had a significant influence on attitude (K=11.619, P<0.05), with other health professionals excluding medical officers, nurses, general surgeons anesthetists, and neurosurgeons having the highest mean rank (40.80).

Also, years of clinical experience had a significant influence on attitude (K=26.77, P<0.05). Participants with greater than 16 years of clinical experience had the highest mean rank (44.53) (Table 4). A strong positive but no significant correlation was found between knowledge and attitude of the participants (rho=0.026, p=0.844). (Table 5).

Table 1: Socio- demographic characteristics of the participants

Variables	Class	Frequency(n)	Percentage
Sex	Male	34	56.3
	Female	24	43.3
Marital status	Single	33	55
	Married	27	45
	Divorced	0	0
Age	20-29	31	51.7
	30-39	16	26.7
	40-49	7	11.7
	50-59	6	10
	60 and above	0	0
Educational attainment	No education	0	0
	Primary education	0	0
	Secondary education	2	3.3
	Tertiary education	58	96.7
Profession	Medical officers	24	40
	Nurse	27	45
	Anesthetists	3	5
	Others	6	10
Clinical experience	1-5 yrs	29	48.3
	6-10yrs	13	21.7
	11-15yrs	3	5
	16yrs and above	15	25
ICU setting	General medical	26	43.3
	Surgical	13	21.6
	Neurological	9	15
	Pediatric	10	16.7
	Coronary care unit	1	1.7
	Mixed high dependency unit	0	0
	Traumatic unit	0	
	Neonatal	1	0
	Others	1	1.7
Duration of ICU experience	<1yr	24	40
	1-3yrs	24	40
	4-6yrs	2	3.3
	7yrs and above	10	16.7

Table 2: Knowledge and attitude of the participants.

Variables	Class	Frequency	Percentage	Range	mean±SD
Knowledge	Acceptable knowledge	40	66.6	5-14	10.4±2.05
	Unacceptable knowledge	20	33.4		
Attitude	Negativeattitude	0	0	27-36	32±2.4
	Positive attitude	100	0		

KEY:

SD= Standard deviation

Table 3: Influence of some selected socio-demographic characteristics on knowledge of the participants.

Variables	Class	Mean ranks	U/K value	P-value
Sex	Male	32.6	U=358.500	P=0.208
	Female	27.29		
Age	20-29	27.68	K=10.714	P=0.013*
	30-39	33.34		
	40-49	20.43		
	50-59	49.25		
	60 and above	0		
Educational attainment	No education	0	K=1.56	P=0.212
	Primary education	0		
	Secondary education	15.50		
	Tertiary education	31.02		
Profession	Medical officers	78.40	K=5.227	P=0.383
	Nurse	26.31		
	Anesthetists	39.33		
	Others	29.67		
Clinical experience	1-5 yrs	30.53	K=1.902	P=0.593
	6-10yrs	27.58		
	11-15yrs	43.83		
	16yrs and above	30.50		

Table 4: Influence of some selected socio-demographic characteristics on the attitude of the participants

Variables	Class	Mean ranks	U/K- value	P-value
Sex	Male	27.51	U=340.500	0.127
	Female	34.40		
Age	20-29	25.37	K=14.228	P=0.003*
	30-39	34.28		
	40-49	50.57		
	50-59	20.92		
	60 and above	0		
Educational attainment	No education	0	K=1.451	P=0.228
	Primary education	0		
	Secondary education	45		
	Tertiary education	30		
Profession	Medical officers	72.11	K=11.619	P=0.04*
	Nurse	35.02		
	Anesthetists	5.83		
	Others	40.80		
Clinical experience	1-5 yrs	19.62	K=26.722	<0.0001*
	6-10yrs	40.73		
	11-15yrs	21.17		
	16yrs&above	44.53		

Table 5: Correlation between knowledge and attitude of the participants.

Variables	Rho value	P value Attitude
Knowledge vs Attitude	0.026	0.844

Discussion

This study sought to determine the knowledge and attitude of HCPs in South East, Nigeria towards physiotherapy in the ICU; and to investigate the influence of the socio-demographic profile of the participants on the constructs. The outcome of the study showed that females accounted for the majority of the participants, with more than half married, thus revealing the numerical significance of female participants, which is consistent with the general trend in the professions. This may be a reflection of the gender disparity within the professions, which has seen increased participation of women in the medical and health care professions.

Ramakrishnan, et al [29] referred to this trend as the "feminization of medicine", characterized by a dramatic increase in women's enrolment in the medical field, leading to major shifts in the gender composition of the workforce. About one-half of them (51.7%) fell within the age range of 20- 29 years. This finding is similar to a study conducted in Sudan in which a majority of the respondents were within the same age range. Kheir, et al [30] stated that this would imply that more younger medical personnel are in the workplace in different specialties and ranks. A large number of the participants were nurses (45%), had 1-5 years of clinical experience (48.3%), worked in a general medical ICU setting (43.3%), and had less than 1-3 years of work experience in ICU (80%). In addition, the majority of the participants were working in General Medical ICUs possibly due to the fact most of the hospitals included in this study had the General Medical ICU as its major ICU. There is also evidence that most hospitals have a General Medical ICU as the primary ICU, which is also designed to care for a variety of critically ill patients, including adult and pediatric populations [31].

The majority of the participants (66.6%) had an acceptable level of knowledge on the role of physiotherapy management in ICU. This knowledge was presented in terms of the importance of physiotherapy services in the ICU in general, knowledge of commonly applied physiotherapy practices in the ICU, and the effectiveness of physiotherapy treatment on the critically ill patient, including the prevention of complications, length of stay in the hospital or ICU, functional status, and quality of life. This finding corresponds with a survey study done by Shimpi et al [32] which found that participants had a good awareness of physiotherapy among referring doctors. These findings regarding the knowledge of participants about physiotherapy management in the ICU in selected hospitals in south Eastern Nigeria suggests that they may possess better knowledge about physiotherapy in the ICU than participants in other African countries. For example, a study conducted in Northern Ethiopia mapped out that nearly 50% of medical doctors had inadequate knowledge and negative attitudes towards physiotherapy [33], and 74.7% in Ethiopia All the participants (100%) had a positive attitude regarding the role of physiotherapy in ICU patients.

This positive attitude of the participants can be interpreted in two ways. Firstly, the high percentage of adequate knowledge of the HCPs may have resulted in a high percentage of positive attitudes among them. Secondly, the Nigerian physiotherapists they worked with may have effectively carried out their roles in the ICU, prompting positive attitudes from other team members.

A study supporting this finding showed that nurses who worked as part of the critical care team had positive perceptions towards the role of physiotherapists in ICU[28]. This study justifies the finding of the current study regarding the positive attitudes of other HCPs towards physiotherapists in the ICU. According to Brilli et al [25], this is important to note because the prevalent attitude among medical staff will affect the process of teamwork as well as the referral process having a subsequent effect on patient care.

Age had a significant influence on knowledge. This may have been because as age increases people tend to have more knowledge on the role of physiotherapy in ICU. Those within the age 50-59 years had the highest mean. This study also showed that the attitude of participants had a significant positive association with overall years of clinical experience, as well as the number of years of ICU experience. Participants with more years of experience demonstrated better knowledge in their practice, possibly acquired through their additional working experience [34]. In contrast, however, Gomes [35],

found a weak correlation between the number of years working in the ICU and knowledge. However, the study also reported that this correlation is insignificant. It is also interesting to note that 100% of HCPs working in the ICUs were found to have a positive attitude toward the physiotherapists 'role in the ICU, regardless of their professions. They accepted physiotherapists as part of the ICU team, contributing to the effective management of patients through medical staff rounds, case discussions regarding the patient's condition, decisions regarding weaning from mechanical ventilation, and discharge planning from both the ICU and hospital.

No significant correlation was found between the knowledge and attitude of the participants, although a previous similar study regarding the knowledge, attitudes, and practices around health promotion amongst Physiotherapists, found a significant positive correlationsh between knowledge and attitudes[36]. The knowledge and attitudes of team members are considered to be significant factors that affect teamwork interaction and influence the quality of care provided in the ICU [37].

LIMITATION

The study did not put into cognizance the HCPs working in various dimentions of the intensive care unit.

CONCLUSION

Based on the findings from this study, HCPs working in the ICU team have adequate knowlsedge and positive attitudes regarding physiotherapy management in the ICU.

Author contributions

All the authors contributed significantly in the study conception, design, data analysis, preparation and revisions of the manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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COMPREHENSIVE ANALYSIS OF BROUGHT IN DEAD CASES: A RETROSPECTIVE OBSERVATIONAL STUDY IN A TERTIARY HOSPITAL IN NORTH-EASTERN NIGERIA

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ABSTRACT

Introduction: The Accident and Emergency unit is often the main entry point to hospitals for unexpected diseases, even though no medical care can be provided to Brought In Dead (BID) cases upon arrival. However, valuable information can be deduced from forensic investigations and analysis. Despite a life expectancy of 53 years and civil unrest in North-Eastern Nigeria, there is a lack of studies on BID in the region.

Aims: This research aimed to evaluate the frequency, age, and sex distribution, as well as clinical conditions associated with BID cases at the University of Maiduguri Teaching Hospital.

Materials and Methods: This retrospective observational study was conducted in the Accident and Emergency Unit of the University of Maiduguri Teaching Hospital, Maiduguri, Borno State, Nigeria. Ethical approval was obtained, and data collection included all BID cases registered between January 2018 and December 2020. The data was summarized using frequency and percentages.

Results: Out of 955 deaths recorded during the study period, 204 cases (21.3%) were BID. The BID cases consisted of 136 males (66.7%) and 68 females (33.3%), with a male-to-female ratio of 2:1. The age range of BID cases varied from 0-18 to above 75 years, with the highest frequency observed in the age range of 38-56 years. The most common known clinical conditions associated with BID cases were bleeding from gunshot, cardiopulmonary arrest, chronic kidney disease, and severe malaria. Male BID cases were commonly associated with cardiopulmonary arrest, while female BID cases were associated with cancer.

Conclusion: This study provided valuable insights into BID cases at the University of Maiduguri Teaching Hospital. The findings can guide strategies to mitigate BID occurrences and improve health-seeking behavior, especially among young adults.

Key Words: *Brought-In Dead cases, Accident and Emergency, North-Eastern Nigeria, University of Maiduguri Teaching Hospital*

INTRODUCTION

Hospital establishments are primarily aimed at treating ailments and promoting healing, however, there are cases where individuals arrive at the hospital already clinically dead. This condition is commonly known as "brought in dead" (BID). Regrettably, a significant number of these BID cases could have been prevented if the actual cause of death had been identified earlier.[1] The main route of entry to the hospital in case of unexpected disease/ailment is via Accident and Emergency unit. Even though no medical care or support can be given to BID when received; much information can be deduced from the relatives and also following forensic investigations and analysis.[2] The information obtained from forensic investigations may give clue on how to mitigate the frequency of BID.[3]

Despite the average life expectancy of 53 years,[4] and faced with high level of civil unrest in North-Eastern Nigeria, there is dearth of studies on BID,[5,6,7]

The research is aimed at reviewing comprehensive data to evaluate the frequency, age and sex pattern of distribution as well as clinical conditions associated with the Brought In Dead cases at University of Maiduguri Teaching Hospital, a tertiary institution in North-Eastern Nigeria.

MATERIALS AND METHOD

Study Area

This was a retrospective observational study carried out in the Accident and Emergency Unit of University of Maiduguri Teaching Hospital, Maiduguri metropolis, Borno State of Nigeria. Maiduguri is the capital and largest city of Borno State located in the North-East geopolitical zone of Nigeria Latitude 11° 49' 59.99" N and Longitude 13° 08' 60.00" E with a population of 1,907,600 people. Most inhabitants of the state are farmers.

Ethical Consideration

Ethical approval was obtained from University of Maiduguri Teaching Hospital research and ethics committee (OHRP-IRB00013572 UMTH/REC/22/1043) prior to the commencement of the study. Confidentiality and data protection were strictly maintained throughout the study. All procedures were conducted in accordance with the ethical guidelines outlined in the declaration of Helsinki 2010.[8]

Data Collection

Decedents that were registered as brought-in-dead at the Accident and Emergency unit of University of Maiduguri Teaching Hospital Death register, whether from suspected medical causes or not were included in the study. Deaths that occurred within the Hospital setting were excluded from the study, BID registered outside the range of January 2018 and December 2020 were also excluded from the study. All cases that met the inclusion criteria from January 2018 to December 2020 were recorded and data obtained were presented using frequency tables and percentages.

RESULTS

A total of 955 deaths were recorded between January 2018 and December, 2020, out of which 204 cases (21.3% of the total deaths) were Brought In Dead (BID). In 2018, out of 279 deaths, 57 cases (20.4%) were BID.

In 2019, out of 309 deaths, 86 cases (27.8%) were BID. In 2020, out of 367 deaths, 61 cases (16.6%) were BID (Table 1). The BID cases were composed of 136 males (66.7%) and 68 females (33.3%), resulting in a male-to-female ratio of 2:1

The age range of the BID cases varied from below 0-18 years to above 75 years. The lowest number of cases, 1.96% (4), was observed in the age range of 0-18 years, while the highest number of cases, 43.63% (89), was observed in the age range of 38 -56 years (see Table 2). Table 3 presents the different clinical conditions associated with the BID cases in this study. The majority of cases, 21.6% (44), had unknown clinical conditions. However, among the known clinical conditions, bleeding from gunshot, cardiopulmonary arrest, chronic kidney disease, and severe malaria were the most common. Bleeding from gunshot accounted for the highest number of associated clinical conditions with BID cases, with 33 cases (16.2%).

Table 4 provides the breakdown of associated clinical conditions according to age groups. The study revealed that road traffic accidents (RTA) were the most common associated clinical condition among the age group 0 to 18. In the age groups 19 to 37, 57 to 75, and above 75 years, the majority of BID cases had no known associated clinical condition. However, the most common clinical conditions associated with these age groups were cardiopulmonary arrest (9), chronic kidney disease (9), and severe malaria (2), respectively. Among the age group 38 to 56 years, bleeding from gunshot was the most common associated condition with BID cases, accounting for 19 cases.

Table 5 presents data of gender and associated clinical conditions. A significant number of male BID cases (34) had no known associated clinical condition. The commonest clinical condition associated with male gender was cardiopulmonary arrest (27). Among female BID cases, the highest frequencies were observed in those with no known clinical condition and those with cancer, both accounting for 10 cases.

Table 6 shows the distribution of BID cases by month. The highest rate of BID cases, 17.2% (35), was observed in the month of December. Road traffic accidents were the most common associated clinical condition with BID cases in that month.

Table 7 provides information on the residential locations of the BID cases. The study found that 71% (145) of the BID cases lived within the metropolis.

Table 1: Mortality distribution for 3-year period

Year	Hospital cases	BID cases (%)	Total mortality
2018	222	57 (20.4)	279
2019	223	86(27.8)	309
2020	306	61 (16.6)	367
Total	**751**	**204 (21.3)**	**955**

Table 2: Age and sex distribution of BID

Age (years)	Sex		
	Male (%)	Female (%)	Total (%)
0-18	1	3	4(1.96%)
19-37	40	11	51(25%)
38-56	59	30	89(43.63%)
57-75	32	17	49(24.02%)
Above 75 years	4	7	11(5.39%)
Total	**136 (66.7%)**	**68 (33.3%)**	**204(100%)**

Table 3: Clinical conditions associated with BID Cases.

Clinical Condition	Frequency	Percent
Abdominal Pain	6	2.9
DM	3	1.5
DM/HTN	3	1.5
Epigastric pain	2	1.0
HTN	3	1.5
Parkinsons Diesease	2	1.0
Pneumonia	2	1.0
RVI	1	0.5
Severe Malaria	19	9.3
Stroke	1	0.5
Suicide	2	1.0
Cardiopulmonary arrest	29	14.2
Unknown	44	21.6
RTA	14	6.9
Bleeding Dissorder	1	0.5
Cancer	11	5.4
Gunshot Case	33	16.2
CKD	24	11.8
Diarrhoea	4	2.0
Total	**204**	**100.0**

RTA= Road Traffic Accident; CKD= Chronic kidney disease; HTN= Hypertension; DM= Diabetes mellitus; DM/HTN= Diabetes Mellitus and Hypertension; RVI=Retroviral Infection.

Table 4: Age range and associated clinical condition

Associated health condition	Age range					Total
	0-18	19-37	38-56	57-75	76-94	
Abdominal Pain	1	3	2	0	0	6
DM	0	0	1	2	0	3
DM/HTN	0	0	2	1	0	3
Epigastric pain	0	1	0	1	0	2
HTN	0	1	0	1	1	3
Parkinsons Diesease	0	0	1	1	0	2
Pneumonia	1	0	0	0	1	2
RVI	0	0	1	0	0	1
Severe Malaria	0	4	8	5	2	19
Stroke	0	0	1	0	0	1
Suicide	0	2	0	0	0	2
Cardiopulmonary Arrest	0	9	16	4	0	29
Unknown	0	10	16	15	3	44
RTA	2	7	4	1	0	14
Bleeding Dissorder	0	0	1	0	0	1
Cancer	0	1	5	3	2	11
Gunshot Case	0	8	19	5	1	33
CKD	0	4	10	9	1	24
Diarrhoea	0	1	2	1	0	4
Total	**4**	**51**	**89**	**49**	**11**	**204**

Table 5: Gender and associated health condition

Associated clinical condition	Gender		
	Male	Female	Total
Abdominal Pain	0	6	6
DM	2	1	3
DM/HTN	3	0	3
Epigastric pain	2	0	2
HTN	2	1	3
Parkinsons Diesease	2	0	2
Pneumonia	1	1	2
RVI	0	1	1
Severe Malaria	12	7	19
Stroke	1	0	1
Suicide	2	0	2
Cardiopulmonary Arrest	27	2	29
Unknown	34	10	44
RTA	7	7	14
Bleeding Dissorder	0	1	1
Cancer	1	10	11
Gunshot case	24	9	33
CKD	15	9	24
Diarrhoea	1	3	4
Total	**136**	**68**	**204**

Table 6: Month and associated health condition

Associated Health Condition	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Abdominal Pain	0	5	0	0	0	0	0	0	0	0	0	1	**6**
DM	0	0	1	0	0	0	0	0	1	0	0	1	**3**
DM/HTN	0	2	1	0	0	0	0	0	0	0	0	0	**3**
Epigastric pain	0	1	1	0	0	0	0	0	0	0	0	0	**2**
HTN	1	0	0	1	1	0	0	0	0	0	0	0	**3**
Parkinsons Diesease	0	0	0	1	0	0	0	0	0	0	1	0	**2**
Pneumonia	1	0	0	0	0	0	0	0	0	1	0	0	**2**
RVI	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Severe Malaria	1	2	0	2	3	1	1	0	5	2	2	0	**19**
Stroke	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Suicide	0	0	0	0	0	0	1	0	0	0	0	1	**2**
Cardiopulmonary Arrest	2	2	1	0	2	8	0	0	2	1	2	9	**29**
Unknown	5	2	7	4	3	0	3	2	7	3	5	3	**44**
RTA	1	1	0	0	1	1	0	0	0	0	0	10	**14**
Bleeding Dissorder	0	0	0	0	0	0	0	0	1	0	0	0	**1**
Cancer	2	2	2	0	2	0	0	1	2	0	0	0	**11**
Gunshot Case	3	3	2	1	2	1	6	0	1	6	2	6	**33**
CKD	4	1	0	0	5	0	1	3	2	2	2	4	**24**
Diarrhoea	0	0	1	0	0	0	1	0	0	1	1	0	**4**
Total	**20**	**21**	**16**	**9**	**19**	**11**	**14**	**6**	**22**	**16**	**15**	**35**	**204**
(Total Percentage)	**(9.8)**	**(10.3)**	**(7.8)**	**(4.4)**	**(9.3)**	**(5.4)**	**(6.9)**	**(2.9)**	**(10.8)**	**(7.8)**	**(7.4)**	**(17.2)**	**(100)**

Table 7: Location of BID Cases

Location of BID cases	Frequency of BID	Percentage
Within metropolis	145	71
Outside metropolis	59	29
Total	**204**	**100**

DISCUSSION

This study delved into the BID cases in the accident and emergency unit of the University of Maiduguri Teaching Hospital. The findings shed light on various aspects of BID cases and offer valuable insights into the local healthcare landscape. The number of hospital deaths observed in 2018 was lower than in 2019, while 2020 witnessed the highest number of hospital deaths. The significant reduction in BID cases during 2020 can be attributed to the impact of the COVID-19 lockdown, which prompted numerous patients relying on life support or undergoing specialized treatments to refrain from visiting the hospital altogether. Additionally, individuals were reluctant to bring their deceased loved ones to the hospital for fear of the COVID-19 stigma. This finding aligns with a study[9], which concluded that between March and June 2020, there was a significant increase in mortality, with 87% of the deaths being COVID-19-related. The dramatic decline in BID cases during 2020, likely influenced by the COVID-19 lockdown and fear of hospital visits, emphasizes the importance of adapting healthcare strategies during pandemics

The overall frequency of BID cases in this study was 21.3%, which is somewhat consistent with a similar study conducted in a referral hospital in the western region of Ghana[10]. However, when compared to studies conducted in Rivers and Cross River States of Nigeria, the frequency of BID cases in this study appears to be significantly higher. In those studies, the frequencies of BID were reported as 3.5% at the University of Port Harcourt Teaching Hospital[3] and 4.2% at the University of Calabar Teaching Hospital[11]. This discrepancy can be attributed to the unique characteristics of the study area. The University of Maiduguri Teaching Hospital serves as a tertiary health institution and the sole referral point with the only active histopathology and mortuary services in the entire Borno State, catering 27 local government areas and neighboring states.

Consequently, the burden of BIDs is on the University of Maiduguri Teaching Hospital, with cases even coming from primary or secondary health facilities. In contrast, the previously mentioned cited studies had hospitals that shared the burden with other referral hospitals, as multiple facilities exist with active mortuary services[3,11].

The study revealed a lower frequency of BID cases among children aged 0 to 18 years, while the highest frequency was observed among adults aged 38 to 56 years. This finding aligns with a study conducted in the United States of America[12], which indicated lower death rates among American teenagers compared to adults. The prevalence of factors contributing to death is generally higher among adults than teenagers and young adults.

The high frequency of BID cases in the older age group can be attributed to the burden of family and relative responsibilities, as individuals in this age range often find themselves engrossed in the struggle to provide for their families, sometimes neglecting their own health. Additionally, the study demonstrated that male BID cases were twice as frequent as female BID cases. This discrepancy can be attributed to the risky and unhealthy behaviors more commonly exhibited by men, such as cigarette smoking, heavy drinking, involvement in gun-related incidents, employment in hazardous occupations, engaging in risky recreational activities, and driving. These findings align with Roger's interpretation[13] that highlights the physical risks related to road traffic accidents and personal lifestyle risks associated with poor diet, smoking, and alcohol consumption, leading to higher mortality rates among men.

A significant proportion of the BID cases (21.6%) had no known clinical condition recorded in the death register (Table 3). This finding is consistent with studies by Cummings, which reported sudden death as the most common cause of non-traumatic death[11]. Undiagnosed cardiovascular diseases and hypertension are plausible explanations for this occurrence. These conditions are becoming increasingly prevalent in Africa[14], and it is possible that they were either undetected or missed during the BID cases. To address this issue, it is crucial for legislators and policymakers to advocated compulsory post-mortem examinations for all BIDs. By doing so, the actual cause of death can be ascertained, potentially mitigating avoidable BID cases.

Furthermore, the involvement of governments, legislators, religious leaders, traditional leaders, and media communities in raising awareness about the significance of forensic investigations can play a vital role in addressing various challenges, including health and security issues affecting the population of the study area.

One notable finding from the study is that bleeding from gunshots was the most common known condition associated with BID (16.2%). This finding is strongly linked to the prevailing insurgency and high levels of insecurity in the study area. Implementing forensic scientific analysis, including forensic crime scene analysis, can aid in identifying culprits and criminals involved in murder cases, as gunshot-related incidents were among the prominent factors associated with BID in the study area.

It was observed from the study that a majority of BID cases in almost all age groups had no known clinical conditions. However, in the age group of 19-37 years, cardiopulmonary arrest was the commonest clinical condition associated with BID. This finding is consistent with the findings of Amakiri[15], who identified cardiovascular diseases and hypertension as prevalent conditions among young adults in Africa. In the age group of 38-56 years, bleeding from gunshots emerged as the most common condition associated with BID. This can be directly attributed to the insurgency affecting the study area, with men being disproportionately affected due to their involvement in various risky activities, such as farming, fishing, and security-related roles. Although a majority of BID cases had no known clinical conditions, chronic kidney disease emerged as the most common condition associated with BID. This finding aligns with research indicating a significant decline in kidney function with increasing age[16]. It highlights the importance of addressing the prevalent issue of kidney disease among the elderly population in the study area.

dden death, particularly among young adults.

The study revealed that cardiopulmonary arrest was the most common clinical condition associated with male BID cases which is consistent with the notion that men are at increased risk of developing heart disease earlier than women due to physiological, behavioral, and emotional responses to stressful events[17]. The second most common condition associated with male BID cases was bleeding from gunshots, which can be attributed to their higher exposure to risky lifestyles, as previously discussed. In contrast, cancer was the most common clinical condition associated with female BID cases. While it contradicts findings suggesting higher cancer death rates among men, the high incidence of breast and cervical cancer among women in the study area provides a reasonable explanation[18].

December stood out with the month with the highest percentage of cases (17.2%). This can be attributed to various factors, including the festive season, weddings, increased travel activities, and a surge in road traffic accidents. Insurgent attacks on roads leading to Maiduguri city also contribute to accidents during this period. People often begin preparations well in advance, prioritizing their engagements over their health concerns. Additionally, individuals living outside the state may skip their hospital appointments due to travel back home, further delaying medical attention. It is crucial to raise awareness about health issues and encourage individuals to prioritize their well-being, especially during such significantly busy and potentially risky periods of heightened activity.

Furthermore, the majority of BID cases (62.2%) were observed to be from the metropolis and this finding indicates that there is still a segment of the population in urban areas with poor health-seeking behavior. While accessibility to hospital facilities plays a role in BID cases, it is important to note that even within the metropolis, individuals who are far from health facilities may face reduced chances of survival by the time they reach the hospital[19]. Psychological, social, and economic factors can also contribute to delays in seeking medical care[20]. These findings emphasize the need to improve health education and promote a culture of seeking timely medical attention to prevent avoidable cases of su

CONCLUSION

In conclusion, the study highlighted the frequency, clinical patterns, and challenges associated with Brought In Dead (BID) cases at the University of Maiduguri Teaching Hospital in North-Eastern Nigeria. Male adults appear to be the most vulnerable group to BID cases, underlining the need for targeted health initiatives. The need for post-mortem forensic examinations was highlighted.

Conflict of interest: The authors declare that **there is no** conflict of interest regarding the publication of this manuscript

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Histological Changes In The Liver Of The Adult Wistar Rat Following Exposure To Cement Dust

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ABSTRACT

Background: The Liver regulates many important metabolic functions, and any injury causes distortion of these metabolic functions.

Aim: This study investigated the histological changes in the liver of Wistar rats following exposure to cement dust.

Methodology: 24 Wistar rats weighing between 250g and 280g were divided into 4 groups of 6 rats per group. **Group A** rats were placed in a cement dust free environment while Group B-D rats were exposed to various concentration of cement dust dispersed from 5g, 10g and 20g of cement respectively. The weights of the rats were taken weekly and the difference between them and previous weights were noted. At the end of the 30th day exposure, the animals were euthanized under chloroform anaesthesia and the liver was harvested and processed for histological examination. The obtained data analyzed using the paired t-test, with level of significance set at <0.05.

Results: The histological sections of the liver of rats in **Group A** showed normal histoarchitecture of hepatocytes radiating from the central vein. There were observable histological variations in the liver histoarchitecture of the exposed rats **(Group B-D)** which include lymphocytic infiltration around the portal vein and in patches within the hepatic tissue and congestion of the sinusoids and portal vessels around the central veins.

Conclusion: It was concluded that cement dust has histomorphologic effects on the liver tissue which are capable of compromising the health of the research animals.

KEYWORDS: Cement dust*;* liver; histoarchitecture; hepatic disease

Introduction

The Liver is the largest solid organ in the body.[1] It regulates many important metabolic functions, and any injury causes distortion of these metabolic functions. As per an estimate, about 20,000 deaths occur every year in United States due to liver disorders.[2] Prolonged inhalation of cement dust is susceptible to liver damage and if not corrected can lead to liver failure.[3] Besides cement dust, some other conditions can increase susceptibility to the development of liver disease e.g., obesity, heavy alcohol use, type 2 diabetes, tattoos, unprotected sex, injecting drugs using shared needles and undiagnosed hepatitis infection.[4] Therefore, a logical long term strategy to avoid or deal with liver disease and its complications is to aim at the causes, prevention and treatment of liver disorders.

Cement dust is a serious atmospheric pollutant. It is emitted during manufacturing and processing of cement, transportation, bag dumping, storage, usage, concrete cutting and when workers empty bags of cement.[5] The basic components of cement dust include: Calcium, Silicon, Aluminium, Manganese, Iron and Zinc.[6,7] Many of the chemical elements of cement dust have been found to be toxic or mutagenic to both animals and humans [8,9] Despite the health risks and hazards of cement dust there is no way use of cement can be avoided in building industries and this is attributable to its superiority to other building materials e.g., metakaolin, ashcrete, flyash and ground granulated blast-furnace slag.[10] Cement mill workers are the high risk exposed group to cement dust.[11] Construction laborers, cement transporting workers. Masons and everyone with cement dust related occupation are also exposed to cement dust during the course of their work.

Prolonged exposure to cement dust has been implicated in a variety of maladies. Previous studies have shown that prolonged inhalation of cement dust can damage the liver, lungs, respiratory tract, stomach, liver, kidneys and blood/blood-forming organs.[12] Signs and symptoms of cement dust related liver disorders include chronic fatigue, abdominal pain, nausea and vomiting, general malaise and pruritus.[12,3] Hence, the objective of this paper was to evaluate the effects of cement dust on the liver of adult Wistar rats.

Materials and method

Experimental Animals:
Twenty-four (24) adult Wistar rats weighing between 250g and 280g were purchased from the animal house, Department of Anatomy, University of Benin and were utilized for this experimental research. The rats were given a period of two (2) weeks to adapt to their new environment before commencement of the experiment. During this period, the animals were allowed free access to standard animal feed (Vital grower's feed, Manufactured by Bendel Flour Mill, Ewu) and clean water *ad Libitum.* The weight of the animal in each group was taken and recorded weekly so as to get the cumulative weight required for experimental use.

Ethical Considerations
Each animal procedure was carried out in accordance with approved protocols and in compliance with the recommendations for the proper management and utilization of laboratory animals used for research.[13]

Experimental Design:
Twenty-four adult Wistar rats of either sex were randomly assigned into four study groups of six rats per group. Dust Distributor Glass-Chamber of dimensions 32.5cm^3 in length, 32.5cm^3 in width and 16.5cm^3 in height was used in this experimental research for uniform dispersion of cement dust. This exposure modality simulated a general construction site in which cement dust saturated the ambient air to which people with cement dust related occupation actually encountered daily for hours during the course of their work. **Group A** rats which served as control was placed in a cement dust free environment while **Group B** rats were exposed to cement dust dispersed from 5g of cement 1 hour daily for 30 consecutive days (Low concentration exposure). **Group C** rats were exposed to cement dust dispersed from 10g of cement 1 hour daily for 30 consecutive days (Moderate concentration exposure) while **Group D** rats were exposed to cement dust dispersed from 20g of cement 1 hour daily for 30 consecutive days (high concentration exposure).

Method of Sacrifice and Sample Collection

At the end of 30th day exposure, the animals were weighed and euthanized under chloroform anaesthesia; a midline incision was made through the ventral wall of the abdomen of the rats to access the liver. The liver was harvested and immediately fixed in 10% formal saline for24 hours before the histological analysis.

The tissues were trimmed to about 3-5mm thick sections and processed according to method of Drury and Wallington (1980).[14] And then histologically assessed using the following methods: fixation, embedding and tissue staining for microscopy. Histological sections were examined under Leica DM750 research microscope with a digital camera (Leica ICC50) attached. Photomicrographs of the tissue sections were taken at various magnifications i.e. x40 and x400.

Statistical Analysis:

Results were presented as Mean (X) and Standard error of mean (SEM). The data were subjected to statistical analysis of paired t-test, with level of significance set at $P \leq 0.05$.

RESULTS

**Table 1: Changes in Body Weights of the Rats in All the Experimental Groups**

Period Of Exposure	Group A	Group B	Group C	Group D	P Values
Ist week	5.60 ± 0.68	0.60 ± 0.19*	0.42 ± 0.16*	0.38 ±0.16 *	0.000
2nd week	6.70 ± 0.93	0.30 ± 0.05*	0.30 ± 0.09*	0.20± 0.14*	0.000
3rd week	7.40 ± 1.24	0.06 ± 0.17*	0.20 ± 0.05*	0.16± 0.07*	0.000
4th weeks	7.74 + 0.60	0.18 ± 0.09*	0.36 ± 0.10*	0.04± 0.08*	0.000

n=6; Values are Mean ± S.E.M

Figure 1: Photomicrograph of liver of rats in Control (**Group A**) showing A, sheets of hepatocytres, B, Portal tract and C, Central veins with areas of congestion (**H&E x 40**)
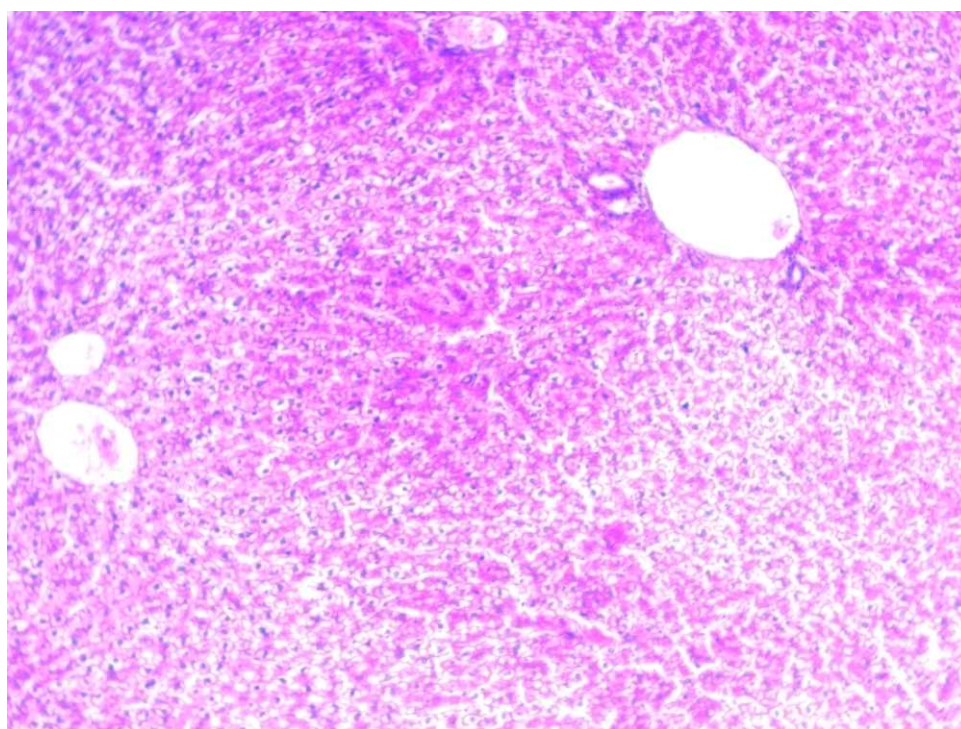
Figure 2. Photomicrograph of liver of Rats in Control (Group A) showing A, sheets of hepatocytes, B, portal tract and C, central veins with areas of vascular congestion.. (H&E x 100)
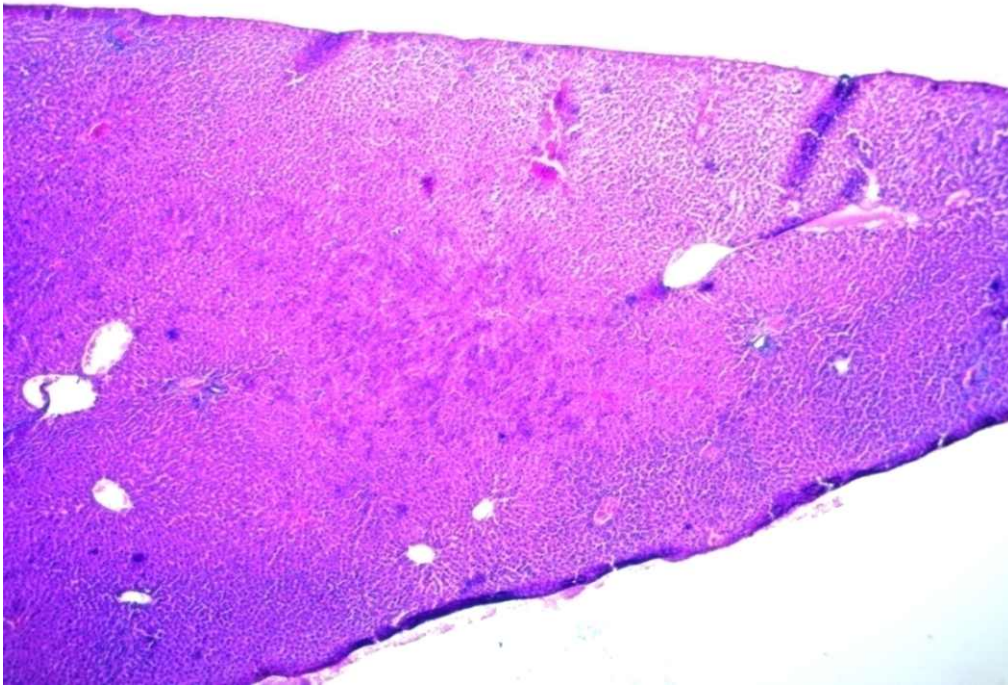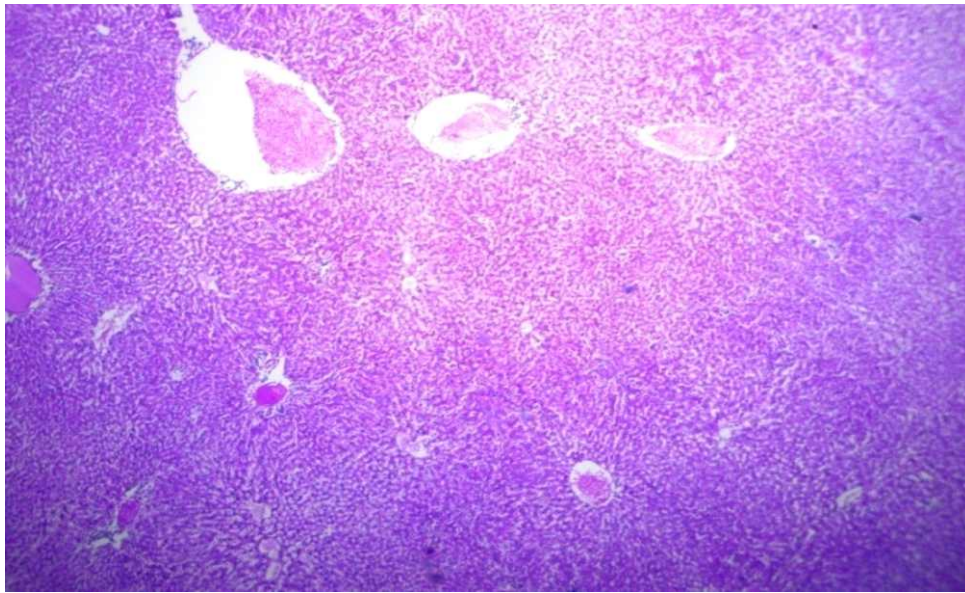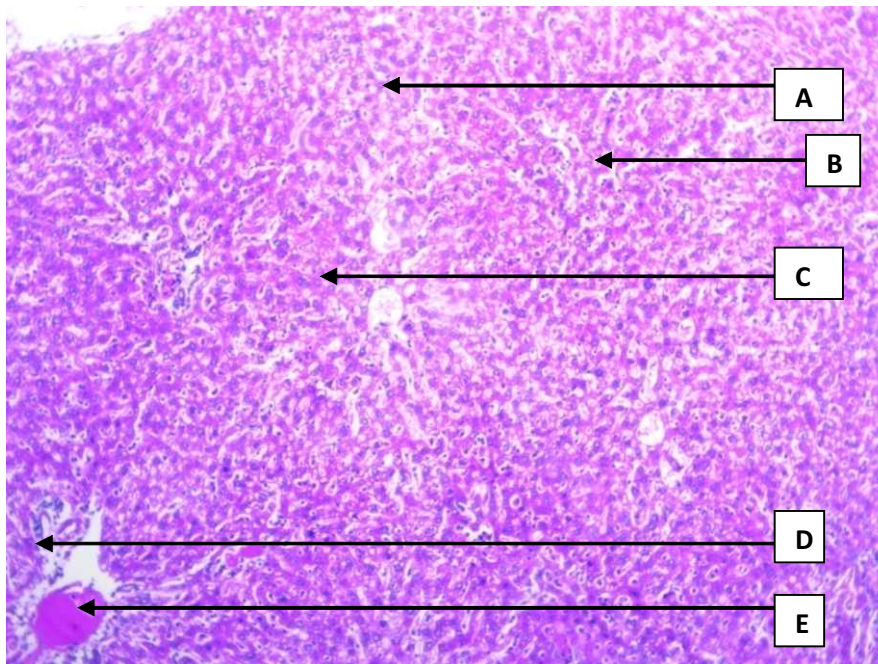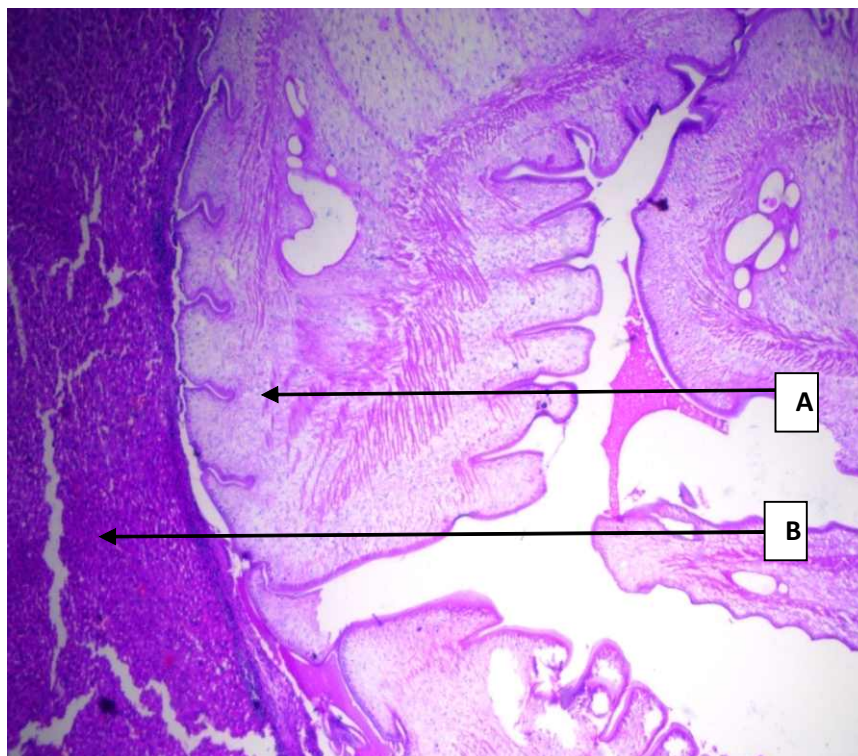
Figure 3. Photomicrograph of liver of Rats exposed to 5g cement dust (Group B) showing: A, sheets of hepatocytes, B, portal tracts and C, central veins with areas of vascular congestion (H&E x 40)
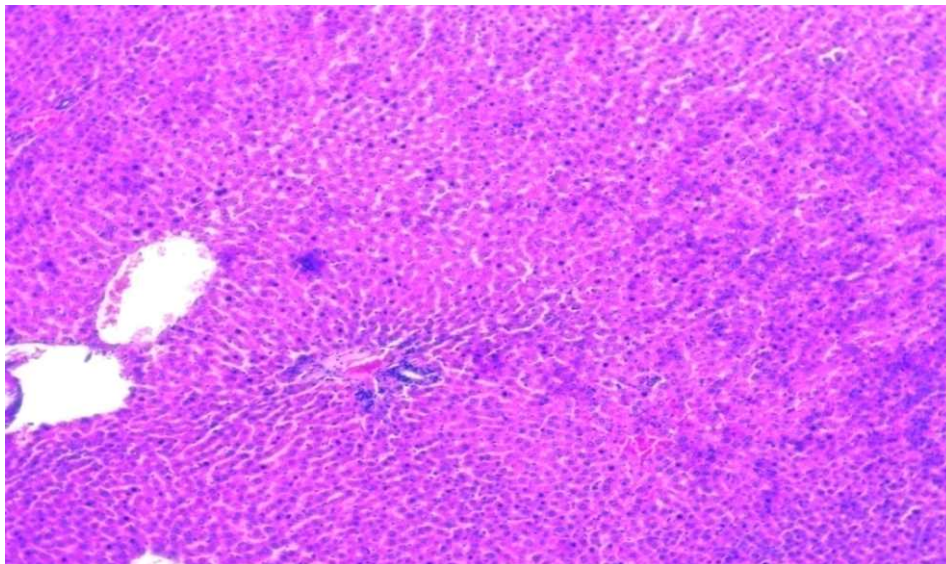
Figure 4. Photomicrograoh of liver of Rats exposed to 5g cement dust (Group B) showing   A, sheets of hepatocytes, B, portal tracts and areas of vascular and C, sinusoidal congestion. There are area   s of D, lymphocytic infiltration around the portal vein and in patches within the hepatic tissue.(H&E x 100)

Figure 5. Photomicrograph of liver of Rats exposed to 10g cement dust (Group C) showing: A, sheets of hepatocytes, B, portal tracts and C, central veins with areas of vascular congestion (H&E x 40)

.

Figure 6. Photomicrograph of liver of Rats exposed to 10g cement dust (**Group C**) showing: A, sheets of hepatocytes, B, congested sinusoids and C, central veins. There were D, lymphocytic infiltration around E, a portal vein and in patches within the hepatic tissue. (H&E x 100)

Figure 7 . Photomicrograph of liver of Rats exposed to 20g cement dust (G   roup D) showing: a remarkable encysted larva and segments of tapeworm. A, the cyst wall and B, the encysted parasite are shown. (H&E x 40)
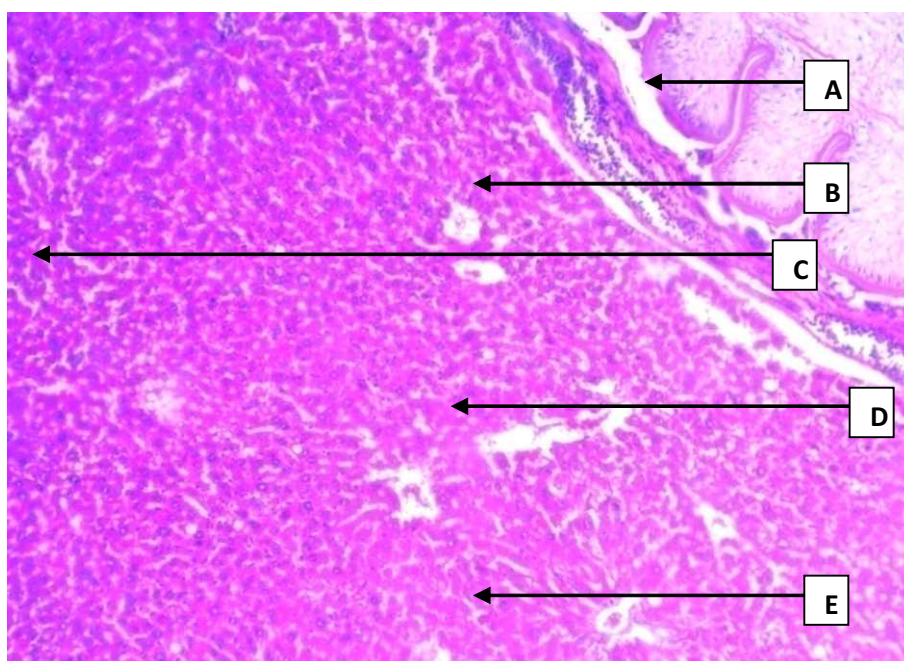
Figure 8. Photomicrograph of liver of Rats exposed to 20g cement dust (**Group D**) showing: A, a remarkable encysted larva and segments of tapeworm and B, lymphocytic infiltration around th e cyst wall and in patches within the hepatic tissue. There is also congestion of the C, central vein, D, sinusoids and E, the portal vessels. (H&E x 100)

Discussion

Results show there was significant increase in body weight of rats in the control group **(Group A).** Significant decrease was observed in body weight of the rats exposed to cement dust **(Group B, C and D)** which was what we actually expected because cement dust is toxic and so, it's expected to case decrease in body weight and this concurs with previous work.[12] The weight loss could be attributable to dysguesia,[15] anorexia[8] or toxicity of the basic constituent chemical elements of cement dust.[7]

The histological sections of the liver of the control group **(Group A)** shows normal histo-architecture of hepatocytes radiating from the central vein with intervening sinusoids **(Figure 1 and 2)**

There were observable histological variations in the liver histoarchitecture of the rats exposed to cement dust dispersed from 5g **(Group B)**, 10g **(Group C)** and 20g **(Group D)** of cement respectively **(Figure 3, 4, 5, 6, 7, and 8).** The significant histopathological findings in the rats treated with cement dust include lymphocytic infiltratas around the portal vein and in patches within the hepatic tissue, encysted larva, segments of tapeworm (which might be due to coataminated feed/water) and congestion of the sinusoids and portal vessels around the central veins. It was therefore concluded that cement dust has histomorphologic effects on the liver tissue which are capable of compromising the health of the exposed animals. The histological findings from this research are inversely proportional to the doses administered and they agree with a similar work done by Poinen-Rughooputh *et al.,* (2006)[16] where they used silica dust to induce hepatic disease.

Apart from the use of liver-protective herbal drugs such as *Amaranthus tricolor* aqueous leaf extract[17] , how else can cement dust related-hepatic disease be prevented?

Over time, condition that damage the liver can lead to scarring (cirrhosis) which may result ultimately in liver failure, a life-threatening condition. But early treatment may give the liver time to heal. Cement dust-related liver disease and its associated complications can be prevented by adherence to proper safety precautions e.g., wearing of personal protective equipment (such as face masks, face shields, goggles, hand gloves, boots and coveralls) in order to minimize the degree of exposure to cement dust.; routine medical checkups, especially among cement factory workers and other people with cement dust related occupation should be encouraged so as to avert any occupational health risks and hazards of cement dust; sensitizing the general public regularly by providing them with current information regarding the health risks and hazards of cement dust; and management of cement factories in developing countries adopting the use of modern machines and technologies that can reduce the amount of cement dust released to the environment.

CONCLUSION

Cement dust caused decreased body weight in the treated rats and also caused distorted liver histoarchitecture which are capable of compromising the health of the research animals and may ultimately lead to death. The histomorphological findings are consistent with usual histological findings in hepatic disease.

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PREVALENCE AND CONTRIBUTING FACTORS TO FRAILTY AND FALLS AMONG COMMUNITY-DWELLING OLDER ADULTS IN NORTH-CENTRAL NIGERIA

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ABSTRACT

Background: Frailty and falls are becoming more important health issues as the population ages. The lack of information and understanding about falls and frailty limits the benefits of general care for the elderly. The study investigated the prevalence and factors contributing to falls and frailty in North-Central Nigerian communities.

Methods: This was a cross-sectional study of 494 older adults aged 60-110 years, who were mostly Tiv residing in Benue State, Nigeria. The Fried Frailty Phenotype (FFP) scale was used to assess their frailty status, and information regarding falls (two or more times) over the past year was collected. Multivariate logistic regression was performed to determine factors that increased frailty and falls in older adults.

Results: A total of 494 older adults with mean age, 76.411.23 years participated in the study. Frailty and falls were reported to be prevalent in 62.9% and 33.2% of participants, respectively. The results of the study further indicated that the prevalence of both frailty and falls was higher in those who were older (≥85 years) and those without formal education. The risk of falling (odds ratio = 0.51; 95%CI: 0.31 to 0.86) and frailty (odds ratio = 0.39; 95%CI: 0.22 to 0.69) were also significantly lower in males as compared to females. Frailty and falls were also more prevalent in smokers and those with poor functional status.

Conclusion: Among older rural residents, frailty and falls are common, especially among women, smokers, and those with poor physical health. The aging population may require lifestyle interventions because of frailty and falls.

Keywords: Frailty, falls, older adults, community-dwelling, North-Central Nigeria.

Introduction

Chronic conditions are more likely to increasingly affect functional independence, general well-being and quality of life due to ageing of the global population.[1-4] One of the commonest chronic conditions affecting the elderly is frailty. According to Carneiro *et al*,[3] frailty is defined as a gradual disintegration of an individual's biological, psychological, and social functions leading to a reduction of their functional ability.[3] Similarly, falls are a major cause of death and a significant cause of morbidity and disability in older adults.[5] Frailty and falls are major geriatric syndromes that impact higher-order functions like ambulation[1], which can result in hospitalizations or even death.[6,7]

The prevalence of frailty among older adults in 62 countries aggregated was 12%, and females were more likely than males to be frail.[8] It is estimated that Africa (22%) has a higher prevalence of frailty than Europe (8%). In contrast, an analysis of 104 papers found that falls occur among older adults at a pooled prevalence of 26.5%, with higher prevalence rates in Oceania (34.4%) and America (27.9%).[9] In Nigeria, Ajayi and his co-authors[10] estimated the prevalence of frailty among older adults attending care facilities to be as high as 51.3% based on the Fried phenotyping, and 15.2% using the Canadian Study of Health and Aging Scale.[10] Bekibele and Gureje also report high fall rates among older Nigerians, with females (24.0%) more at risk.[11] Also, Atoyebi and others found that rural dwellers suffered lower rates of falls (25.3%) than urban dwellers (41.3%).[12] Additionally, older adults residing in assisted-living facilities have been reported to have a higher fall risk than those living in the community[13], thereby prompting the need for further evaluation among community dwelling older adults to ascertain the associating factors with old age in these individuals. Furthermore, though older people are prone to fall and frailty, women, individuals who lack formal education, smoke, drink alcohol, and use assistive devices are more likely to be frail and fall.[10,12,14-17]

A broader view of quality improvement in healthcare is receiving increasing attention and sometimes requires data collection and feedback mechanisms from broader perspectives.[18,19] In most Nigerian studies, data from hospitals are used[12,16], therefore, making quick decisions on older adults residing in communities may be challenging. As a result, these findings are expected to provide useful insight into how to improve healthcare services to older adults living in the community. The purpose of this study was to determine the prevalence of falls and frailty among older adults living in the North Central region of Nigeria and the factors that contribute to them.

Materials and Methods

Study design, setting and eligibility criteria

We conducted cross-sectional study in seven villages in Buruku Local Government Area of Benue State involving older adults (≥60 years) living in the selected locations. Buruku Local Government Area (LGA) is one of the 23 local government areas in Benue state of Nigeria, predominantly inhabited by the Tiv people and with a population of 203,721 people as at 2006 census. Due to the high proportion of older adults in this area, the setting was ideal for the study. Inclusion in this study required that the participant must be 60 years of age or older, based on WHO guidelines for older adults in developing countries.[20] Exclusion criteria for the study included older adults reporting frequent hospital visits, those who are non-ambulant, and those who had visual impairments.

Study population and sample size

Recruitment of eligible participants was conducted using the snowball sampling technique. Stata software (17.0 SE) was used to estimate the sample size using Pearson's Chi squared test proportion of 0.633 and odds ratio of 0.9560 for frailty from a previous Nigerian study[16], at alpha value of 0.05 and 80% power. According to these parameters, 374 samples are required for the analysis. Surveys were conducted from August to December 2020 to recruit participants.

Ethical Consideration

The study was approved by the Ethics Committee of Bayero University, Kano (BUK/CHS/HREC/127), and the Benue State Ministry of Health. The Buruku LGA, Benue State also granted permission for the study to be conducted in the study area. Staff of Buruku LGA secretariat were assigned the role of gatekeepers, and we also sought and obtained permission from the village heads. To ensure the well-being, safety, and protection of study participants, ethical protocols of the Helsinki Declaration were implemented[21], such as informed consent, voluntary participation, withdrawal, and privacy protections. We translated questionnaires into Tiv language (the language spoken in the study setting) to ensure consistency in the data collection process.

Data collection

Outcome Measurements

In this study, frailty and falls were both considered dependent variables, and the independent variables included socio-demographic factors, anthropometrics and clinical features, multi-morbidity, polypharmacy, and physical activity levels. All participants filled out self-developed proformas for socio-demographic, lifestyle, clinical, and anthropometric information.

Socio-demographic variables

The socio-demographic information of the participants was recorded using a self-developed study proforma, which sought information on age, gender, marital status, level of education, and financial status. If the age of a participant was unknown, it was confirmed and estimated within 5 years by asking about the participant's life history, historical events, the age of their children, or obtaining a menopausal record or an old hospital card, as previously suggested.[22]

Information regarding lifestyle was collected, including smoking status (0: no, yes =1), alcohol consumption (0: no, 1 = yes), living alone (0: no, 1 = yes), and walking with a cane (0: no, 1 =yes). Multi-morbidity was defined as the co-occurrence of at least one chronic condition (e.g., osteoarthritis, hypertension, diabetes, tuberculosis, cardiovascular disease, tumour growth, presbycusis, upper respiratory infection, lumbar spondylosis), while poly-pharmacy was defined as the use of two or more medications daily to treat chronic conditions.

Anthropometric variables

Body weight and height measurements were measured in accordance with ISAK's guidelines.[23] Body mass index (BMI) was also calculated as kilogram per-square-metre.[24] Anthropometric measurements, BMI, circumference of mid-arm and weight were used to assess nutrition status; a value of 1 indicated good nutrition, and a value of 0 indicated poor nutrition. An assessment of functional mobility was conducted using a performance-based test called Timed Up and Go (TUG).[25] During this test, participants sat in armchairs with armrests, walked three meters along a line, turned around, and returned to their chairs. An individual who took more than 14 seconds was classified as having poor functional mobility (0: poor function), while an individual who took less than 14 seconds was classified as having good functional mobility (1: good function).

Functional status

The Timed Up and Go (TUG) test assesses functional status in older adults. Among older adults, TUG tests have been reported to be reliable, with an intraclass reliability of 0.92-.99.[25] To complete the test, the participant stood up from a seated position, walked 3 meters on a drawn line, turned around, walked back to the chair and sat down. Stop watches were used to time the participant and time was stopped when seated. If needed, the participant could use an assistive device. Participants taking 14 seconds or longer were classified as being at high risk of falling (0: Poor functional status) and those taking less than 14 seconds as having low risk (1: Good functional status).

Physical Activity

The Yale Physical Activity Survey (YPAS) standardized questionnaire assesses activities across a range of intensity levels, including household, recreation, and exercise settings. The survey offers three summary indices and five subscales. The three indices are the Total Time Summary Index (TTSI), Energy Expenditure Summary Index (EESI), and Activity Dimensions Summary Score (ADSS). Its test-retest correlation coefficients are in the range of 0.42 to 0.65, which indicates relatively good repeatability.[26] The YPAS was then adapted to assess the time spent on physical activity per week.

Frailty and falls

A standardized, validated Fried frailty phenotype (FFP) questionnaire was adopted to assess frailty. Frailty is defined by the Fried frailty phenotype (FFP) as unintentional weight loss, fatigue, weak grip strength, slow walking speed, and low levels of physical activity. In order to determine frailty, individuals were asked if they experienced poor appetites three or four times a week, weakness (lifting 12 kilograms was difficult), exhaustion (individuals were asked if they felt "they couldn't get going" or " that everything they did was an effort" often or most often in the past week), slowness (difficulty walking 200 meters or 300 meters), or low physical activity (failing to engage in any outdoor activity once or twice a week). A frail individual is defined as someone who exhibits at least three elements of frailty.[27] Individuals were asked whether they had experienced two or more falls during the past year, and their responses were scored as either Yes (1) or No (0).

Statistical analysis

Descriptive statistics to describe the demographic characteristics of participants, expressed as frequency (percentage) for categorical variables and mean and standard deviation for normally distributed continuous variables. Continuous variables were checked for normality using a Kolmogorov-Smirnov test and assumed to be normally distributed if the p-value was greater than 0.05. The frequency of frailty and falls, as well as their 95% confidence intervals, were calculated. Chi-square test for independence was used to compare frailty and falls based on demographic characteristics. In addition, an adjusted multivariate logistic regression was conducted to examine the factors associated with frailty and falls. Results were presented as odds ratio and 95% confidence intervals. Statistical analyses were performed using SPSS version 25.0 and alpha was set at 0.05.

Results

Participants

Four hundred and ninety-four community-dwelling older adults were studied. Their mean age was 76.4±11.23 years. Among these participants, 52.6% were males and 209 (42.4%) did not have a formal education (Table 1). Approximately 46% of the participants reported chronic co-morbidity conditions (95% CI: 41.79-50.58%), and about two-thirds reported poor function (95% CI: 61.89-70.24%) and poor nutrition (95% CI: 56.13-64.76 The survey also reported that 21.3% reported poly-pharmacy as well as 21.1% reporting using an assistive device (cane), 24.1% reporting taking alcohol, and 27.7% reporting being a smoker.

Frailty and falls

About 62.9% of the participants of this study reported frailty (95% CI: 58.5 to 67.0), while 33.2% reported falls (95% CI: 29.2 to 37.6). Based on gender, 165 (70.5%) women compared to 145 (56.0%) in men reported frailty. Furthermore, fall rates were higher among female participants (37.6%) than male participants (29.2%). In addition, highest percentage of elderly participants (85+) reported falls (42.7%), as well as frailty (78.9%). Furthermore, it was found that participants without a formal education reported the highest prevalence of falling (36.4%) and frailty (71.8%) (Table 2).

Factors associated with frailty and falls

Based on the adjusted logistic regression model (Table 3), frailty (OR = 0.39; 95%CI: 0.22 to 0.69) and falls (OR = 0.51; 95%CI: 0.31 to 0.86) were significantly lower in males than in females. The results of the study also found that people who reported poor function were 2.45 times more likely to report falls (OR = 2.45; 95%CI: 1.40 to 4.30), and 2.75 times more likely to report frailty (OR = 2.75; 95%CI: 1.63 to 4.70). Among smokers, there was also a 1.85-fold increase in the probability of having a fall (OR = 1.85; 95%CI: 1.16 to 2.94) and a 2.19-fold increase in the probability of having frailty (OR = 2.19; 95%CI: 1.26 to 3.74) among those who smokers compared to non-smokers.

Table 1: Characteristics of the participants (N = 494)

Characteristics	Mean®SD	Frequency (N)	Percent (%)
Demographics			
Age	76.42®11.23		-
Age (%)			
60-74 years		232	47.00
75-85 years		138	27.9
85 years		124	25.1
Gender			
Male		260	52.6
Female		234	47.4
Education			
No formal education		209	42.4
Primary education		167	33.9
Secondary education		69	14.0
Tertiary education		48	9.7
Living alone			
No		484	98
Yes		10	2
Health behaviours			
Multimorbidity			
No		266	53.8
Yes		228	46.2
Polypharmacy			
No		389	78.7
Yes		105	21.3
Alcohol			
No		375	75.9
Yes		119	24.1
Smoking			
No		357	72.3
Yes		137	27.7
Function status			
Good		167	33.8
Poor		327	66.2
Nutrition			
Good		195	39.5
Poor		299	60.5
Using cane			
No		388	78.9
Yes		104	21.1
Behavioural lifestyle			
BMI (Mean®SD)	24.62®4.48	-	-
Physical Activity (hr./wk.)	11.19®9.23	-	-

hr./wk.: hour per week

Table 2: Prevalence of falls and frailty in community-dwelling older adults (N = 494)

Variables	Falls N (%)	Frailty N (%)
Overall, percent & 95% C.I	33.2% [95%CI: 29.2 – 37.6]	62.9% [95%CI: 58.5 – 67.0]
Gender (n, %)		
Female	88 (37.6)	165 (70.5)
Male	76 (29.2)	145 (56.0)
p-value	*0.048*	*0.001*
Age categories (n, %)		
60-74y	57 (24.6)	120 (51.7)
75-84y	54 (39.1)	93 (67.4)
85y	53 (42.7)	97 (78.9)
p-value	*0.001*	*0.001*
Education		
No formal education	76 (36.4)	150 (71.8)
Primary	54 (32.3)	110 (66.3)
Secondary	22 (31.9)	26 (37.7)
Tertiary	12 (25.0)	24 (50.0)
p-value	0.474	*0.001*

Proportions reported for only "yes" to falls and frailty

Table 3: Logistic regression of factors associated with falls and frailty

Variables	Falls			Frailty		
	OR	95% for OR	p-value	OR	95% for OR	p-value
Gender						
Female	Reference			Reference		
Male	.51	.31 to .86	**.011**	.39	.22 to .69	**.001**
Age						
60-74y	Reference			Reference		
75-84y	1.64	.96 to 2.79	.07	.78	.44 to 1.37	.39
85y	1.70	.90 to 3.21	.10	.71	.34 to 1.46	.35
Education						
No educ.	Reference			Reference		
Primary	1.54	.89 to 2.66	.12	2.06	1.13 to 3.75	**.02**
Secondary	2.31	1.06 to 5.03	**.04**	.89	.41 to 1.93	.76
Tertiary	.84	.35 to 2.03	.70	.90	.39 to 2.07	.80
Multimorbidity						
Yes	.68	.43 to 1.08	.10	1.74	1.06 to 2.83	**.03**
Polypharmacy						
Yes	1.14	.68 to 1.92	.61	.46	.27 to .79	**.005**
Function						
Poor	2.45	1.40 to 4.30	**.002**	2.76	1.63 to 4.70	**.001**
Living alone						
Yes	1.90	.44 to 7.9	.38	17.07	1.14 to 239.0	**.04**
Using cane						
Yes	.66	.39 to 1.13	.13	4.66	2.11 to 10.41	**.001**
BMI	1.01	.96 to 1.05	.82	.97	.93 to 1.02	.29
Alcohol						
Yes	.58	.34 to .97	**.04**	.95	.55 to 1.56	.78
Smoking						
Yes	1.85	1.16 to 2.94	**.01**	2.19	1.26 to 3.74	**.005**
Activity	.98	.94 to 1.01	.15	.95	.92 to .99	**.01**

Discussion

Frailty and falls are two of the foremost chronic conditions affecting functional status in older adults. The findings of this study indicate that about 62.9% of rural community-dwelling older adults are frail, whilst about 33.2% of elderly individuals have at least a history of fall every year. Our findings are similar to previous findings in southwest Nigeria, which reported that older women are more likely to report frailty and falls than men of the same age.[10,12] Our findings of frailty, however, were a little higher than those reported by O'Caaimh et al.[8] in a review of 62 countries.[8] Predictably, O'Caaimh et al.[8] derived their estimates from meta-analyses of several studies, nevertheless, it should be noted that studies in Africa reported a higher prevalence of frailty compared to other regions.[8] Globally, older adults are living longer and experiencing more chronic diseases.[2,28] Therefore, as an individual advances in age, pathological changes accumulate and could cause reduction in the efficiency of different body systems.[1,3] A number of geriatric syndromes are prevalent, such as frailty and falls, so early identification, comprehensive assessment, and prevention are crucial.

Several risk factors have been found to increase the vulnerability to frailty and falls in older adults. First, males were less likely than females to report both frailty and falls. A number of studies have found that women are more likely to fall and be frail than men.[10,12,28] Menopause, for instance, causes women's physiology to undergo hormonal changes, which affect their bone mineral density more than men's.[29] Moreover, females have lower muscle and bone mass than men[12], which causes a greater risk of age-related functional decline. In addition, aging is also associated with fat infiltration of muscle tissues, increasing the risk of musculoskeletal dysfunction.[6,30]

Our study also indicated that older adults who were frail and falling more often were those with poor function. As a result of pathological processes, the multisystem function of older adults gradually declines over time.[31] Thus, it is not surprising that our study findings support the reports that older adults who use assistive devices are less mobile and more likely to fall than people who do not use them.[32]

Generally, education has been shown to prevent adverse health outcomes in older adults.[6,12] In this study, people with no formal education were found to be more likely to suffer from frailty and fall. One plausible reason may be that rural communities with low levels of education face difficulties accessing medical care.[33] Moreover, education also informs people about their health choices and motivates them to seek medical attention.[6,33] Our results also indicate older adults who smoke are nearly twice as likely to fall and become frail. Probably, this is because cigarettes contain harmful chemicals that irritate the lungs and decrease gaseous exchange, leading to reduced cardiopulmonary endurance, and reduced functional capability.[30]

About 46.2% of the study participants reported having multiple comorbidities such as hypertension, arthritis, presbycusis among other degenerative conditions. Multimorbidity leads to use of 3 or more medications in older adults, which is termed polypharmacy. Those who reported use of 3 or more medications in the present study also reported frailty. This finding is supported by findings in the study by Cakmak and Ozturk,[34] among older adults in Europe and Vernese et al,[35] among older adults in the US. A lower number of medications use has been shown to decrease the risk of frailty.[36] Furthermore, medications such as those used in treating dementia and Alzheimer's disease and some laxatives are known to cause muscle weakness and weight loss in older adults, contributing to frailty states.[37] A 27% risk of frailty has been associated with one number increase in medications being used[38], similar stratification has also been associated with 15% increase risk for falls.[38] Nevertheless, the link between polypharmacy and fall was contrary to the results reported in the present study. This is probably due to the negative effect from single medication rather than combined effect, warranting the need to consider reviewing negative effects of individual medications among this population of older adults.

This study also found that active older adults face a lower frailty risk, even though their protection is minimal. Although frailty and falls are common in this setting, many participants reported participating in activities such as farming, walking to the market, washing clothes, cooking, dishwashing, brisk walking, and caring for children, elderly relatives, and disabled family members. Consequently, one would expect the estimates among the study population to be lower. Nevertheless, it is possible that these activities may, however, not have been performed at an optimum level that can yield to significant health benefits. The American College of Sports Medicine recommends at least 150 minutes of physical activity per day for maintaining optimum fitness.[39] Interestingly, we noticed that many of the indigenous activities are not captured, when measuring physical activity in a rural setting. Hence, this study used Yale Physical Activity Surveys (YPAS), which can be a more comprehensive and appropriate tool for this population. Consequently, we recommend that there is a potential to develop native tools to capture all the unique characteristics of this or a similar group of individuals.

We believe that our study was the first of its kind in this setting to explore the burden of frailty and falls in older adults from rural communities, and that our results will be helpful to older adults and stakeholders in recognizing frailty and falls as public health issues. This study is also notable for its generalizability and large sample size of older residents in rural communities. To accommodate the unique characteristics of older adults in this setting, we used YPAS to allow for variability in physical activity across age groups. However, in spite of these strengths, our study had some limitations. Some of the information collected were based on self-reports. Due to age-related cognitive decline, older adults tend to have difficulty recalling past events. Hence, it is possible that some data were over-reported or under-reported.

Conclusion

Falls and frailty are highly prevalent among older community-dwelling adults, especially among women, those who smoke, those with low educational levels, and those with poor physical health. The lack of primary healthcare facilities in our setting, where older adults can promptly seek care may contribute to the higher estimates of frailty and falls in this study population. So, proactive assessment of falls and frailty is needed, as well as targeted interventions for those living unhealthy lifestyles.

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AWARENESS OF POTENTIAL AMBIENT RADON GAS INHALATION HAZARDS AMONG UNDERGRADUATE STUDENTS AND STAFF OF A MEDICAL SCHOOL IN SOUTH-EAST, NIGERIA

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ABSTRACT

Background: Radon is a noble radioactive gas considered as one a significant ambient indoor air pollutant and eminently associated with lung carcinoma. There is paucity of research on knowledge and awareness of ambient inhalation of radon gas and associated potential radiological hazards among health workers.

Aim: This study aimed at assessing the awareness of potential ambient radon gas inhalation hazards among undergraduate students and staff of students and staff of College of Health Sciences, Nnamdi Azikiwe University.

Materials and Methods: This cross-sectional study involved students and staff of College of Health Sciences, Nnamdi Azikiwe University, using a questionnaire. A 20-item semi-structured questionnaire was administered to 550 participants (undergraduate students, academic staff and non-academic staff). Information on demographic characteristics of the respondents, knowledge of radon gas and radiological effects hazards were collected. The obtained data were summarized using descriptive statistics.

Results: Majority of the participants were female 300 (54%). Most of the respondents 415 (75.5%) had no knowledge of Radon gas and have not even heard about it before this study. Only respondents 135 (24.5%) had knowledge of Radon gas before. Most of the respondents 448 (81.5%) were not aware that Radon gas is ionizing radiation of natural origin. Most participants 430 (78.2%) were not aware that Radon gas can cause serious health hazards to the Deoxyribonucleic acid (DNA) and can potentially cause lung cancer to the general population.

Conclusion: Poor knowledge and awareness of ambient Radon gas and associated potential health hazards due to inhalation were eminent among students and staff of the College of Health Sciences, Nnamdi Azikiwe University.

Key Words: Knowledge, Awareness, Radon, Radiation, Radiological Hazards.

Introduction

Radon is a naturally occurring noble radioactive gas formed by disintegration of radium, which is domiciliary in earth crust, groundwater and building materials such as granites, cement, among others[1]. Radon is a colorless, odorless, tasteless noble gas with a half-life of 3.8 days. It occurs naturally in minute quantities as an intermediate step in the normal radioactive decay chains through which thorium and uranium slowly decay into lead and various short-lived radioactive elements; radon itself is the intermediate decay product of radium,[2] and its short-lived daughter nuclei are hazardous to respiratory organ such as the lungs. It can radiate inside our homes, offices, classrooms through cracks in floors, walls, or building foundation and accumulate indoors. It can also radiate from the building materials or from groundwater obtained from wells that contain radon.[3]

Radon levels can be higher in homes that are well insulated tightly sealed and/ or built on soil rich in the elements such as uranium, thorium and radium. Basement and building first floors typically have the highest radon levels because of their proximity to the ground.[1]. Radon escapes easily from the ground into the air, where it decays and produces further radioactive particles such as alpha particle. As we breathe, the particles are deposited in the cells, lining the airways, where they can damage DNA and potentially cause lung cancer. Therefore, health hazard from radon do not come primarily from radon itself, but rather from the radioactive product formed during the decay of radon.[4, 5]. The general effects of radon to the human health are caused by its radioactivity and consequent risk of radiation-induced cancer.

Radon is the most important cause of lung cancer after smoking[6]. It is estimated that radon causes between 3-14% of all lung cancers, depending on the average radon level and the smoking prevalence. In fact, smokers are estimated to be 25 times more at risk from radon-induced health hazards than non-smokers.[6]

When radon gas is inhaled, densely ionizing alpha particles emitted by deposited short-lived decay products of radon (Polonium-218 and Polonium-214) can interact with biological tissue in the lungs leading to DNA damage. Cancer is generally thought to require the occurrence of at least one mutation and proliferation of intermediate cells that have sustained some degree of DNA damage can greatly increase the pool of cells available for the development of cancer. Since even a single alpha particle can cause major genetic damage to a cell, it is possible that radon-related DNA damage can occur at any level of exposure. Therefore, it is unlikely that there is a threshold concentration below which radon does not have the potential to cause lung cancer.[4]

Out of the average annual radiation dose of 2.4mSv from natural radiation sources to man, about 1.2mSv comes from inhaling radioactively contaminated particles in the air and radon gas.[7] Although the adverse effects of radon gas are known to vary according to the dose and duration of exposure, it is assumed that there is actually no safe dose of ionizing radiation. The focal point for radiation safety based on this assumption is 'the ALARA concept'. This entails that radiation exposure be reduced to 'As Low As Reasonably Achievable (ALARA)' but not exceeding the limit on effective dose recommended by International Commission on Radiological Protection.[8]

In a study carried out in Obafemi Awolowo University (OAU), Ile-Ife, it was revealed that there were poor awareness and knowledge of Radon gas among staff of the studied institution.[9] Low knowledge about radon among respondents and poor/negative perception of radon risk[10] was also noted in another related study carried out among lecturers in the same institution.

Nnamdi Azikiwe University, Nnewi Campus hosts significant number of staff and students who spend about eight hours (8:00am to 4:00pm) daily in and around the school, offices, classrooms and around school buildings and the rest at their respective homes. This population may have little or no knowledge and awareness of radon gas as well as potential radiological hazards associated with it. Documented reports are available concerning the level of awareness and knowledge of radon gas in some other institutions, but there is dearth of information concerning this subject at Nnamdi Azikiwe University, Nnewi Campus. Assessment of this possible knowledge gap will aid the Government through the Ministry of Health in mapping out blueprint for public health care policy making. Therefore this study is aimed at assessing the knowledge and awareness of radon gas and potential radiation hazard among students and staff of College of Health Sciences, Nnamdi Azikiwe University, Nnewi Campus, and Anambra State, Nigeria.

Materials and Methods

Study Design: A cross sectional survey design was adopted for this study and involved selected members of the community of Nnamdi Azikiwe University, Nnewi Campus.

Study setting/area: The College of Health Sciences, Nnamdi Azikiwe University, Nnewi Campus was used for this study, located geographically on latitude 5.970191 and longitude 6.944716 coordinates.

Study Population: Undergraduates, academic and non-academic student of the university were involved in the study.

Sample Size Calculation and Sampling: A total of 550 participants (undergraduates, academic staff and non-academic staff) from the aforementioned area who were previously informed and consecutively sampled were recruited for this study upon consenting to voluntarily participate.

Eligibility Criteria: Only students and staff of the studied area were allowed to participate and those that did not consent to participate in the study were excluded.

Study Instrument Design: A 20 items semi-structured questionnaire developed in English language was used for this study.

Validity and Reliability Testing: A test re-test study was conducted among twenty-four (24) subjects prior to full commencement of the study and the Cronbach's alpha reliability test was carried out. The questionnaire had an acceptable internal consistency (Cronbach's alpha = 0.81).

Ethical Consideration: Ethical approval was obtained from the Ministry of Health, Anambra State with approval number MH/Awk/M/321/423.

Study Procedure: The questionnaires were administered to the participants using one-on-one method of administering questionnaire. All completed questionnaires were retrieved by researchers and the research assistants. Information on demographic variables of the respondents, knowledge of radon gas inhalation, its sources and radiological hazards were collated.

Data Analysis: The obtained data were summarized using descriptive statistics of frequency and percentages.

Results

A total of 550 respondents participated in the study, amongst which 250 (45.5%) respondents were males, while 300 (54%) were females. Most of the participants (300 or 54.5%) were within the 15-25 years age range, while the age range of 56-65years had the least number of respondents 15 (2.7%). A total of 370 (67.3%) of the participants were students, 94 (17.1%) were academic staff and 86 (18.6%) non-academic. The 200 level students had the modal class of respondents with 160 (29.1%), while 400 level students had the least with 30 (5.5%). Majority of the student participants were from Anatomy department with 370 (15.4%) while the least were students from Environmental Sciences department 20 (5.4%). Majority of the staff participants were from Anatomy department with 30 (16.7%), while Medicine department 8 (4.4%) recorded the least. Majority of the study participants reside off-campus 530 (96.4%), and only 5 (0.9%) and 15 (2.7%) reside within the staff quarters and the dormitory respectively, as shown in table 1.

On respondent's knowledge of Radon gas and its associated potential radiological hazards, the study revealed that 415 (75.5%) respondents had no knowledge of Radon gas when compared with 135 (24.5%) respondents who had knowledge of Radon gas. A total of 448 (81.5%) respondents were not aware that radon gas is an important source of ionizing radiation of natural origin compared to 102 (18.5) participants who accepted were aware of Radon gas and its origin. Majority 328 (59.6%) of the participants did not know that radon gas is colorless, odorless and tasteless noble gas as against 98 (17.8%) who were aware.

A significant majority 550 (69.5%) did not know that Radon gas could radiate into houses, offices and class rooms through cracks in the floors, on the walls and even accumulate indoor, while 85 (15.5%) knew about it. A total of 384 (69.8%) respondents were not aware that Radon gas was present in soil, water and building materials such as granite, bricks, cement, tiles, among others, while 80 (14.5%) of the respondents were aware. Majority of the respondents 404 (73.5%) were not aware that Radon gas levels can be higher in homes that are tightly sealed, while 68 (12.4%) know about it. A total of 423 (79.9%) respondents were not aware that basements and first floors potentially have the highest Radon gas levels because of their proximity to the ground, while 52 (9.5%) of the respondents were aware about it. A total of 475 (86.4%) respondents were not aware that radon gas escapes easily from the ground into the air where it decays and produces further radioactive particles, while 75 (13.6%) knew about it. A significant majority 499 (90.7%) of the participants were not aware that Radon gas can be routinely checked using Radon survey meter or Radon test kit as against 51 (9.3%) who were aware of it, as shown in table 2.

A total of 430 (78.2%) respondents were not aware that Radon gas can cause serious health hazards that can damage the DNA and potentially can cause lung cancer in the general population while 120 (21.8%) respondents were aware of it. A total of 482 (87.7%) of the respondents were not aware that Radon gas was the leading cause of lungs cancer after smoking, while 68 (12.4%) were aware of it. A total of 440 (80%) of the respondents were not aware that exposure to indoor radon gas can cause risk of lung cancer in the general population, while 110 (20%) of the respondents knew about it. A total of 493 (89.6%) of the respondents do not know that the increased risk of developing lung cancer is dependent on the radon concentration and length of exposure, however, 57 (10.3%) knew about it, as shown in table 3.

Table 1: Socio-demographic Characteristics of the Participants

Gender	Frequency		Percent	
MALE	250		45.5	
FEMALE	300		54.5	
Total	550		100.0	
Age	Frequency		Percent	
15-25	300		54.5	
26-35	150		27.3	
36-45	40		7.3	
46-55	45		8.2	
56-65	15		2.7	
Total	550		100.0	
Designation	Frequency		Percent	
STUDENT	370		67.3	
ACADEMIC STAFF	94		17.1	
NON-ACADEMIC STAFF	86		15.6	
Total	550		100.0	
Educational Level	Frequency		Percent	
200LEVEL	160		29.1	
300LEVEL	100		18.2	
400LEVEL	30		5.5	
500LEVEL	80		14.5	
STAFF	180		32.7	
Total	550		100.0	
Departments	**Students**		**Staff**	
	Frequency	Percent	Frequency	Percent
ANATOMY	57	15.4	30	16.7
BIOCHEMISTRY	0	0.0	25	13.9
ENVIRONMENTAL SCIENCES	20	5.4	17	9.4
MEDICINE	35	9.5	8	4.4
MEDICAL LAB SCIENCES	55	14.9	20	11.1
MEDICAL REHABILITATION	55	14.9	15	8.3
NURSING	53	14.3	20	11.1
PHYSIOLOGY	40	10.8	25	13.9
RADIOGRAPHY	55	14.9	20	11.1
Total	370	100	180	100.0
Place of Residence	**Frequency**		**Percent**	
DORMITORY	15		2.7	
OFF CAMPUS	530		96.4	
STAFF QUARTERS	5		0.9	
Total	550		100.0	

Table 2: Knowledge and Awareness of Radon gas among the Studied Participants

Have you heard of radon gas?	Frequency	Percent
YES	135	24.5
NO	415	75.5
Total	550	100.0
Are you aware that radon gas is an important source of ionizing radiation of natural origin?	Frequency	Percent
YES	102	18.5
NO	448	81.5
Total	550	100.0
Radon gas is a colorless, odorless and tasteless noble gas?	Frequency	Percent
YES	98	17.8
NOT SURE	124	22.5
NO	328	59.6
Total	550	100.0
Radon gas can enter homes, offices, classrooms, through cracks in floors, walls or foundation and accumulate indoors?	Frequency	Percent
YES	85	15.5
NOT SURE	83	15.1
NO	382	69.5
Total	550	100.0
Radon gas is present in soil, water and building materials like block, cement, tiles etc.?	Frequency	Percent
YES	80	14.5
NOT SURE	86	15.6
NO	384	69.8
Total	550	100.0
Do you know radon gas can be released from building materials or water obtained from wells that contain radon?	Frequency	Percent
YES	72	13.1
NOT SURE	81	14.7
NO	397	72.2
Total	550	100.0
Are you aware that radon gas levels can be higher in homes that are tightly sealed?	Frequency	Percent
YES	68	12.4
NOT SURE	78	14.2
NO	404	73.5
Total	550	100.0
Basements and first floor typically have the highest radon gas levels because of their closeness to the ground?	Frequency	Percent

	Frequency	Percent
YES	52	9.5
NOT SURE	75	13.6
NO	423	79.9
Total	550	100.0
Do you know that radon gas escapes easily from the ground into the air where it decays and produces further radioactive particle?	**Frequency**	**Percent**
YES	75	13.6
NO	475	86.4
Total	550	100.0
Are you aware that radon gas can be routinely checked using radon survey meter or radon test kit?	**Frequency**	**Percent**
YES	51	9.3
NO	499	90.7
Total	550	100.0

Table 3: Knowledge of the Radiological Hazards from Radon Gas.

Do You Know That Radon Gas can Cause Serious Health Hazard That Can Damage DNA and Potentially Cause Lung Cancer in the General Population?	Frequency	P Percent
YES	120	21.8
NO	430	78.2
Total	550	100.0
Are You Aware That Radon Gas is the Leading Cause of Cancer after Smoking?	Frequency	Percent
YES	68	12.4
NO	482	87.7
Total	550	100.0
Exposure to Indoor Radon Gas can Cause Risk of Lung Cancer in the General Population?	Frequency	Percent
YES	110	20
NO	440	80
Total	550	100.0
Do You Know that the Increased Risk of Developing Lung Cancer Depends on the Radon Concentration and Length of Exposure?	Frequency	Percent
YES	57	10.3
NO	493	89.6
Total	550	100.0

Discussion

Majority of the participants in this study had poor knowledge of radon gas and its associated radiological hazards prior to this study. Similar findings were reported among academics in Obafemi Awolowo University (OAU)[9-11] among University employees; Peterson and Howland in Boston University[12] and in Canada by the HOME PROTECTION CENTRE and in India by Niphadkar et al.[13] This perhaps could be due to poor public health awareness of the risk posed by indoor air pollution by radon among others.

Majority of the respondents were not aware that radon as is an important source of ionizing radiation of natural origin, and they did not also know that Radon gas is colorless, odorless and tasteless noble gas. Radon gas is a radioactive colorless, odorless and tasteless naturally occurring, it is a by-product of uranium decay in the soil, water and rocks.[14] Radon is an important source of ionizing radiation because radioactive particles from radon decay such as alpha particle when inhaled, could get trapped in the lungs and possibly lead to lung cancer, especially when the radon concentration in the houses are high, people spend long times indoors and even severe in heavy smokers.[14-16]

A significant majority of the studied population were not aware that Radon gas could radiate into houses, offices and class rooms through cracks in the floors, on the walls and even from accumulated indoor. Radon gas enters into houses, offices, and class rooms through cracks in the floors, on the wall and foundations, thus it builds up to high concentrations that could be dangerous when ingested or inhaled by humans. The risk of cancer developing from exposures to radon gas however depends on the measure of radon gas concentration (dose), the length of time that an individual spends in such a room (duration) and the smoking status of the individual exposed to radon gas.[14,15,17]

A good number of respondents were not aware that Radon gas was present in soil, water and building materials like bricks, cement, tiles, among others. Most of the respondents were unaware that building basements and first floors often possess high Radon gas levels because of its proximity to the ground and that Radon gas escapes easily from the ground into the air where it decays and produces further radioactive particles. The primary routes through which the harmful gas gets into man are through inhalation from the air and ingestion of water with dissolved radon especially from underground well water.[14,15] Cheng[18] recommended increasing under-floor ventilation, installing a radon pump system in the basement, improve the overall ventilation of the building, and sealing all cracks and holes in the floors and wall among others to minimize the spread of radon gas throughout the building. When this radioactive substances are inhaled/ingested, they tend to transfer their energy to the cells, thereby causing cellular changes which results in the formation of free radicals[19,20] and if the dose accumulates significantly, the damage may be irreversible, thus causing cell death or continued cellular proliferation which can result in various malignancies like the cancer of the lungs among others.[21]

A significant majority of the participants were not aware that Radon gas can be routinely checked using Radon survey meter or Radon test kit. Previous studies by Tammy et al.[22] reported similar findings, where there was poor public health knowledge about radon gas and the methods used in detecting radon gas in homes. There is therefore need by the government and healthcare professionals as well as regulatory bodies to intensify effort in creating public health awareness of radiation hazards.[24]

This study found a poor level knowledge among the participants on the potential health hazards associated with exposure to Radon gas. Radon gas was labelled a human carcinogen by the International Agency for Research on Cancer.[18] Majority of the participants were not aware that Radon gas was the second leading cause of lung cancer after smoking. The risk of lung cancer is reportedly multiplied ten times among smokers.[25-28] The life time risk of lung cancer from exposure to radon gas among smokers is 62 per 100 persons and 7 per 100 persons for non-smokers. Implying an 8.86 times increased tendency of developing lung cancer for a smoker if exposed to radon gas than non-smoker in a life time.[29] Thus the recommended test for all homes by the U.S surgeon general and the United Sates Environmental Protection Agency[14,30,31] to know the average levels of radon concentration and to implement appropriate recommendations when the findings are beyond the normal limits of 4 pCi/L.

The testing is done by exposing the radon detector in air for up to four days in an enclosed house usually in the lowest inhabiting spaces of the house. If the screening test result is 4 pCi/L or even more, the home owner is advised to take certain remedial actions.[28,32, 33]. It is also very important to note that DNA damage may occur at any levels of exposure as no threshold values has been established, therefore, indoor residential radon concentration should be reduced to the barest minimum as possible. [20,31,34-39] There is therefore urgent need by the University management to intensify her awareness and enlighten campaign to the entire university community about radon gas and associated radiation hazards.

Conclusion

Participants revealed poor knowledge and awareness of Radon gas and its associated potential health hazards when inhaled. Public health education through seminars, webinars, workshops, billboards, print and electronic media, will go a long way in enlightenment and creating awareness to the general public about the potential hazards of high ambient radon gas as well as regular home and building radon testing are possible ways of ameliorating the potential health hazards associated with radon gas.

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KNOWLEDGE AND IMPLEMENTATION OF CAUTI-BUNDLES IN PATIENTS' CARE AMONG NURSES IN A NIGERIAN TERTIARY HEALTH FACILITY

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ABSTRACT

Background: Between 15-25% of hospitalized patients receive urinary catheters during their hospital stay, predisposing majority to catheter-associated urinary tract infection (CAUTI). Owing to the high prevalence of CAUTI globally, CAUTI-Bundle was introduced and adopted as a gold standard of care which should be utilized by nurses while providing care to admitted patients on catheter.

Aim: This study assessed the knowledge and implementation of CAUTI-Bundles in patients care among nurses in a Nigerian Tertiary Hospital.

Materials and methods: A cross-sectional descriptive survey was carried out among 466 registered nurses purposively recruited from Federal Medical Centre Asaba. Data were collected using a pretested researchers' developed questionnaire. The data obtained were analyzed using frequencies, percentages and Chi-square at value less than 0.05 level of significance.

Results: More than half of the nurses 251(66.4%) had adequate knowledge about the use of CAUTI bundles in patients' care while only 175(46.2%) implemented and sparingly adhered to the CAUTI-Bundle protocol while caring for the patients on catheter. There was a significant association between years of experience, cadre (p < 0.05) and knowledge of CAUTI-Bundle.

Conclusion: Although more than half of the participants had adequate knowledge about CAUTI-Bundles, its implementation was suboptimal. As CAUTI continues to pose a challenge to hospital safety and quality healthcare of the patients, nurses who are the keystones to CAUTI bundle implementation, need to have better understanding of which, and in what context implementation strategies should be best utilized to ensure reductions in CAUTIs and catheter days of their patients.

Keywords: *CAUTI-Bundle, Knowledge, Implementation, Patients care, Nurses*

INTRODUCTION

Catheter-associated urinary tract infection (CAUTI) is the most common healthcare associated infection worldwide,[1] which has led to increased costs, prolonged hospital stays, and substantial morbidity for patients on indwelling catheter admitted in the hospitals. Seventy-five (75%) percent of urinary tract infections (UTIs) are acquired in the hospital when the patients are catheterized with incidence directly proportional to the length of catheter days.[2,3,4,5]

There are several strategies with varying levels of evidence which can help to prevent CAUTI before and after placement of urinary catheters in the healthcare institutions,[6] as majority of cases of CAUTI are avoidable with the appropriate implementation of infection prevention bundles of care which it's elements include; appropriate use, aseptic insertion and maintenance, early removal, and hand hygiene, which are together referred to as Care Bundle.[7] CAUTI BUNDLE package was developed by Centre for Disease Control and Prevention (CDC) and the Association for Professionals in Infection Control and Epidemiology (APIC) and it's evidenced based result contributes to infection prevention, reduction in unnecessary antibiotic prescribing, and also significant decline in the development of antibiotic resistance in health care facilities.[8]

Similar studies conducted in this regard among nurses showed low level of knowledge and poor practice of CAUTI Bundle. Report of study by Algarni et al[9] on nurses' knowledge and practices towards prevention of catheter-associated urinary tract infection at King Abdulaziz University Hospital Jeddah, Saudi Arabia showed that more than half of nurses (62.77%) had a low level of knowledge while 83.94% of nurses had a poor level of practice.

Another similar study in India also revealed that only 57% of the respondents could identify all the measures for prevention of CAUTI and the knowledge regarding the indication for catheterization though not up to the expected recommended standard was significantly better amongst the doctors as compared to nurses.[10] Also a study on utilization of CAUTI Bundle among Critical Care Nurses at Kenyatta National Hospital showed weak correlation between the observed and reported low bundle utilization[11].

In Nigeria however, there is paucity of information with regards to the knowledge and implementation of CAUTI BUNDLES among nurses. A reviewed study available was zeroed down to perceived causes and prevention of catheter-associated urinary tract infections,[12] thus, the need for a study of this kind on CAUTI Bundles cannot be overemphasized as nurses' role is key to reducing inappropriate catheter use and preventing CAUTI among patients. This study therefore assessed the knowledge and implementation of CAUTI Bundles among Nurses in a Nigerian Tertiary Health facility. Specifically, the study ascertained knowledge of nurses with regards to CAUTI Bundles in the care of patients; their level of Implementation/application; and also tested the association between sociodemographic profile of the nurses and their knowledge of CAUTI-Bundle.

MATERIALS AND METHODS

Study design: A cross sectional descriptive design was adopted for the study. This was used to assess knowledge and implementation of CAUTI BUNDLES among nurses in Federal Medical Centre (FMC) Asaba, Delta State.

Study Setting: The study was conducted at Federal Medical Centre (FMC), Asaba which is a tertiary health institution located in Oshimili -South Local Government Area, Delta State, Nigeria.

The FMC Asaba is one of the two tertiary health institutions located in Delta state, which is situated in the South-South geo-political zone of Nigeria.

Population for the study: The target population consisted of all registered nurses practicing at Federal Medical Centre Asaba. The total number of registered nurses in FMC Asaba was 466 (Nurses' Annual Report, 2019). The study involved the total population; thus there was no sampling carried out. All the 466 registered nurses in FMC Asaba were consecutively recruited for the study.

Instrument for Data Collection: Data was collected using participants' self-administered questionnaire designed by the researchers in accordance with the set objectives of the study on knowledge and application of CAUTI BUNDLES among nurses in Federal Medical Centre (FMC) Asaba, Delta State. The questionnaire has four parts containing fort- six (46) items. Section A has seven (7) items which elicited information on participants' demographic characteristics. Section B contains twenty-five (25) questions which elicited information on knowledge of CAUTI Bundle, while section C contain fifteen (15) questions which elicited information on implementation of CAUTI BUNDLE among nurses**.** Face and content validation of the instrument was carried out by experts in the field of Nursing, urology, public health and infection prevention. Their inputs were utilized in modifying the tool before actual field use. The reliability of the instrument was ensured by collecting pilot data at Okwe General Hospital in Asaba, which has similar characteristics with the study population. The internal consistency of the items was established using Cronbach's Alpha method. The four-point rating scale used in collecting data on implementation of CAUTI Bundles was given values as follows; Always(A)-4, most times (MO)-3, occasionally(O)-2, not at all (NA)-1.

Data Collection: Data was collected with the aid of a pretested questionnaire during all shifts for period of two (2) weeks.

Ethical Consideration: Ethical approval was obtained from the FMC Health Research Ethics Committee. Informed oral consent was obtained from the respondents before administering the instrument and confidentiality of the data collected was ensured.

Data analysis: Data obtained from the study were summarized using descriptive statistics of frequency, percentages, mean and standard deviations and Chi-square. The results were presented in tables. Level of significance, was set at less than 0.05.

Results

Result on socio-demographic data of the client showed that most of the participants 345(91.3%) were within the age range ≤30-39years; predominantly females 357(94.4%); with majority 271(71.7%) having 1-10 years of professional experience; majority are within Nursing officer 11/1 cadre 175(46.3%) and have their unit mainly to be medical ward 75(19.8%). Table 1 showed the participants' knowledge about catheter associated urinary tract infection (CAUTI). Majority 286(75.7%) of the participants had heard about CAUTI; most of the participants 357(94.4)% have no written policy or guidelines on how to prevent CAUTI. 342(90.5%) agreed that this is the first time they heard of CAUTI Bundle. Knowledge summary showed that more than half (66.4%) of the participants had adequate knowledge about CAUTI-Bundle as many were able to correctly answer 18-24 items on knowledge section.

Table 2 shows 85(22.5%) occasionally Pass catheter when bladder is full (preferably) for wash-out effect, none 0(0.0) use ultrasound guidance while passing catheter, majority 214 (56.6) Keep peri-urethral area clean and dry , 303 (80.2) did not agree to securing of catheter to the patients thigh, 19(5%) of respondents always wash hands before emptying urine from the urine bag while 76(20%) always use separate disinfected jug to collect urine from each bag. 60% always obtain urine sample from port using aseptic technique and not by disconnecting closed drainage bag. 38(10%) prevent contact of the drainage spigot with the non-sterile collecting jug container.

Table 3 shows association between some socio-demographic factors and adequate knowledge of catheter associated urinary tract infections (CAUTI) bundle. Sex, years of experience, level of education of the respondents are statistically non-significant determinants of adequate knowledge of CAUTI-Bundle.

The P-values of above 5% on the sex showed that knowledge of CAUTI-Bundle is independent of the sex. Also, the P-values on the years of experience showed that knowledge of CAUTI-Bundle is not dependent on the years of experience with exception of those with 11-20years of experience who are more likely to have 2 times more knowledge compared to other respondents (p=0.004, AOR=2.0). Similarly, those in children's unit showed 4 times more knowledge compared to other respondents in other units (p=0.001, AOR=4.0).

Table 1: Knowledge about catheter associated urinary tract infections (CAUTI) bundle

S/N	VARIABLES	Yes	NO
1	Have you heard of catheter associated urinary tract infections (CAUTI)?	286 (75.7)	92 (24.3)
2	Do you have a written policy or guidelines on how to prevent CAUTI?	21 (5.6)	357 (94.4)
3	Are you aware of the CAUTI bundle?	36 (9.5)	342 (90.5)
4	Is this the first time you hear about this bundle?	342 (90.5)	36 (9.5)
5	Do you know the components of CAUTI Bundle?	18 (4.8)	360 (95.2)
5	Have you received any training on CAUTI Bundle?	0 (0.0)	378(100.0)
6	Insertion of urethral catheter poses a great risk for CAUTI	375 (99.2)	3 (0.8)
7	CAUTI Bundle is considered a good infection control measure	375 (99.2)	3 (0.8)
8	CAUTI Bundle can reduce prevalence of CAUTI to <2%	314 (83.1)	64 (16.9)
9	Healthcare workers should avoid unnecessary catheterization of patients	369 (97.6)	9 (2.4)
10	Catheter is passed preferably when bladder is full	168 (44.4)	210 (55.6)
11	For CAUTI insertion Bundle, sterile items/equipment must be used	375 (99.2)	3 (0.8)
12	Are you aware that closed (not open) drainage system must be applied?	243 (64.3)	135 (35.7)
13	For maintenance Bundle, you must review the need for the catheter daily	174 (46.0)	204 (54.0)
14	Aseptic technique must be used for daily catheter care	378 (100.0)	0 (0.0)
15	Hand hygiene is required before emptying urine from uri-bag	211 (98.4)	167 (1.6)
16	Periurethral area must be always clean and dry	378 (100.0)	0 (0.0)
17	Perineum must be cleaned as soon as possible after fecal incontinence	378 (100.0)	0 (0.0)
18	Drainage bag tubing must be free from kinks to allow free flow of urine	378 (100.0)	0 (0.0)
19	Break in the close drainage system must be avoided unless absolutely necessary	377 (99.7)	1 (0.3)
20	Drainage should never be raised above bladder level	200 (52.9)	178 (47.1)
21	The drainage tubing should be secured on the patient's thigh	133 (35.2)	245(64.8)
22	The drainage bag must never touch the floor	317 (83.9)	61 (16.1)
23	Drainage bag should be emptied every 8 hours or when 2/3rd full	214 (56.6)	164 (43.4)
24	Separate disinfected jug should be used to collect urine from each bag	218 (57.7)	160 (42.3)
	Knowledge Summary	**Frequency**	**Percentage**
	Adequate (18 – 24)	251	66.4
	Inadequate (< 18)	127	33.6

Table 2: Implementation of catheter associated urinary tract infections (CAUTI) bundle

S/N	ITEMS	Always	Most times	Occasionally	Not at all
1	Pass catheter when bladder is full (preferably) for wash-out effect	92 (24.3)	93 (24.6)	85 (22.5)	108 (28.6)
2	Use bladder ultrasound when catheterizing	0 (0.0)	0 (0.0)	2 (0.5)	376 (99.5)
3	Keep peri-urethral area clean and dry	214 (56.6)	154 (40.7)	10 (2.6)	0 (0.0)
4	Secure catheter appropriately (on patient's thigh) to prevent movement in urethra	2 (0.5)	7 (1.9)	66 (17.4)	303 (80.2)
5	Clean patient's perineum after fecal incontinence	313 (82.8)	38 (10.0)	18 (4.8)	9 (2.4)
6	Check catheter, bag and tubing often for kinks and obstructions	4 (1.1)	109 (28.8)	265 (70.1)	0 (0.0)
7	Avoid break in close drainage system unless absolutely necessary	255 (67.5)	97 (25.7)	7 (1.9)	0 (0.0)
8	Ensure the drainage bag is never raised above the height of the bladder	5 (1.3)	66 (17.5)	112 (29.6)	195 (51.6)
9	Do not hold the bag upside down when emptying	4 (1.1)	77 (20.4)	293 (77.5)	4 (1.1)
10	Make sure drainage bag does not touch the ground	297 (78.5)	77 (20.4)	1 (0.3)	3 (0.8)
11	Empties the bag every 8hours or when 2/3rd full	14 (3.7)	90 (23.8)	236 (62.4)	38 (10.1)
12	Wash hands before emptying urine from the urine bag	19 (5.0)	47 (12.4)	227 (60.1)	85 (22.5)
13	Obtain urine sample from port using aseptic technique and not by disconnecting closed drainage bag	227 (60.1)	63 (16.7)	25 (6.6)	63 (16.7)
14	Use separate disinfected jug to collect urine from each bag;	76 (20.1)	28 (7.4)	66 (17.5)	208 (55.0)
15	Prevent contact of the drainage spigot with the non-sterile collecting jug/container	38 (10.0)	76 (20.1)	236 (62.4)	28 (7.4)

Table 3: Association between some socio-demographic factors and adequate knowledge of CAUTI bundle

Variable	Adequate knowledge of CAUTI Bundle (n=251)		AOR	Confidence interval	*p*- value
Sex					
Male	10 (4.0)		-	-	-
Female	241 (96.0)		0.4	0.181 – 1.060	0.067
Years of experience					
1 – 10	191 (76.1)		-	-	-
11 – 20	54 (21.5)		2.0	1.239 – 3.196	0.004*
21 – 30	5 (2.0)		0.5	0.055 – 4.152	0.477
31 and above	1 (0.4)		0.1	0.010 – 0.538	0.072
Qualification / level of education					
RN	1 (0.4)		-	-	-
RN/RM/HND	98 (39.0)		1.0	0.059 – 15.557	0.977
B.SCN	150 (59.8)		0.2	0.013 – 3.394	0.270
MSN/PhD Nursing	2 (0.8)		0.5	0.013 – 19.562	0.711
Facility/Unit					
A&E	50 (19.2)		-	-	-
FMC Maternity complex	41(16.3)		1.9	0.865 – 4.041	0.111
Theatre	29 (11.6)		1.1	0.457 – 2.889	0.767
Medical ward	48 (19.1)		1.9	0.890 – 3.950	0.098
Surgical ward	33 (13.2)		1.2	0.504 – 2.914	0.667
Children's ward	21 (8.3)		4.0	1.751 – 8.994	0.001*
Other	29 (11.6)		1.7	0.737 – 4.031	0.209
Cadre					
NOII/NOI	79 (31.5)		-	-	-
SNO/PHO	138 (55.0)		0.2	0.105 – 0.285	<0.001*
ACNO/CNO	21 (8.4)		0.04	0.005 – 0.298	0.002*
Directorate	13 (5.2)		0.06	0.008 – 0.494	0.009

Discussion

On the knowledge of the participants about CAUTI-Bundles in the care of patients, the result from the findings showed that more than half of the participants (66.4%) had adequate knowledge about CAUTI bundle in the care of their patients. Although, none have undertaken any form training or retraining on CAUTI-Bundle. This result supported the findings of Kose et al[14] which stated there was high level of knowledge among the nurses especially those with associate degree. High level of knowledge among nurses with regards to CAUT-Bundle was also reported by Mong et al[15] which may be as a result of similarity in professional characteristic knowledge. This result contradicts a report from a similar study,[16] which stated that there still existed a significant gap in knowledge regarding nursing practices of infection control and also another similar report which stated that the nurses were the least knowledgeable about different approaches to catheterization and specimen collecting method in patients care.[17]

On the implementation of CAUTI-Bundle, the participants had suboptimal application of CAUTI bundle in the care of their patients although some CAUTI-Bundle elements were better applied more than others. Those that were highly applied by more than 70% of the participants were to pass catheter when bladder is full (preferably) for wash-out effect, cleaning patient's perineum after faecal incontinence, ensuring that drainage bag does not touch the ground and being overfilled. The other elements were implemented by less than 50% of the participants. These were washing hands before emptying urine from the Uri- bag; empties the bag every 8hours or when 2/3rd full; prevent contact of the drainage spigot with the non-sterile collecting jug/container; check catheter, bag and tubing often for kinks and obstructions.

CAUTI Bundle care protocol should always be practised while taking care of any patient on urinary catheter. Nurses should ensure that urine drainage bags are not touching the floor and overfilled. The over 70% utilized components of the Bundle elements among the participants was also reported in a similar study by Thompson et al[18] where 88% of the participants ensured that the drainage bags were not touching the floor.

It is important to reiterate that drainage bags should be emptied regularly since when they are overfilled, they may cause traction to the urethral meatus predisposing patients to inflammation and eventually CAUTIs. Another report on implementation of CAUTI-Bundle elements among nurses from a similar study showed nurses have sufficient information on how to insert a urinary catheter which depicts knowledge, but not enough information on catheter care, use of urine bags and the intidactions of urinary catheterization which can be likened to implementation not been at the best possible standard level by implication.[14,19] This results contradicts other reports from similar studies where nurses were rated overall good in perceived practice regarding CAUTI prevention,[15] and also report of 100% utilization of the bundle by the participants in patients care.[13]

Report of the hypothesis showed that most of the socio demographic characteristics did not influence the knowledge of CAUTI-Bundle to the care of patience among the nurses. There was no significant relation between level of education and Knowledge of CAUTI Bundle. However, Cadre showed more significant influence on the knowledge of CAUTI-Bundle. Although, one would expect level of education to be a determinant of knowledge and implementation to CAUTI bundles, but this study showed the opposite. This contradicts the findings in a similar study which reported education to be positive in relation to compliance with CAUTI Bundle implementation.[20,21] This finding is also in agreement with Kose etal[14] who found a significant positive relationship between nurse's knowledge and years of nursing experience. It is therefore important to improve knowledge as one gain experience through years of practice for effective implementation of standard preventive and health promotive protocols like the CAUTI-Bundle. This can be through constant awareness creation, sending of reminders, training cum continuous education provision for nurses, staff education, monitoring, care techniques, setting CAUTI among the high priority list in various health institution amongst other measures.[22,23]

Conclusion

CAUTI is one of the major healthcare associated infections and the need to ensure it is prevented cannot be overemphasized. It is largely preventable if the CAUTI-Bundle is dutifully followed. In this study, there were knowledge gaps and suboptimal implementation of CAUTI-Bundle among Nurses in the health institution. The study showed that level of education does not have a signification relation to infection control among nurses but cadre showed significant relation with the Knowledge CAUTI-Bundle among nurses.

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EVALUATION OF NUTRITIONAL VALUES, PHYTOCHEMICAL CONSTITUENTS AND IN VITRO ANTIOXIDANT STUDIES OF SIX INDIGENOUS NIGERIAN PLANTS

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ABSTRACT

Background: Plants are known to contain minerals and many bioactive compounds which provide several health benefits on consumption.

Aim: The aim of present study was to assess the nutritional composition, phytochemical constituents and antioxidant properties of methanolic and ethanolic extracts of *G. kola mesocarp, V.* doniana *stem, fruit and leaf, L. aculeate leaf* and *L. inermis leaf, C. ferruginea* fruit *and P. soyauxii* stem.

Methods: Fully automated Soxhlet solvent extraction technique was used using ethanol and methanol. Solvent-Solvent fractionation was also done to obtain purer form of the plants extracts using Ethylacetate, N-hexane and N-butanol. Standard methods were employed in the phytochemical screening, quantitative phenols and flavonoid determination and antioxidant assays (DPPH radical and ascorbic acid were determined). Solutions of ascorbic acid and gallic acid served as positive controls. Data obtained were analysed using paired t-tests and one-way Analysis of variance (ANOVA) as well as Pearson Correlation with statistical significance set at < 0.05.

Results: Alkaloids, saponins, terpenoids, carbohydrates and flavonoids were detected in the extracts of studied plants. *V. doniana* leaves had the highest phenolic content (2684.47 ± 55.62 mg/g) in terms of gallic acid equivalents (GAE), From all extracts assayed, *V. doniana leaf* extract was observed to have the highest antioxidant activity with IC_{50} value of 94.48.

Conclusion: The result of this investigation suggests that these plants could be used as wild edible plants, and the natural antioxidants be incorporated as functional ingredients of food.

Key words: *Wild plants, proximate composition, phytochemical constituents, antioxidant properties.*

Introduction

Wild plants have been playing a very momentous role in human life for thousands of years. They have been used for food, medicine, fiber and other purposes and also as food for domestic animals [1]. They have occupied a unique place as they are rich sources of essential minerals, vitamins and bioactive compounds which have several health benefits [2,3].

Plants contain many phytochemicals such as alkaloids and phenolic compounds in addition to nutrients such as minerals, vitamins, proteins and carbohydrates, and several studies have shown that consumption of fruits, vegetables and plant derived food products have health benefits against chronic diseases including cardiovascular disease and certain types of cancer [3, 4, 5]. More than 900 different phytochemicals have already been identified in foods and in just one vegetable or plant food, more than 100 different phytochemicals are found to be present [6]. Many of these phytochemicals have antioxidant properties and support in protection of cells against the oxidative damage caused by reactive oxygen species [7, 8]. Antioxidants are the molecules which have the ability to scavenge or inhibit the oxidation of other molecules. Oxidation reactions can generate reactive oxygen species like oxygen free radicals which initiate chain reactions that may lead to formation of unwanted products or cell damage causing many diseases such as cancer, arthritis, diabetes, and other diseases related to humans [9,10,11].

Phytochemicals such as polyphenols and other bioactive compounds can prevent these chain reactions by scavenging free radicals and obstruct oxidation of other biomolecules [12, 13]. These phytochemicals provide endless prospects for new drug development due to the unmatched availability of chemical variety and plant derived food products are considered to be less toxic and more free from the side effects than synthetic drugs [14]. According to World Health Organization (WHO), 80% of the world's population still depends on traditional remedies for their medicines which have compounds derived from plants. The massive traditional knowledge of medicinal plants is presently playing a very essential role in the development of new drugs. However, six indigenous Nigeria plants studied includes; *G. kola* mesocarp*, V.* doniana *stem, fruit and leaf, L. aculeate leaf* and *L. inermis leaf, C. ferruginea* fruit *and P.soyauxii* stem.

Garcinia kola Heckel (Clusiaceae), commonly known as bitter kola is a widespread tree of evergreen forest valued in Nigeria for its medicinal nuts which has led to its exploitation in the natural forests [15]. *G. kola* stem and bark has been shown to contain a complex mixture of phenolic compounds such as tannins, guttiferin [16], biflavonoids, xanthenes, benzophenone, kolaflavanone and *Garcinia* flavanone [17] all of which have antimicrobial activity. *G. kola* mesocarp (fruit part) also contains alkaloids, anthocyanins, quinines and anthraquinones [18]. *Vitex doniana* (Verbanaceae) is a tropical fruit bearing tree widely distributed in West Africa and high rainfall areas. It is commonly known as Fon or Ewe oyi by traditional healers and plants sellers in Bénin [19].

It is also widely distributed in Eastern, Western and Northern parts of Nigeria as a perennial tree, the plant commonly called black plum or African olive (English). It is locally called Uchakoro (Igbo), Ori nla (Yoruba) and Dinyar (Hausa), [20]. Chemical constituents of the plant include glycosides, flavonoids, alkaloids, essential fatty acid [21]. The presence of flavonoids in this plant extract explains its antioxidant activity. Flavonoids are potent water-soluble antioxidants and free radical scavengers which prevent oxidative cell damage and have strong anticancer activity. Flavonoids also lower the risk of heart diseases [22, 23]. *Lantana aculeata* is a well known medicinal plant in traditional medicinal system and recent scientific studies have emphasized the possible use of *L. aculeata* in modern medicine [24]. It is a flowering ornamental plant belonging to the family Verbenaceae.

Different parts of *L. aculeata* are reported to possess essential oils, phenolic compounds, flavonoids, carbohydrates, proteins, alkaloids, glycosides, iridoid glycosides, phenyl ethanoid, oligosaccharides, quinine, saponins, steroids, triterpens, sesquiterpenoides and tannin as major phytochemical groups [25]. *Lawsonia inermis* (Henna) is a medicinal plant that is widely distributed across the Northern and Southern parts of Nigeria [27]. *Lawsonia inermis* is used as a kind of natural dye and is used as a raw material for natural hair dye [28]. The use of *L. inermis* as counter stain has been reported [29]. The plant contains substances such as lawsone (principal colouring matter), gallic acid, glucose, mannitol, fats, resin, mucilage and traces of an alkaloid. The leaves extract of *L. inermis* also contain phytochemicals such as glycosides, phytosterol, tannins, steroidal compounds and flavonoids [30].

99

The presence of flavonoids explains the antioxidant property of this plant extract. *L. inermis* leaves, flower, seeds, stem bark and roots have been found to exhibit antioxidant, antidiabetic, hepatoprotective, hypoglycemic, antimicrobial, anticancer and wound healing properties [31]. *Cnestis ferruginea* (Connaraceae) is a shrub or climber of deciduous forest and secondary scrubled widely dispersed in West Africa and other tropical parts of Africa and bears orange-red fruits with velvety hairs on the follicle [32]. Common names of the plant in Nigeria include "Fura amarya", "otito" (Hausa); "Okpu nkita", "amunkita" (Igbo); and "Akara oje", "Bonyin bonyin" (Yoruba); and"Ukpo-ibieka" (Edo).

The plant is about 3.0-3.6m high with densely, rusty brown, pubescent branches, indecidous leaves with more or less alternate or sometimes opposite, ovate to narrowly oblong leaflets. *Pterocarpus soyauxii* is a 30-55 feet high rain forest tree. It belongs to the Papilionaceae family, branch of spermaphytes [33]. The plant stem bark, greyish brown to brown-colour, scales off in fine irregular scales and contains a red sap. Other common names are mukwa or narra. Hence, this study is to evaluate the nutritional values, phytochemical constituents and in vitro antioxidant studies of six indigenous Nigerian plants.

Materials and methods

Design of study
Random sampling was adopted for this study because of the geographical locations and distributions of the different plants.

Collection of Plants
Six indigenous plants were used which were collected across three different states in the Southern region of Nigeria, namely: Edo, Delta and Anambra states. The plants are *Garcinia kola, Vitex doniana, Lantana aculaeta, Lawsonia inermis, Cnestis ferruginea and Pterocarpus soyauxii*. The six plants were collected as follows: *Lawsonia inermis* leaf and *Lantana aculata* leaf were collected in Edo State, *Cnestis ferruginea* fruit was obtained from Delta State, *Garcinia kola* fruit *and Pterocarpus soyauxii* stem, *Vitex doniana* leaf, stem and fruit were collected from Anambra State.

Plant Identification & Authentication
Plants collected were identified authenticated by plant Taxonomists using their local names and standard texts. Samples of plants were deposited in the herbarium of the Department of Plant Biology and Biotechnology University of Benin. Their Voucher numbers are as follows: UBH365 *(Garcinia kola)*, UBH366 (*Vitex doniana*), UBH367 (*Lantana aculata*), UBH368 (*Lawsonia inermis*), UBH369 *(Cnestis ferruginea)* and UBH370 *(Pterocarpus soyauxii)*.

Study Site
Analysis on the plants parts were carried out in the Faculty of Pharmaceutical Sciences, Agulu, Nnamdi Azikiwe University, Anambra state.

Ethical Approval

The study was approved by the institutional ethics committee at Hospitals Management Board, Benin City, Edo state and Ethical Committee Faculty of Health Sciences (the ethical approval number: (HA 577/VOL.11/173).

Extraction/Processing

Analytical high pressure liquid chromatography (HPLC), Electron Spray Ionisation Mass Spectrometry (LC-ESI-MS) were employed.

Quantitative Analysis of the Constituents

Determination of Alkaloid by Dragendroff's method [34], Determination of saponin content by Frothing test method [35], Determination of Tannin Content by Ferric chloride test method [35], Determination of Flavonoid Content by Aluminium chloride test method, Determination of Cardiae glycosides by Keller-Killani test method, Determination for terpenoids by Salkowaki test, Proximate Analysis, Determination of Ash Content [35], Determination of Moisture Content [35], Determination of Carbohydrate by Molish test method, Crude Protein Determination by Millions test method [35], Test for Antioxidant Property, DPPH (2, 2-diphenyl-1-picrylhydrazyl) radical scavenging activity[36].

Result

Phytochemical analysis of all sampled plants extracts showed presence of alkaloids, tannin and cardiac glycoside. The only extract observed to contain steroids was *L. aculaeta leaf extract,* while terpenes were only detected in *L.* inermis leaf extract, while *G. kola mesocarp extract* was the only extract observed to have very low content of flavonoids (Table 1).The highest concentration of alkaloids, saponin, tannin, flavonoid, was observed in *C. ferruginea fruit*, *L. aculata leaf, V. doniana leaf* and *C. feruginea fruit* respectively (Table one).

However, the HPLC analysis of *L. inermis leaf ex*tract from n-hexane solvent fraction yielded five major compounds identified as Luteolin-5-0-glucopyranoside, Apigenin-5-0-glucopyranoside, Kaemferol-3-0-glucoside, Leuteotine and Apigenin (Figure 1).

Pterocarpus soyauxii analysis revealed four major compounds namely: Malvidin 3-phydroxybenzoylsophoroside, Malvidin 3-acetylatedsophoroside, Malvidin and Tectoridine (Figure 2).

The DPPH method is widely used for screening antioxidant activity of plant extracts. DPPH is a stable free radical having a characteristic absorption at 760 nm. With reference to antioxidant activity, their activities increased with increasing concentration of extracts and standard (Vitamin C). The IC_{50} values of the extracts and Vitamin C were calculated from the percentage inhibitions at various concentrations.

The IC_{50} values are presented in figure four (4). Analysis of total phenolic content of plant extracts as shown in Table three (3) shows that *V. doniana* leaves had the highest phenolic content (2684.47±55.62 mg/g) in terms of gallic acid equivalents (GAE), while the next higher value was found in *G. ferruginea* (971.47±15.03 mg/g), *P. soyuaxii stem* (728.92±13.40 mg/g), *L. aculata* (670.76±5.37 mg/g), *L. inermis* (517.57±14.49 mg/g), *G. kola* (406.93±17.85 mg/g), *V. doniana fruits* (261.30±2.83mg/g), and *V. doniana stem* (189.91±17.10 mg/g).

From all extracts assayed, *V. doniana leaf* extract was observed to have the highest antioxidant activity with IC_{50} value of 94.48. The least antioxidant activity was observed with extracts of *V.doniana stem* with IC_{50} value of 34375.52. This is presented in Table four (4).

The correlation between antioxidant activity and TPC (total phenolic content) in Figure four point eleven, obtained by plotting $1/IC_{50}$ (ml/mg) against TPC (mg/g) showed that the phenolic compounds are responsible for DPPH free radical scavenging of the extract
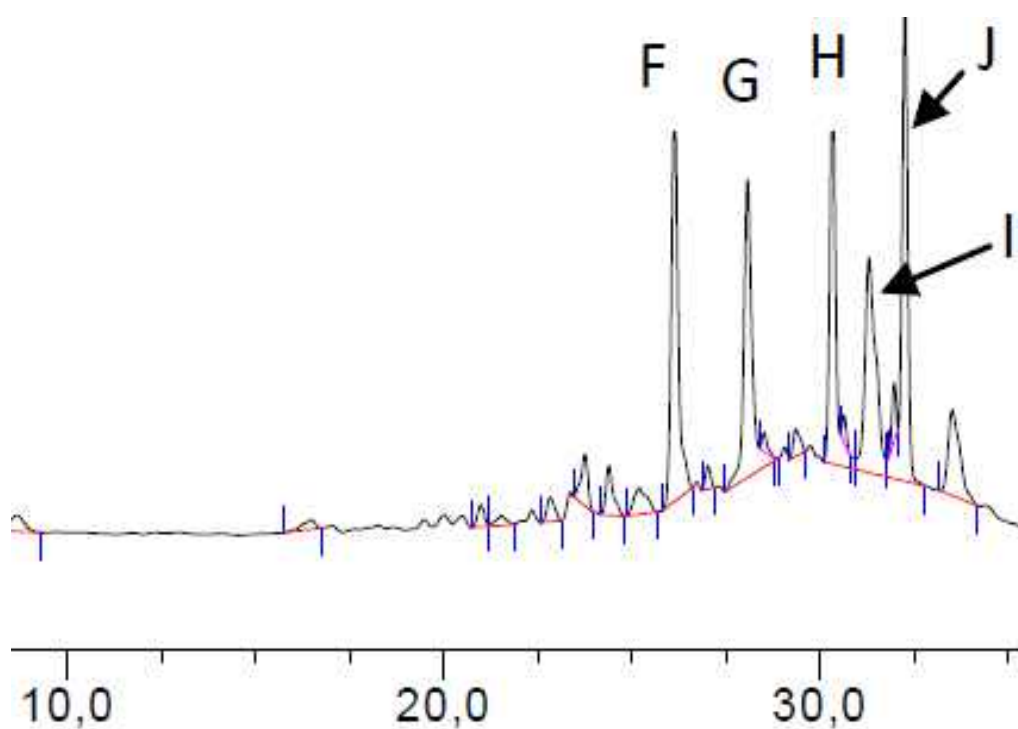
Table 1?Qualitative Analysis of Phytochemical Composition of Six Tested Indigenous Plants Parts'

| Plant Part/Extract	Alkaloid	Saponin	Tanin	Flavonoid	Steroids	Terpenes	Cardia glycosides
Ethanolic solvent							
G. kola mesocarp	+	+	+	+	–	–	++
V. doniana stem	+	+	++	++	–	–	++
V. doniana leave	++	++	++	++	–	–	++
V. doniana fruit mesocarp	++	++	++	++	–	–	++
Lantana aculata	+	+++	++	++	++	–	+
Lawsonia inermis	+	++	++	+	–	+	+
Cnestis ferruginea fruit	++	–	++	+	–	–	++
Methanolic solvent.							
Pterocarpus soyauxii stem.	+	+++	++	++	–	–	+
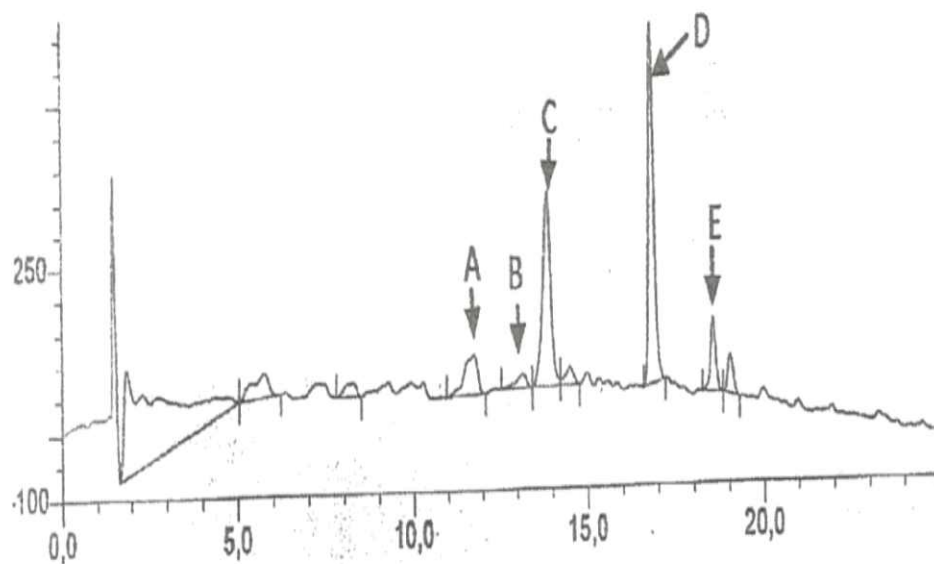
A= Luteolin-5-O-glucoside; B = Apigenin-5-O-glucoside; C= Kaempferol-3-O-glucoside;
D= Luteolin; E= Apigenin

Figure 1: Components of *L. inermis* on HPLC

K= Malvidin 3-phydroxybenzoylsophoroside; L= Malvidin 3-acetylatedsophoroside;
N= Malvidin; O= Tectoridine

Figure 2:   Components of *P. soyauxii* on HPLC
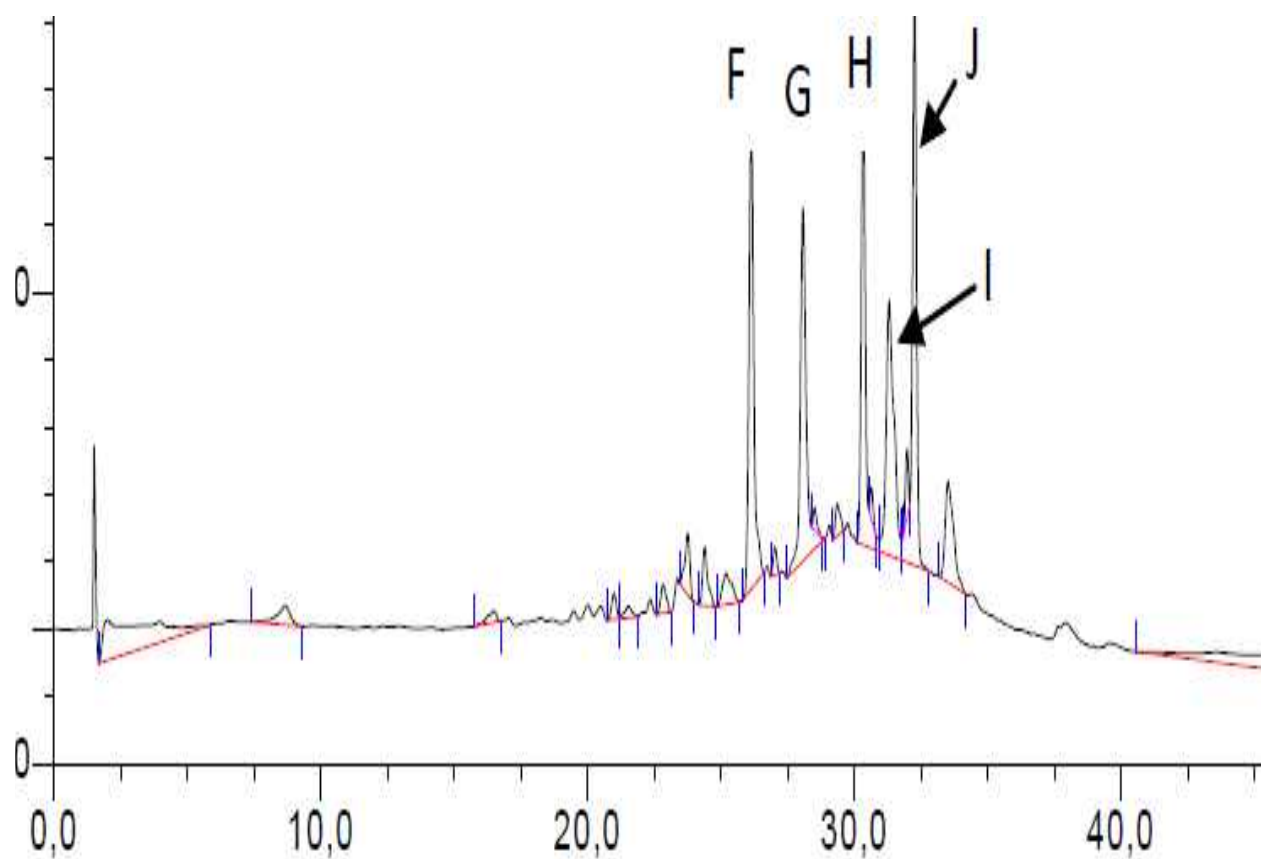
F=Tectorigenin, G=Peonidin 3-(6"-p-hydroxybenzoyl) glucoside, H=Tectorigenin 3-p-hydroxybenzoyl-5-frulate, I=Peonidin 3-(6"-p-methoxybenzoyl) glucoside, J=Tectorigenin 3-(6"-p-methoxybenzoyl glucoside.

Figure 3: Components of *V. doniana fruit* on HPLC

Table 2. Quantitative analysis of Phytochemical Screening and Nutritional Composition of Six Tested Indigenous Plant Parts

S/N	Plant Extract	Alkaloid (%)	Saponin (%)	Tanins (%)	Flavonoids (%)	Total Ash (%)	Moisture content (%)	Crude fibre (%)	Lipid (%)	Carbohydrate (%)	Protein (%)
1	*G. kola*	11.4	5.3	2.94	1.2	2.5	12.5	51.4	15.4	4.5	1.0
2	*V. doniana* stem	2.4	15.0	2.27	2.7	1.5	8.3	82.4	2.8	5.5	8.4
3	*V. doniana* leaves	0.2	3.79	4.91	9.5	8.5	6.0	41.8	3.2	12.4	1.4
4	*V. doniana* fruit	9.4	10.2	3.31	11.4	13.0	7.8	51.4	5.2	15.4	16.8
5	*L. aculeta* leaf	7.8	17.5	3.18	6.9	17.5	4.2	35.0	10.0	74.9	2.5
6	*L. inermis* leaf	4.2	11.2	3.2	9.1	6.5	4.0	28.6	10.6	46.3	2.10
7	*C. ferruginea* fruit	24	1.28	1.28	12.8	3.5	9.0	30.2	4.8	45.4	1.75
8	*P. soyauxii* stem	21	10.7	2.14	9.6	2.5	5.0	79.2	3.6	52	1.4

Table 3. Absorbance of Standard Compound (Gallic Acid)

Concentration (Mg/ml)	Absorbance (Mean) $\Lambda max = 760nm$
1.6	0.0448
3.12	0.0500
6.25	0.787
12.5	0.1129
25	0.1930
50	0.3874

TABLE 4. Total phenolic content of six tested indeginous plant extracts

Plant extracts	Total Phenolic Content (mgGAE/g extract)
G. kola mesocarp	406.93 ± 17.85
V. donnana stem	189.91 ± 17.10
V. doniana fruit	261.30 ± 2.83
V. donianna leaf	2684.47 ± 55.0
L. aculata leaf	670.76 ± 5.37
L. inermis leaf	817.57 ± 14.49
C. ferruginea fruit	971.47 ± 15.03
P. soyauxii stem	728.92 ± 13.40

Discussion

Phytochemical analysis of *G.kola* mesocarp revealed alkaloids, saponins, tannins and cardiac glycoside as constituent parts. Similar work had been done in another study in Congo which reported saponin, alkaloids, tannins and flavonoid as intergral part of *G. kola* mesocarp extract [37]. Their findings are in agreement with this very study, except cardiac glycosides which was found only in this study. This may be as a result of differences in geographical location of the two studies. Phytochemical composition indicated that *G. kola* mesocarp has good chemotherapeutic value. Also the nutritional composition of *G. kola* mesocarp extract showed similar findings. It had very low protein content (1.0%) and crude fibre. The low protein content observed in *G kola* mesocarp in this study and that of Morabandza *et al.,* (2013) shows that *G. kola* mesocarp as not a good source of protein. Low concentrations of saponin (5.3%) and flavonoid (1.29%) were recorded in extract of *G. kola* mesocarp in this work. Furthermore, no other study however, has been carried out to the best of my knowledge on *G. kola mesocarp.*

All the *V. doniana* parts studied (leaf, stem and fruit), *V. doniana* fruits was observed to have the highest protein content of 16.8%. Indeed, of all extracts studied, *V doniana* fruit was found to have the highest protein content. This finding has great implication for its use as a rich protein source. All parts of *V doniana* (stem, leaf, and fruit) used in this study were observed to contain alkaloids, flavonoids saponin, tannins, and Cardiac glycoside. Contrasting findings to that of this work has also been reported by study conducted by [38], which also did not report saponin and terpenes as counstituent parts of *V. doniana* stem and leaf.

A vast array of phytochemical constituents was detected in the extract of *L. aculaeta* leaf. Indeed it is the only plant extract that Terpenes was found out of the eight extracts assayed. In a recent Indian study carried out on *L. aculaeta* leaf, a host of compounds were detected ranging from flavonoids, tannins, alkaloids, saponins, steroids among others[38]. In another study conducted in India on *L. aculaeta* root, alkaloids and steroids were not detected. This finding may suggest that leaves of *L. aculata* contain more bioactive compounds than roots. This however will require more investigations to verify. Interestingly in this study, *L. aculata* leaf was found to have the highest carbohydrate and saponin content of all plants extracts assayed making it a good source of energy and anticancer agent.

No steroid was detected in *L. inermis* leaf extract in this study. Phytochemical analysis of *L. inermis* revealed alkaloids, saponin, tannins, flavonoids, terpenes, and cardiacglycoside [39] confirmed the presence of cardiac glycosides, steroids, saponin, tannins and flavonoids. Contrary to findings in this study, no protein was detected in the nutritional composition in the study conducted by [39]. The presence of these constituents in the fruit extract of *C. ferruginea* in this study indicates that it has good pharmacological and therapeutic value. In herbal medicine and some literatures, the fruit extract has diverse therapeutic uses against infections like snakebite, dysentery, syphilis, gonorrhea, cough, dysmenorrhea, ovarian troubles and aphrodisiac. The root and fruit extracts however, prevents abortion, constipation, fever and pain [40,41].

In the HPLC analyses of the six different plants part extracts, the ethylacetate solvent fraction of the *V.doniana fruit,* revealed five compounds which were identified to be Tectorigenin, Peonidin 3–(6-parahydroxybenzyl) glucoside, Tectorigenin–3–p–hydroxybenzyl–5–frulate, Peonidin–3–(6"– p – methoxybenzoyl) glucoside and Tectorigenin –3–(6"–p–methyoxybenzoyl) glucoside . These compounds are generally called flavonoids which are divided into six sub groups, of which these five compounds detected fall into two subgroups: namely; Isoflavones and Anthocyanins. Tectorigenin, Tectorigenin (3–p–hydroxybenzoyl–5–frulate) and Tectorigenin 3–(6"–p– methydoxybenxoyl) glycoside are Isoflavones while Peonidin 3–(6"–p–hydroxybenzol) glucoside and Peonidin 3(6"– p– methoybenzoyl) glucoside are Anthocyanins.

Isoflavones are found in a class of plants known as phytoestrogens because of their similar chemical structure and function to the female sex hormone estrogen; while *Vitex doniana* fruit is rich in isoflavones and the three types of isoflavones discovered have 13.15%, 11.70% and 14.62% respectively as peak area. Isoflavones are widely appreciated and are currently the subject of intense research and discussion, this is because it protects against hormone related disorders such as breast cancer prostate cancer, osteosarocoma, lung carcinoma, and ovarian cancer [43,44].

Anthocyanins are polyphenols and generally accepted as the most important group of water soluble pigment in nature [45]. They are responsible for the blue, purple, red or orange colour of many fruits and vegetables [45].

They are distinguished from other flavonoids due to their capacity to form flavylium cations [46]. One of them is Peonidin found in this study which is responsible for the colour found in *V.doniana fruit* (Purplish blue colour) and this is also influenced by the abundance of hydroxyl group. The hydroxyl is responsible for the bluish shade while the methoxyl influence the reddish colour [47],[48].

Anthocyanins can exert a major chemopreventive activity due to their antioxidant property [49] by scavenging reactive oxygen and reactive nitrogen species or by chelating trace metals involved in free radical production [50].

In the analysis of *lawsonia inermis* leaf extract, the ethylacetate solvent fraction yielded five major compounds identified as Luteolin–5–glucopyranoside, Apigenin–5–0–glucopyranoside, Kaemferol – 3- 0 – glucopyranoside, Luteoline and Apigenin.

Apigenin monoglycosides is also a flavone present in form of glycosides in *Lawsonia inermis* with peak area of 1.35% concentration. Apigenin suppresses cancer cells, by altering a very specific step in gene regulation making cancer cells to die like normal cells. Apigenin also binds a very important protein called HnRNPA2 and this connection thus inhibit breast cancer cells and so cells die in programmed way (Restors the single splitting of cells instead of double splitting which is a characteristics of breast cancer cells (induces apoptosis). It also has anti-inflammatory properties. It blocks the production of uric acid. It has antidepressant-like effect. Some other sources of Apigenin are found in thyme, peppermint, chamomile herbs, red wine and tomatoes sauce.

Kaempferol monoglucoside, this is a flavone, present at a high percentage (peak area) as 14.87% in *lawsonia inermis* leaf extract, it is a natural flavonol a type of flavonoid, and appear as a yellow crystalline solid, this contributes to the yellow colour exhibited by *Lawsonia inermis leaf extract*. Kaempherol is also found in apples, grapes, tomatoes, broccoli, cucumbers, letuce, green beans and moringa. It is a strong antioxidant and it combines with quecitin to reduce proliferation of cancer cells [51, 52]. It is a potent promoter of apoptosis [53]. In Chemotherapy it is much less toxic to normal cells in comparison with standard chemotherapy drugs[54].

The n-hexane solvent fraction of *Pterocarpus soyauxii* yielded six different compounds. The four compounds identified were: Malvidin 3-p-hydroxylbenzolsophoroside, Malvidin 3-acetylatedsophoroside, Malvidin and Tectoridine.

Malvidin is an anthocyanin (flavonol) in the group of flavonoid (polyphenol) found abundantly in berries (bilberry and blueberry). The diversity of anthocyanins are due to the number and position of hydroxyl and methoxyl groups on the basic anthocyanidin skeleton; the number and positions at which sugars are attached, and also the extent of acylation and the identity of the acylating agent. The intensity and type of the colour of anthocynins is affected by the number of hydroxyl groups: if more methoxyl prevail, then redness increases [48].

With reference to antioxidant activity, their activities increased with increasing concentration of extracts and standard (Vitamin C). The IC_{50} values of the extracts and Vitamin C were calculated from the percentage inhibitions at various concentrations.

The correlation between antioxidant activity and TPC obtained by plotting 1/IC50 (ml/mg) against TPC (mg/g) showed that the phenolic compounds are responsible for DPPH free radical scavenging of the extracts. Antioxidants in the extracts react with DPPH and convert 1, 1-diphenyl-2- picrylhydrazyl (deep violet color) to 1, 1-diphenyl-2-picrylhydrazine, a stable molecule (yellow color or bleached product) by accepting an electron or hydrogen radical at a very rapid rate resulting in a decrease in absorbance at 760 nm [10]. IC50 value is defined as the inhibitory concentration of the crude extract that scavenges 50% of reactive oxygen species or inhibits the process of oxidation by 50%. It is inversely related to antioxidant capacity and lower IC50 value signals better antioxidant activity. In this investigation, all the plant extracts were compared with ascorbic acid as standard reference. From all extracts assayed, *V. doniana leaf* extract was observed to have the highest antioxidant activity with IC_{50} value of 94.48. The least antioxidant activity was observed with extracts of *V.doniana stem* with IC_{50} value of 34375.52.

Conclusion

Some of these plants have been evaluated for the first time and these plant extracts contain some bioactive compounds namely: flavonoids, alkaloids, steroids, tannins, cardiacglycosides saponins, terpenes, and nutrients such as carbohydrate, protein, crude fibre, lipid, total ash moisture, and have relatively strong antibacterial properties and also antioxidant activities which are associated to free radical scavenging activities. Hence, the plants could be good sources of nutritional value and natural antioxidants in improving malnutrition problems, combating many human deficiency diseases and could also be developed as drugs for the prevention and treatment of diseases especially caused by oxidative stress. However, further study on mineral contents of these plants should be done using Atomic Absorption Spectrometer.

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EPIDEMIOLOGY OF CRYPTOSPORIDIOSIS IN HIV POSITIVE PATIENTS TREATED IN MAJOR TERTIARY/SECONDARY HOSPITALS IN RIVERS STATE, SOUTHERN NIGERIA

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ABSTRACT

Background: Cryptosporidiosis is one of the protozoan, opportunistic infections that are common in HIV positive patients and is characterized by gastroenteritis marked with spurious diarrhea that may lead to death if not treated.

Aim and Objectives: To evaluate the epidemiology of Cryptosporidiosis in HIV positive patients undergoing treatment at University of Port Harcourt Teaching Hospital(UPTH) and Zonal Hospital Ahoada (ZHA), Rivers State, Southern Nigeria.

Materials and Methods: 250 HIV positive patients were randomly recruited for the study consisting of 101 males and 149 females. Demographic data/information was obtained using a well-structured self –administered questionnaire. Stool samples were collected from each of the patients by standard methods. Modified Ziehl Neelsen (MZN) technique was employed to stain thick stool smears which were microscopically examined under high power magnification for the diagnosis of Cryptosporidium species ocysts.

Results: Out of the 250 samples, 19 were positive giving a prevalent rate of 7.6%. The age group with the highest prevalence (2.4%) was 30-40 years followed by 26-30 years (1.6%). The prevalent rate in females (5.6%) was significantly more than that of males (2%) ($P < 0.05$). Farmers were significantly more affected (3.2%) than other occupational groups ($P < 0.05$). Patients whose source of domestic water was bore hole had the highest percentage (89.5%) of infection. Personal hygiene (hand washing) had a significant effect on infection rate. Diarrhea was the most frequent presentation of the disease.

Conclusion and recommendation: Cryptosporidiosis was prevalent in HIV positive patients who presented in UPTH and ZHA in Rivers State, Southern Nigeria. Strict environmental sanitation and provision of portable water are public health measures recommended to reduce the prevalence of this disease especially in HIV/AIDS patients.

Key words: *Cryptosporidiosis, epidemiology, HIV, Rivers, Nigeria.*

INTRODUCTION

Cryptosporidiosis is one of the commonest opportunistic infections in Human Immunodeficiency Virus (HIV) positive patients Worldwide. It is believed to be one of the commonest causes of chronic diarrhea in immune-suppressed individuals throughout the World [1,2,3]. Both man and animals are infected by Cryptosporidium species including *Cryptosporidium hominis* and *Cryptosporidium parvum* and infection is usually by the faeco-oral route when the infective ocysts are ingested in food, water and other contaminated surfaces [4]

The prevalence of Cryptosporidiosis has varied from one locality of study to another. Whereas a study [5] in the Southeastern State of Enugu did not report any incidence of Cryptosporidiosis in 2002, Erhabor et al [6] reported a prevalence rate of 2.9% Cryptosporidiosis in 2011 with female patients being the most affected. Studies in Southwest Nigeria [7,8] reported prevalence rates ranging from 2.3% to 2.6% with the highest rates reported in HIV positive patients with diarrhea. Other epidemiological studies outside Nigeria [9,10] have shown similar rates with HIV positive patients bearing the highest burden of disease. Epidemiological factors which play significant roles in the transmission of cryptosporidiosis include the source of domestic water supply, food hygiene and life style habits including practice of oral sex and other unhealthy habits [4].

The present study was therefore designed to evaluate the prevalence and epidemiology of Cryptosporidiosis in HIV positive patients treated in a tertiary hospital and secondary hospital in Rivers State, Southern part of Nigeria.

MATERIALS AND METHODS

Study area: The study was conducted at the University of Port Harcourt Teaching Hospital (UPTH) Choba, Port Harcourt and the Zonal Hospital, Ahoada (ZHA) all in Rivers State, Southern Nigeria. Rivers State is one of the 36 states of the Nigerian Federation located in the geopolitical zone known as South-South Nigeria. It has an estimated population of 5.2M people according to 2006 census [11] It's neighboring states include Abia, Imo, Delta and Edo states.

Study Population: A total of 250 subjects were recruited for the study consisting of 135 subjects from UPTH and 115 subjects from ZHA respectively. All the subjects were screened for HIV using the conventional methods and grouped as follows:

    i) HIV positive subjects on Highly Active Antiretroviral Therapy (HAART) and not diarrheic

    ii) HIV positive subjects not yet on ART

    iii) HIV positive subjects who had diarrhea

Study Design: This was a cross sectional study and random sampling method was used.

The minimum sample size was calculated using the formula:

$N = Z^2 \times P(1-P)/D^2$ (Naing et al 2008)

Where N = Minimum sample size for blood and stool

P = Prevalent rate for Cryptosporidiosis in HIV positive patients with diarrhea in Niger Delta = 2.9% (Erhabor et al, 2011)

D = Desired level of significance = 95% (0.05)

Z = Confidence interval 95% = 1.96

Ie $N = 1.96^2 \times 2.9/100 \times (1-2.9)/100 \div 0.05^2$

    = 37

Questionnaire: A well-structured, self-administered questionnaire was used to obtain demographic data

Ethical Clearance: This was obtained from the Ethics Department of the University of Port Harcourt Teaching Hospital (UPTH) and from the Nigerian Institute for Medical Research, Yaba, Lagos, Nigeria)

Informed consent: This was obtained from all the participants and those who did not want to participate were allowed to opt out.

Inclusion Criteria:

- All HIV positive patients aged 15-65 years both on HAART and not

- All HIV positive patients who had diarrhea

Exclusion Criteria:

- Children below 15 years of age

- Subjects above 65 years of age

Statistical Analysis: Chi square (X^2) test was used to analyze the data obtained and the level of significance used was $P \leq 0.05$

Collection of Stool samples/Analysis

One gram of stool sample was collected from each of the 250 patients into a clean wide mouthed sterile bottle. A stool smear was made from each fresh faecal sample on a clean frosted end, grease-free glass slide for Modified Ziehl Nielsen (MZN) staining technique. The remaining sample was fixed with 10% formol saline and preserved in a refrigerator at 2° C for further use.

Modified Ziehl Nielsen (MZN) Staining Technique

a) The thick stool smears were fixed with absolute alcohol(methanol) for 5 minutes and air dried at room temperature

b) Carbol fuchsin with phenol was applied for 15 minutes

c) The stain was washed with tap water

d) The stain was decolourized with 1% acid alcohol (1% sulphuric acid in methanol) for 10 minutes

e) Counter staining with 0.4% methylene blue solution for 1 min

f) Slide was washed with tap water and air dried

Microscopy/Diagnosis

The slide was viewed with oil immersion microscope at x400 magnification.
Ocysts of Cryptosporidium species appear as pink to red spherical to oval bodies in blue background.

RESULTS

The overall prevalence of Cryptosporidiosis in the study area was 7.6%. The age group most affected was 36-40 years (2.4%) followed by 26-30 years (1.6%). Prevalence significantly varied according to age ($P < 0.05$, Table 1). Female patients were significantly more affected (5.6%) than males (2%) ($P < 0.05$).(Table 2). The occupational group most affected was farmers (3.2%), followed by traders/business men (2%). A significant difference existed between the occupational groups. ($P = 0.000$; $P < 0.05$) (Table 3). Patients whose water source was borehole suffered most from Cryptosporidiosis while the patients who obtained their domestic water from river or well suffered the least (Fig 1). Personal hygiene (hand washing) significantly affected the incidence of the disease ($P < 0.05$) while diarrhea was the most single important presenting symptom of the disease.

Table 1: Showing Age distribution of Cryptosporidiosis in HIV positive patients treated at a tertiary and secondary Hospital in Rivers State, Southern Nigeria

Age group (years)	Total no	No positive	Prevalence (%)
15-20	9	0	0
21-25	33	5	2
26-30	42	4	1.6
31-35	47	1	0.4
36-40	54	6	2.4
41-45	20	1	0.4
46-50	35	2	0.8
Total	250	19	7.6

$X^2 = 135.493$, $P = 0.000$, $P < 0.05$

Table 2: Gender distribution of Cryptosporidiosis in HIV positive patients treated at a Tertiary and Secondary hospital in Rivers State, Southern Nigeria

Age gp (yrs)	Total no	Male	No positive	Prevalence (%)	Female	No positive	Prevalence (%)
15-20	10	4	0	0	6	0	0
21`-25	35	12	2	0.8	21	3	1.2
26-30	43	19	1	0.4	26	3	1.2
31-35	49	20	0	0	29	1	0.4
36-40	54	22	2	0.8	33	4	1.6
41-45	22	9	0	0	13	1	0.4
46-50	37	15	0	0	22	2	0.8
Total	250	101	5	2	149	14	5.6

$X^2 = 30.335$, P = 0.000, P < 0.05

Table 3: Occupational distribution of Cryptosporidiosis in HIV positive Patients treated at a Tertiary and Secondary hospital in Rivers State, Southern Nigeria

Occupation	Total no	No Positive	Prevalence (%)
Civil Servants	42	2	0.8
Traders	102	5	2
Students	43	1	0.4
Farmers	51	8	3.2
Com Drivers	7	1	0.4
Applicants	5	2	0.8
Total	250	19	7.6

$X^2 = 34.782$, $P = 0.000$, $P < 0.05$
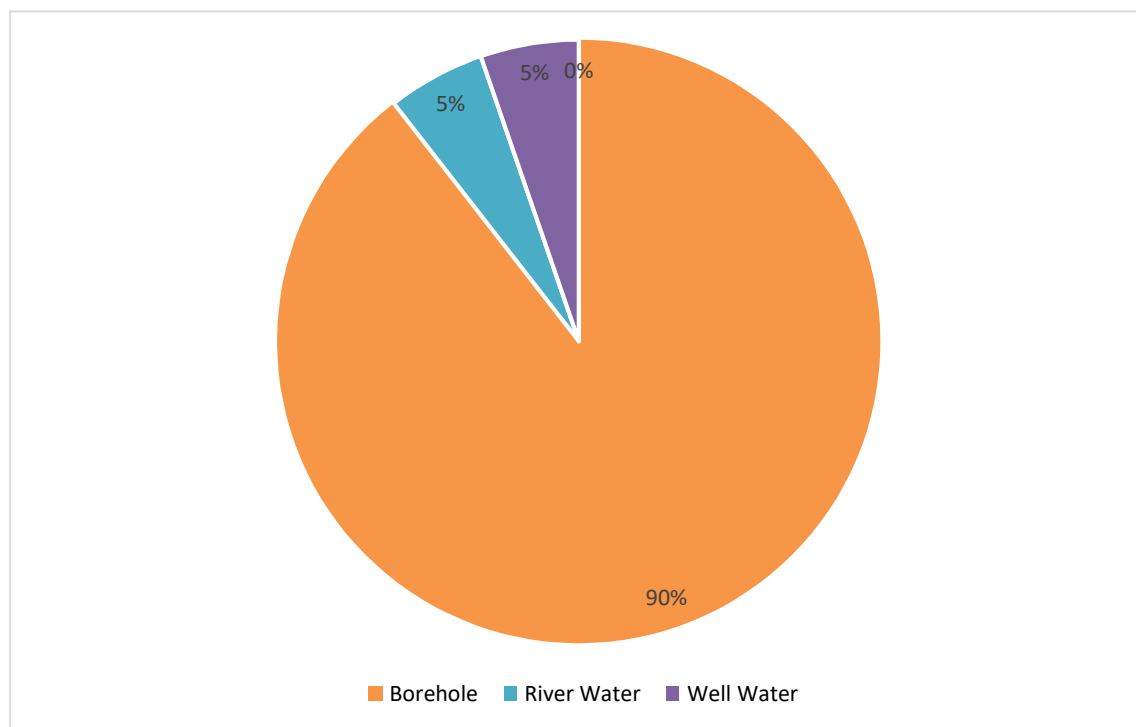
Fig 1: Pie chart showing Distribution of Cryptosporidiosis Cases According to domestic water supply
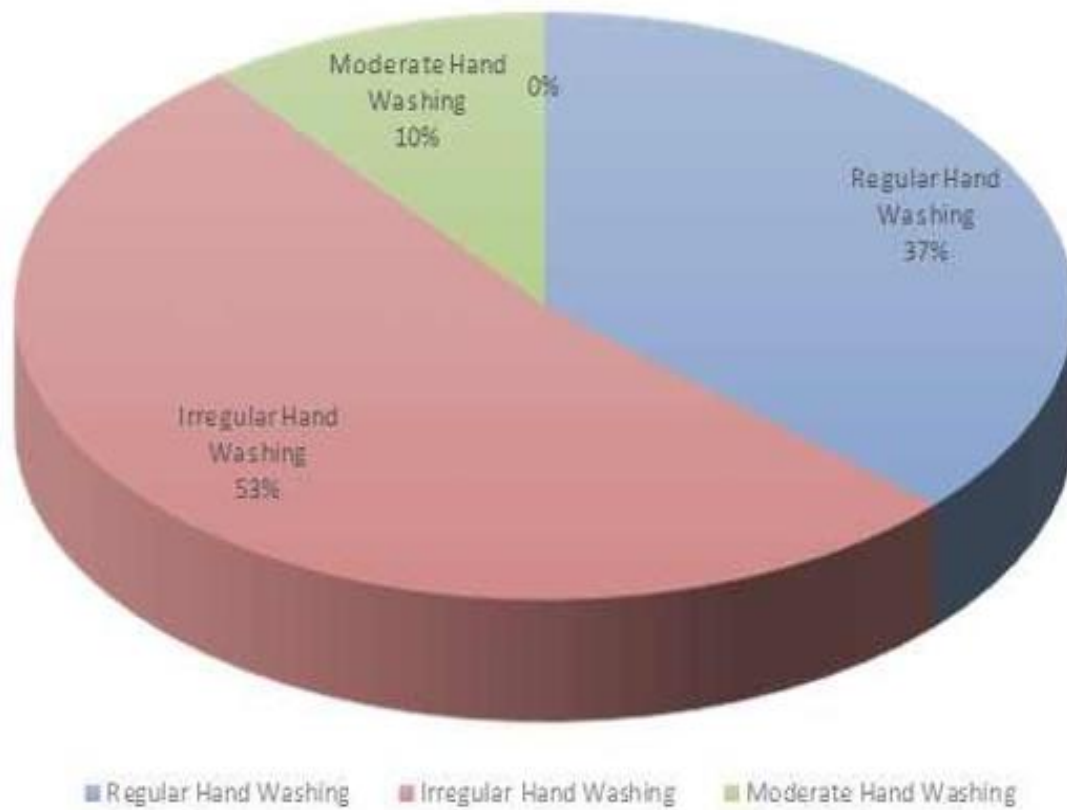
Fig 2: Pie chart showing Distribution of Cryptosporidiosis Cases According to personal Hygiene (hand washing)
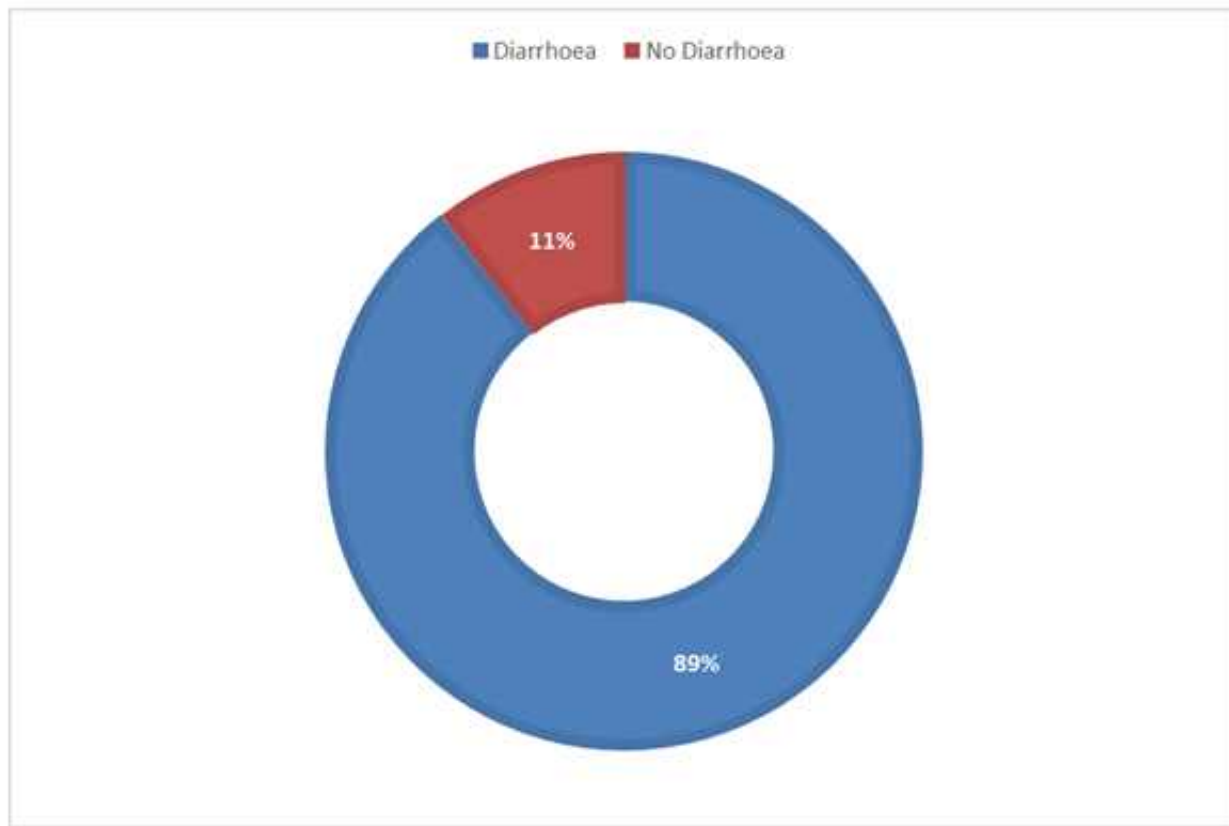
Fig 3: Pie Chart Showing Association of Cryptosporidiosis cases in HIV Patients with diarrhea

DISCUSSION

The present study (Table 1) showed that the overall prevalent rate of Cryptosporidiosis in HIV infected patients in Rivers state was 7.6% with female patients being significantly more affected than their male counterparts (P < 0.05). A similar but community based study in Port Harcourt reported a higher prevalence rate [18]. Previous studies conducted in the other geopolitical zones of Nigeria have reported varying prevalent rates ranging from zero % (as reported in Enugu, Southeastern Nigeria) to 80% (as reported in Wamako, Sokoto State, North Western Nigeria)[5,6,7,8,12,13,14]. In all these studies, the prevalent rates seem to have been influenced by the location of study, the sample size, the age range of subjects recruited and environmental factors to mention but a few. Studies conducted outside Nigeria [4,9,10,15,16] reported prevalent rates ranging from 1.5% to 11% and as observed in the local studies, the reported rates seemed to have been affected by the study population, the age group involved and other environmental factors that depended on the locality of the study.

The study (Table 1) also showed that people aged 36-40 years had the highest infection rates followed by people aged 21-26 years. The prevalent rate was significantly different in the various age groups (P < 0.05). Age normally affects the prevalence of many diseases with the extremes of life (children and elderly people) being most affected. In the present study however, children aged below 15 years and elder[y people above 65 years were excluded. Some previous studies [7,12,14,18] have collaborated this finding with some of them reporting greater prevalence in children than in adults[18]. Children are believed to have weaker and immature immune status. This is made worse when they are HIV positive. They also have poorer toilet habits and hygiene and may come in close contact with domestic animals more frequently [18].

Conversely, children are more exposed to Cryptosporidium infection than adults.

Furthermore, this study (Table 2) revealed that female patients were significantly more affected by Cryptosporidium infection than the male counterparts (P < 0-05). Similar findings have been reported previously [14,19].

However, a study by Egberengbe et al in 2010 [12] reported that more males were infected with Cryptosporidium species than females. In the said study, most of the victims used bush toilet method and fetched their domestic water from ponds and local rivers. It is worthy to note that in all the studies, more females were recruited than males and this could partly account for the difference in prevalent rates.

The study (Table 3) further showed that among the occupational groups investigated, farmers had the highest prevalent rate (3.2%) followed by traders/businessmen (2%). There was a significant difference in prevalence between the various occupational groups (P < 0.05). This may be probably due to the fact that farmers are more likely to come into close contact with animals which carry the ocysts of Cryptosporidium species especially those of them that engage in animal/poultry farming. A previous study in Port Harcourt by Tariuwa et al [18] collaborated this finding. Furthermore, this study (Fig 1) showed that majority (89.5%) of the patients infected by Cryptosporidium species obtained their domestic water supply from bore hole ie pipe borne water. This finding raises a lot of public health concern. Bore hole is a common source of domestic water in this environment. The finding suggests the likelihood of contamination of drinking water by infected people carrying the Cryptosporidium ocysts.

This calls for public health experts to institute investigation to find sources of contamination of domestic water supply in the study area. Surprisingly, people whose water source was rivers and streams had the least number of infection. Considering the fact that Rivers State is a riverine area, it is possible that some local indigenes may practice open defaecation and disposal of wastes thus increasing the chances of contamination of streams with Cryptosporidium ocysts. To guide against this, the Centre for Disease Control (CDC) has proposed the prohibition of people suffering from Cryptosporidiosis from swimming in public water bodies/pools to prevent them from washing their anal and genital areas into the water thereby contaminating the water and spreading the infection [20].

This study further showed that majority of the cases of Cryptosporidiosis occurred in patients who did not observe strict personal hygiene by washing their hands regularly especially after using toilet facilities (Fig 2). Regular hands washing with soap has been associated with reduction of the incidence of many infectious diseases including Covid-19. The higher prevalence of Cryptosporidiosis reported in primary school children [14] may be associated with poor hygiene especially in places where water is not readily available. The place of hygiene may also explain the fact that majority of the Cryptosporidiosis cases (89%) presented with diarrhea (Fig 3). This is marked in HIV/AIDS patients who have not been placed on antiretroviral therapy (ART). Similar findings have been reported in previous studies [12,13,18,19], thus diarrhea is a prominent symptom of HIV/AIDS disease. It is also the major cause of sudden death of the victims as a result of severe fluid and electrolyte imbalance and cardiovascular collapse.

CONCLUSION

Cryptosporidium species was a prominent protozoan cause of gastroenteritis in HIV/AIDS patients who presented in major hospitals in Rivers State, Southern Nigeria and it affected both male and females groups and cut across most occupational groups. Environmental sanitation and provision of safe portable water can go a long way to reduce the incidence especially in HIV/AIDS patients who were the targets of the present study.

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TRANSFUSION TRANSMISSIBLE INFECTIONS AMONG BLOOD DONORS IN A TERTIARY HOSPITAL, SOUTHEAST NIGERIA: ANY CHANGE OVER TIME?

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Abstract

Background: Transfusion-transmissible infections (TTIs) remains a global issue and great health concern. There is need for continuous monitoring, stringent donor testing and selection to ensure downward trend in the prevalence of TTIs and make progress in blood transfusion safety.

Aim: To evaluate the changing trend in prevalence of TTIs among blood donors in a Nigerian Tertiary Hospital.

Materials and Methods: This is a retrospective study of results of donor screening within the study period. Relevant data from the donor register were retrieved and entered into Excel spreadsheet after obtaining ethics clearance. These include demographics, donor type and chemiluminescent microparticle immunoassay results for human immunodeficiency virus (HIV), hepatitis B surface antigen (HBsAg), hepatitis C virus (HCV) and syphilis (venereal disease research laboratory). Statistical analysis was performed using ?STATA-20. Chi-square and regression analysis was used to test for associations and the level of significance was set at P-value < 0.05.

Results/Conclusion: A prevalence rate of 4.8% transfusion-transmissible infections was found amongst the blood donors with prevalence rate of 1.2% for HIV, 1.5% each for HCV and HBsAg, and 1.0% for Syphilis. The trend in prevalence of TTIs, donor type and other demographics remains unchanged in the. This can be attributed to the deep rooted beliefs, myth, cultural perception and practice of the locales.

Key words: Blood donor type, changing trend, transfusion transmissible infections, chemiluminescent micro-particle immunoassay

Introduction

Blood transfusion practice remains an important aspect of patient management and a large number of pints of blood are transfused daily in the hospitals. Even though blood transfusion saves lives, it can also be a source of threat to life due to adverse events such as haemolytic transfusion reaction, anaphylaxis and transmission of infectious blood-borne pathogens.[1,2]

Transfusion transmissible infections is the commonest adverse event of blood transfusion and exposes the recipient to the complications of the infectious agents such as chronic hepatic failure, other organ damage and even death.[3] It is a global public health concern,[4] and concerted effort geared towards continuous awareness and enlightenment together with advancement in screening and donor selection to ensure downward trend in the incidence of TTIs and make progress in blood safety is the key to completely eliminate the problem.[5,6] To minimize these adverse outcomes, stringent rules are applied to ensure that safe blood is provided for the recipient which includes stringent screening for transfusion-transmissible infections.

There are different types of blood donation which include voluntary non-remunerated, autologous, family replacement, commercial or paid blood donation.[7] The WHO and various national blood transfusion agencies emphasize on voluntary non-remunerated donors as it is the best approach to safe and regular blood supply to meet the blood supply needs.[8,9,10] Another safe approach is autologous blood donation which is the method in which the patient donates his or her blood to be re-used in future. It has several advantages of eliminating most of the adverse transfusion reactions seen in homologous blood transfusion as well as closing the gap in supply demand.[11] In a study done in some parts of Nigeria, autologous blood transfusion was effective in meeting the blood demand need.[12]However, this practice is yet to receive wide acceptability especially in developing countries as most hospitals and blood banks in sub-Saharan Africa that rely on paid donors, who are at risk population, for a large pool of donated blood.

The main component of an integrated strategy for blood safety include collection of blood only from voluntary, non-remunerated blood donors, screening for all transfusion transmitted infections and reduction of unnecessary transfusions. According to World Health Organization (WHO), in 2006 more than 75% of the blood donations were received from different families of patient but other 25% were received from the professional blood donors on payment.[13,14] However, in some developed regions, there is increase in voluntary blood donations (77%) as against (23%) who were familial/replacement donors as in the case of research data from western turkey study.[15]

The WHO recognizes and emphasizes blood donation from only voluntary non-remunerated donors, however in Nigeria as shown by some studies, the vast majority of donors are from family (replacement) donors and commercial (paid) donors mainly due to our cultural belief and understanding which made voluntary donations difficult to be widely acceptable as well as our extended family system practice, hunger and poverty which fuel demand for gratification for blood donation.[16,17]

In a national survey on blood transfusion conducted in Nigeria in 2006, it was found that in the public sector, 75% of the donor population was made up of replacement donors while 25% were commercial donors. Voluntary unpaid donors were negligible. It was even a worst case scenario in the private sector with 75% of the donor population being commercial donors and 25% of replacement donors. Voluntary unpaid donors were insignificant.[18,19]

The national blood transfusion service in Nigeria was established in 2006 [18] and was renamed national blood transfusion commission with a law enacted in 2021 with the mandate to change this narrative and promote safe and effective blood transfusion practice in Nigeria.
The different types of blood donors carry different risks of transmitting TTIs but voluntary blood donors remain the safest way of ensuring reduced transmissibility. However, some studies have reported varying prevalence of TTIs even among voluntary blood donors.

A study done in Faisalabad found a high rate of transfusion transmissible infections among voluntary blood donors at 11.55% with positivity rate of 6.97%, 2.02%, 0.01% and 2.43% for hepatitis C, HBV, HIV and syphilis respectively.[20] compared to lower prevalence of 0.24% for HIV infections, 0.38% for Hepatitis B infections, 0 for Hepatitis C and 0.04% for Syphilis in an Indian hospital study.[21]

A review of epidemiology of TTIs among the different categories of blood donors(both voluntary and commercial donors) has been carried out previously in our center by Okocha et al[19] and TTI prevalence rates of 3.7%, 2.0%, 2.0% and 0.1% were detected for HIV, HBsAg, HCV and Syphilis in the study respectively. Since then, certain measures were put in place from the year 2019 towards increasing voluntary blood donation and reducing risk of TTIs in line with global best practices. A separate unit called blood donor recruitment unit was created with the mandate of creating awareness, mobilization and recruitment of voluntary donors, organizing blood drive, donor club and blood donor day celebrations. This unit is well staffed and is given support by the hospital management in carrying out their function.

This study assessed the impact of these interventions and provide current data on seroprevalence of the common transfusion transmissible infections in our environment namely HIV, HBsAg, HCV and VDRL which will aid health policy makers in decision-making and intervention.

Methods

Study area

This study was conducted at the Blood Bank Unit of the Department of Haematology and Blood Transfusion, Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria, a 500-bed public teaching hospital that offers tertiary health services to the people of Anambra state and environs. The blood bank caters for the blood transfusion needs of the entire patients from different departments in the hospital and has qualified staff who man the blood bank. All the testing for TTIs are done using the chemilumnescent microparticle immunoassay method.

Study design and Data collection

This is a descriptive, cross-sectional retrospective study of all potential blood donors who visited the blood bank between September 2020 and May, 2022 to donate blood. The archived donor screening registers were retrieved and relevant data such as age, sex, PCV, screening status, donor type and blood group were extracted. The potential donor must meet the inclusion criteria for blood donation.[22]

Transfusion Transmissible Infection screening for HIV, HBsAg, anti-HCV and VDRL were performed using chemiluminescent microparticle immunoassay with kits from Autobiod Diagnostics Ltd and according to manufacturer's instructions. Positive samples were again re-tested on the following day for confirmation. The samples and blood bag were discarded for which the pilot sample was positive, according to standard procedure and corresponding donors notified. They were consequently referred to infectious diseases or gastroenterology units or IHVN center of the institution as the case may be for Western Blot confirmation and other tests. High-level confidentiality was maintained at every step.

Data analysis

The data collected for this study were thoroughly cleaned and analyzed using the Python 3.10.0 programming language. Summary statistics were used to describe the parametric numerical variables, including means and standard deviations, while non-parametric variables were presented using medians and interquartile ranges. Categorical variables were analyzed in terms of frequencies and percentages to reflect their distributions. Prior to comparing two numerical variables, normality and variance assumptions were checked. Parametric numerical subsets were assessed using Student's t-test and ANOVA, while non-parametric indices were analyzed using Wilcoxon and Kruskal-Wallis tests. Pearson correlation analysis was employed to investigate the relationships between two numerical variables of interest. Additionally, potential predictive variables for the severity of transfusion-transmitted infections in blood donors were evaluated using linear regression analysis. A significance level of $p<0.05$ was considered statistically significant for this study.

Results

The total number of potential donors who were screened for blood donation between September 2020 and May 2022 was 2,672, with 2,280 (85.3%) males and 392 (14.7%) females. The median age of the donors was 26.0 (IQR 23.0 – 34.0) years, ranging from 18 to 70 with male preponderance. Young adults (18-28 years) made up the largest group (58.5%), while those above 50 years made up the smallest group (1.8%). (Table 1). Males were also found to be more than the females in the younger age group 29 – 39 years with a higher median age of 27years compared to 25 years in females which was found to be statistically significant (P-0.0001). Males were also found to have a statistically significant higher mean PCV level (41L/L) than females (37L/L) and more as family replacement donors (P-0.0001).

Regarding the distribution of donors' ABO blood types, blood group O was the highest 1,984 (74.3%) followed by A 495 (18.5%), B 185 (6.9%), and the least was AB blood type 8 (0.3%). Majority of the donors were Rhesus positive (86.2%) while Rhesus negative donors accounted for 13.8%. In this study, commercial donors form the bulk of the donor pool accounting for 69.35% of the donors. The rest were made up of 675 (25.3%) familial replacement, 134 (5.0%) volunteer donors and 11 (0.4%) autologous blood donors.

A total of 127 (Because a total number of 11[eleven] donors were exposed to more than one TTIs) donors were exposed to at least one agent making it a prevalence rate of 4.8% transfusion-transmissible infections. Among them, 32 (1.2%) tested positive for HIV, 39 (1.5%) each for HCV and HBsAg, while 28 (1.0%) for Syphilis. (Table 2). Among the commercial donors, there were a total of 93 instances of TTIs, including 29 (1.6%), 23 (1.2%), 20 (1.1%), and 21 (1.1%) cases of HBA total number of 11 donors were exposed to more than one TTIs.

Also, sAg, HCV, Syphilis, and HIV, respectively. The incidence of TTIs among the family replacement donors was 40 (6%), with 10 (1.5%), 12 (1.8%), 8 (1.2%) and 10 (1.5%) reactive instances of HBsAg, HCV, Syphilis, and HIV, respectively. Four of the volunteer donors had transfusion transmissible infections, with HCV and HIV reactive cases making up 3 (2.2%) and 1 (0.7%) respectively of those cases and only one case (9.1%) of HCV reactivity was recorded among autologous blood donors.

In terms of the prevalence of TTIs associated with blood types, the study recorded 105 (82.7%), 12 (9.4%), 9 (7.1%) and 1 (0.8%) among O, A, B and AB blood types respectively with Rhesus positivity accounting for 119 (93.7%) and Rhesus negative 8 (6.3%).

After adjusting for age, gender and PCV, O positive blood group emerged as the significant predictor of TTI among blood donors in our center.

Table 2: Prevalence of Transfusion Transmissible Infections

Total TTI	Frequency	Percentage (%)
Negative	2545	95.2
Positive	127(138)	4.8
HIV		
Negative	2640	98.8
Positive	32	1.2
HBsAg		
Negative	2633	98.5
Positive	39	1.5
HCV		
Negative	2633	98.5
Positive	39	1.5
VDRL		
Negative	2644	99.0
Positive	28	1.0

Table 3: Association between Gender and other variables

	Total (n=2672)	Male (n = 2280)	Female (n = 392)	p-value
Age	26.0 (23.0-34.0)	27.0 (24.0-35.0)	25.0 (21.0-30.0)	0.0001
Age Category				
18-28	1564 (58.5)	1284 (56.3)	280 (71.4)	
29-39	760 (28.4)	688 (30.2)	72 (18.4)	0.0001
40-50	299 (11.2)	264 (11.6)	35 (8.9)	
Above 50	49 (1.8)	44 (1.9)	5 (1.3)	
PCV	40.0 (38.0-42.0)	41.0 (39.0-43.0)	37.0 (36.0-39.0)	0.0001
Blood group				
A	495 (18.5)	423 (18.6)	72 (18.4)	
AB	8 (0.3)	5 (0.2)	3 (0.8)	0.25
B	185 (6.9)	162 (7.1)	23 (5.9)	
O	1984 (74.3)	1690 (74.1)	294 (75.0)	
Rhesus factor				
B Negative	370 (13.8)	326 (14.3)	44 (11.2)	
Positive	2302 (86.2)	1954 (85.7)	348 (88.8)	0.122
HIV				
Negative	2640 (98.8)	2251 (98.7)	389 (99.2)	
Positive	32 (1.2)	29 (1.3)	3 (0.8)	0.548
HBsAg				
Negative	2633 (98.5)	2247 (98.6)	386 (98.5)	
Positive	39 (1.5)	33 (1.4)	6 (1.5)	1
HCV				
Negative	2633 (98.5)	2246 (98.5)	387 (98.7)	
Positive	39 (1.5)	34 (1.5)	5 (1.3)	0.92
VDRL				
Negative	2644 (99.0)	2256 (98.9)	388 (99.0)	
Positive	28 (1.0)	24 (1.1)	4 (1.0)	1
Type of donor				
Autologous	11 (0.4)	9 (0.4)	2 (0.5)	
Family replacement	675 (25.3)	535 (23.5)	140 (35.7)	0.0001
Paid	1852 (69.3)	1634 (71.7)	218 (55.6)	
Voluntary	134 (5.0)	102 (4.5)	32 (8.2)	
Total TTI				
Negative	2545 (95.2)	2170 (95.2)	375 (95.7)	
Positive	127 (4.8)	110 (4.8)	17 (4.3)	0.771

Table 4: Association between Donor Type and other Variables

	Total	Autologous	Family replacement	Paid	Voluntary	p-value
N	2672 (100)	11 (0.4)	675 (25.3)	1852 (69.3)	134 (5.0)	-
Age	26.0 (23.0-34.0)	38.0 (30.0-43.0)	31.0 (25.0-39.0)	26.0 (23.0-31.0)	30.0 (25.0-38.75)	0.0001
Age Category						
18-28	1564 (58.5)	3 (27.3)	282 (41.8)	1221 (65.9)	58 (43.3)	
29-39	760 (28.4)	3 (27.3)	241 (35.7)	472 (25.5)	44 (32.8)	0.0001
40-50	299 (11.2)	5 (45.5)	126 (18.7)	143 (7.7)	25 (18.7)	
Above 50	49 (1.8)	0 (0.0)	26 (3.9)	16 (0.9)	7 (5.2)	
PCV	40.0 (38.0-42.0)	39.0 (37.0-42.0)	40.0 (38.0-42.0)	40.0 (38.0-42.0)	41.0 (39.0-45.0)	0.0001
Gender						
Female	392 (14.7)	2 (18.2)	140 (20.7)	218 (11.8)	32 (23.9)	
Male	2280 (85.3)	9 (81.8)	535 (79.3)	1634 (88.2)	102 (76.1)	0.0001
Blood group						
A	495 (18.5)	0 (0.0)	136 (20.1)	330 (17.8)	29 (21.6)	
AB	8 (0.3)	0 (0.0)	4 (0.6)	1 (0.1)	3 (2.2)	0.0001
B	185 (6.9)	1 (9.1)	53 (7.9)	117 (6.3)	14 (10.4)	
O	1984 (74.3)	10 (90.9)	482 (71.4)	1404 (75.8)	88 (65.7)	
Rhesus factor						
Negative	370 (13.8)	0 (0.0)	76 (11.3)	278 (15.0)	16 (11.9)	
Positive	2302 (86.2)	11 (100.0)	599 (88.7)	1574 (85.0)	118 (88.1)	0.045
HIV						
Negative	2640 (98.8)	11 (100.0)	665 (98.5)	1831 (98.9)	133 (99.3)	
Positive	32 (1.2)	0 (0.0)	10 (1.5)	21 (1.1)	1 (0.7)	0.829
HBsAg						
Negative	2633 (98.5)	11 (100.0)	665 (98.5)	1823 (98.4)	134 (100.0)	
Positive	39 (1.5)	0 (0.0)	10 (1.5)	29 (1.6)	0 (0.0)	0.513
HCV						
Negative	2633 (98.5)	10 (90.9)	663 (98.2)	1829 (98.8)	131 (97.8)	
Positive	39 (1.5)	1 (9.1)	12 (1.8)	23 (1.2)	3 (2.2)	0.107
VDRL						
Negative	2644 (99.0)	11 (100.0)	667 (98.8)	1832 (98.9)	134 (100.0)	
Positive	28 (1.0)	0 (0.0)	8 (1.2)	20 (1.1)	0 (0.0)	0.642
Total TTI						
Negative	2545 (95.2)	10 (90.9)	637 (94.4)	1768 (95.5)	130 (97.0)	
Positive	127 (4.8)	1 (9.1)	38 (5.6)	84 (4.5)	4 (3.0)	0.437

Table 5: Association between TTI status and other variables

	Total (n=2672)	Negative (n = 2545)	Positive (n = 127)	p-value
Age	29.16 ± 8.13	29.15 ± 8.15	29.38 ± 7.7	0.757
Age Category				
18-28	1564 (58.5)	1495 (58.7)	69 (54.3)	
29-39	760 (28.4)	715 (28.1)	45 (35.4)	0.278
40-50	299 (11.2)	287 (11.3)	12 (9.4)	
Above 50	49 (1.8)	48 (1.9)	1 (0.8)	
PCV	40.49 ± 2.96	40.48 ± 2.95	40.72 ± 3.11	0.361
Gender				
Female	392 (14.7)	375 (14.7)	17 (13.4)	
Male	2280 (85.3)	2170 (85.3)	110 (86.6)	0.771
Blood group				
A	495 (18.5)	483 (19.0)	12 (9.4)	
AB	8 (0.3)	7 (0.3)	1 (0.8)	0.041
B	185 (6.9)	176 (6.9)	9 (7.1)	
O	1984 (74.3)	1879 (73.8)	105 (82.7)	
Rhesus factor				
Negative	370 (13.8)	362 (14.2)	8 (6.3)	
Positive	2302 (86.2)	2183 (85.8)	119 (93.7)	0.017
Type of donor				
Autologous	11 (0.4)	10 (0.4)	1 (0.8)	
Family replacement	675 (25.3)	637 (25.0)	38 (29.9)	0.437
Paid	1852 (69.3)	1768 (69.5)	84 (66.1)	
Voluntary	134 (5.0)	130 (5.1)	4 (3.1)	

Table 6: Univariate Logistic Regression of Predictors associated with Transfusion Transmissible Infections

Predictors	OR	p-value	95th CI
Age	1.003	0.7566	0.982 - 1.025
Age Category			
18-28 (ref)	-	-	-
29-39	1.364	0.1153	0.927 - 2.006
40-50	0.906	0.757	0.484 - 1.694
Above 50	0.451	0.4345	0.061 - 3.318
PCV	1.028	0.3613	0.969 - 1.09
Gender			
Female (ref)	-	-	-
Male	1.118	0.6751	0.663 - 1.885
Blood Group			
A (ref)	-	-	-
AB	5.75	0.1145	0.655 - 50.469
B	2.058	0.1084	0.853 - 4.969
O	2.249	0.0087	1.228 - 4.121
Rhesus Factor			
Negative (ref)	-	-	-
Positive	2.467	0.0146	1.195 - 5.09
Type of Donor			
Voluntary (ref)	-	-	-
Family Replacement	1.939	0.2154	0.68 - 5.526
Paid	1.544	0.4032	0.558 - 4.277
Autologous	3.25	0.3118	0.331 - 31.894

Table 7: Multiple Logistic Regression of Predictors associated with TTI

Index	OR	p-value	95th CI
Age Category			
18-28 (ref)	-	-	-
29-39	1.269	0.2331	0.858 - 1.878
40-50	0.833	0.5696	0.444 - 1.564
Above 50	0.420	0.3947	0.057 - 3.098
PCV	1.022	0.5007	0.959 - 1.089
Gender			
Female (ref)	-	-	-
Male	1.059	0.8426	0.602 - 1.861
Blood group			
A (ref)	-	-	-
O	2.203	0.0108*	1.2 - 4.044
B	2.079	0.1046	0.859 - 5.031
AB	6.275	0.1008	0.7 - 56.278
Rhesus Factor			
Negative (ref)	-	-	-
Positive	2.469	0.0148*	1.194 - 5.106

Discussion

Transfusion transmissible infections remain a major concern in blood transfusion practice, patient management, hence deserves all attention and effort to improve the practice. This study is a way of further strengthening the knowledge base in the field of medicine. The WHO advocates for stringent donor screening to ensure blood safety and adopted by national blood transfusion services, hospitals and blood bank centers.[2,4,18] The potential donors are usually apparently healthy and unaware that they are carriers of the infective agents which can be detected for the first time during screening for blood donation hence, they pose a risk of transmitting the virus to the recipient if not properly screened. In this study, those recruited into the TTI screening were those who met the requirements for age, weight, haematocrit/packed cell volume as well as absence of chronic disease condition.[22] Seropositivity to any of the TTIs may be the only exclusion criteria in the potential donor.

Similar studies have been conducted around the globe and there were similarities and differences found with this present study. In this study, the majority of the donors, 2280 (85.3%) were found to be males and young adults, 1564 (58.5%) between the ages of 18 years and 28 years which is similar to other local studies as well in other parts of the world.[8,15,19,22,23] This is understandable as this age group is the most active and likely healthy group, willing to donate blood, either induced or voluntarily and that may not be burdened by co-morbidities. However, they are more likely be infected by the TTIs as seen in this study because they are more likely to engage in risky sexual behavior as almost all the TTIs are known to be sexually transmitted.

This study revealed a higher prevalence of commercial (paid) donors 1,852 (69.3%) and low voluntary donors 134 (5.0%) with no significant differences when compared to the previous study by Okocha et al [19] in the same study site despite the efforts put in the place to increase awareness, donor drive and recruitment. This may be attributable to the deep rooted beliefs, myth, cultural perception and practices of the locales.[7,24]

These same factors also mitigate against voluntary blood donations in addition to misconceptions of ill-health and death following blood donation, lack of awareness, understanding and prevalent nutritional anaemia in low and middle-income countries. [7,25]

In some other studies done previously in other parts of Nigeria, similar high prevalence of commercial donors was observed.[8,26] however, commercial donors are non-existence or very few in some countries, especially high income countries that have attained WHO mandate of 100% voluntary blood donation.[15,27]

The overall prevalence of TTI in this study was found to be 4.8% which is low when compared to studies done in Calabar, South-South Nigeria with 14.96%[26] and some African countries like Ghana which recorded a prevalence of 18.3% in their study,[28] but higher in study done in Serbia (0.38%),[27] and Bangladesh (1.2%).[29] This can be attributed to the high number of paid donors when compared to the studies that have predominant voluntary and family replacement donors. HIV positivity of 1.2% was found to be lower than national prevalence of 1.36%.[30] The prevalence of Hepatitis C and B viral reactivity of 1.5% each was recorded in this study which was slightly lower than 2.0% recorded in the previous study by Okocha et al [19] while Syphilis contributed 1.0% as against 0.0% in the previous study.

These slight changes may be due to improved screening method employed. Rapid tests were used in the previous study while chemiluminescent immunoassay which has better sensitivity and specificity was used in the present study.

In terms of donor type, TTI was found to be higher in commercial or paid donors than in voluntary donors though not statistically significant and is similar to some other studies done in Nigeria. [8, 26] This finding supports the evidence that voluntary donors are safer to donate blood than paid donors as they have better health seeking behavior.[31]

In this study, the only significant predictive factor associated with TTI is blood group O positive and similar to findings in study done in Telangana, India.[22] Age, sex, donor type nor haematocrit level had no influence on predicting presence of TTI.

Limitation

Nucleic Acid Amplification Technology (NAAT) which is more sensitive for detecting window periods in HIV infection was not used in donor screening due to non-availability and this could have affected the prevalence of HIV. The prevalence rate found in female donors cannot be extrapolated to the general population because of the few number of female donors encountered in this study

Conclusion

The study demonstrated a continued heavy reliance on paid donors and family replacement with male predominance in our center. This clearly demonstrates significant risk exposure to the patient with adverse consequences. A lot of efforts is still needed in Nigeria at national, state and local government level to change the narrative of blood transfusion practice in the country. The National Blood Transfusion Commission should be adequately funded and supported by government in their efforts to bringing about positive change in blood transfusion practice in Nigeria.

Potential donors who pose a high risk of infection should be identified and disqualified from the blood donation process by employing self-exclusion form and review of their medical histories as well as stringent testing protocol.

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SONOGRAPHIC ASSESSMENT OF GALLBLADDER SIZE AND MOTILITY AMONG APPARENTLY NORMAL PREGNANT WOMEN IN ANAMBRA STATE, NIGERIA

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ABSTRACT

Background: Pregnancy had been associated with a number of physiologic changes which affect many organs and systems, for example, the gastrointestinal system. Gallbladder, an accessory organ of digestion could be predisposed to disorders in pregnancy but he nature and to which extent it could be affected remained unclear.

Aim: This study aimed to investigate the gallbladder changes that could occur in pregnancy.

Materials and methods: A prospective cross-sectional survey design was used to sonographically study 201 pregnant and 27 non-pregnant women who met the inclusion criteria, both in the fasting and post prandial states. Both descriptive and inferential statistics were used to analyze data.

Results: Means of age, BMI, fasting gallbadder volume (FGbV), post prandial gallbladder volume (PGbV), ejection fraction (EjF) were respectively, 29.12 ± 7.52 years, 26.00 ± 4.23 kg/cm^2, 26.10 ± 13.32 cm^3, 13.36 ± 8.59 cm^3 and 47.38 ± 17.58%. The means FGbV in pregnant women was 26.12 ± 13.35 cm^3, EjF was 47.41 ± 17.61%. The mean FGbV and EjF in the non– pregnant women was 74.15 ± 28.91 cm^3 and 77.58 ± 9.74% respectively. Age showed no statistically significant difference with FGbV and EjF. Statistically significant difference existed between BMI and FGbV but not with EjF. No statistically significant difference existed between FGbV and PGbV. The mean fetal gestational age was 25.81 ± 8.41 weeks, and showed no statistically significant relationship with FGbV or EjF.

Conclusion: Fasting gallbladder volume and gallbladder motility among pregnant women in Anambra state were both reduced.

Keywords: *Gallbladder, Pregnancy, Sonography, Fasting gallbladder volume, Ejection fraction*

Introduction

The gallbladder is a hollow elastic organ with an average volume of 30-50 ml in adults that functions as the body's bile storage tank. It serves as the repository for bile produced in the liver[1] Some of the bile components are synthesized by the liver cells (hepatocytes) while the rest are extracted from the blood by the liver[2] Bile is a thick alkaline fluid secreted by the liver and stored temporarily in the gallbladder. It consists of water, electrolytes, bile acids, cholesterol, phospholipids and conjugated bilirubin[2]. Between meals, secreted bile is stored in the gallbladder where 80-90% of the water and electrolytes can be absorbed, leaving the bile acids and cholesterol[3]. During a meal, the smooth muscles in the gallbladder wall contract, leading to the bile being secreted into the duodenum to rid the body of waste stored in the bile. The bile salts also help to emulsify fats in the duodenum, so that they can be more easily digested by pancreatic lipase into fatty acids and glycerol[3].

The gallbladder is roughly pear-shaped and its size and shape varies among individuals, with the volume of bile it contains at any point in time. It is a gastrointestinal organ located within the right hypochondriac region of the abdomen[4] It is intraperitoneal and lies within a fossa formed between the inferior aspects of the right and quadrate hepatic lobes. In adults, the gallbladder measures approximately 7- 10 cm in length and 4 cm in diameter when fully distended[5] During embryological development, the gallbladder and biliary tree develop from outpouchings of the duodenum at the end of the 4th week of gestation[6]. The gallbladder is divided into three sections: the fundus, body and neck. The fundus is the rounded base, angled so that it faces the abdominal wall. The body lies in a depression on the surface of the lower right lobe of the liver. The neck tapers and is continuous with the cystic duct, part of the biliary tree[5]. The cystic duct unites with the common hepatic duct to become the common bile duct. The biliary tract refers to the liver, gallbladder and bile ducts and how they work together to make, store and secrete bile[2].

The gallbladder has tone reflecting inherent compliance of smooth muscle and fibroelastic tissues within its walls. Smooth muscle tone is continually influenced by neural and humoral factors. It also contains neural tissues connecting it to the enteric nervous system. These all contribute in making the gallbladder perform its function[6]. The motility and emptying of the gallbladder are stimulated by food.

Three common types of gallbladder disorders are cholelithiasis (characterized by the formation of gallstones and/or the accumulation of biliary sludge in the gallbladder or cystic duct), cholecystitis (characterized by chronic or acute infection and inflammation of the gallbladder) and functional gallbladder disorder (characterized by an inability of the gallbladder to contract or to release bile)[8] The gallbladder though not a major organ of digestion, can experience changes in functional status during pregnancy which poses great risk for the pregnant woman. In as much as not every woman in cyesis is at risk; body changes associated with pregnancy can have serious impact on the gallbladder, presenting complications that could affect the overall health of the baby and even the pregnant woman[9].

It is a known fact that women are at higher risk of presenting with cholelithiasis than men. Pregnancy is associated with greater risk because in this state, more oestrogen is produced by the body. Estrogen increases biliary cholesterol secretion, causing cholesterol supersaturation of bile resulting in decreased gallbladder contractions[9]. This condition is known as cholestasis of pregnancy and slows the emptying of bile into the duodenum. Besides, the gallbladder varies in size, shape and position between different people[7]. It also varies in shape and size between the fasting and post prandial states[10]. Bile is a yellowish liquid made by the liver. It helps the body break down fat and get rid of waste[8]. If bile is not needed for digestive purposes, it is stored for future use in the gallbladder[11]. Under normal conditions, eating is the main stimulus to gallbladder emptying.

Meals containing fat, especially polyunsaturated fat, are the most powerful stimuli but protein and carbohydrate meals also result in some emptying[12-14]. The gallbladder normally contracts when foods such as fats or fatty acids are in the duodenum. These foods stimulate the duodenal mucosa to secrete the hormone cholecystokinin (CCK). Cholecystokinin is a peptide hormone synthesized by the small intestine. It is secreted when fatty food enters the digestive tract. Gallbladder motility is controlled by a complex interplay of hormonal and neural factors. It is being recognized increasingly that the key mediators of gallbladder motility – the gastrointestinal peptides – act through both neural and hormonal pathways to influence gallbladder motility[15]. When triggered by the appropriate hormonal responses, the gallbladder goes ahead to release bile into the duodenum for the digestion of fatty foods. The gallbladder can store up to a volume of 50 ml of bile under normal conditions. Being a distensible sac, it can store more quantity when the cystic duct is obstructed.

During the fasting period the gallbladder maintains a moderate tonic contraction that is superimposed with nonpropulsive and propulsive contractions[16]. The non-propulsive contractions are probably to ensure the insoluble bile contents are kept in solution, to avoid precipitation of contents like cholesterol, avoiding the development of gallstones. The propulsive contractions result in small fractions of bile being emptied into the duodenum during the interdigestive period[17]. In the digestive period strong gallbladder contractions and sphincter of Oddi relaxation lead to the high rates of bile discharge flowing into the common bile duct and duodenum[17]. During this period, the gallbladder motor activity like the rest of the gastrointestinal tract is influenced by the three phases of digestive process: cephalic, antral, and duodenal[18]. The cephalic phase is initiated by stimuli that activate the central nervous system, as individuals are exposed to olfactory, visual and the taste of food.

This phase is mediated by preganglionic vagal fibres that synapse with postganglionic cholinergic neurons[18]. It is estimated that as much as 30-40 % of the gallbladder bile may be emptied during this phase[18] Once food reaches the stomach it triggers an antral- gallbladder reflex also mediated by vagal fibers. The gallbladder empties most of its remaining contents during the intestinal phase induced by the release of CCK from the duodenum and proximal jejunum[19]. Duodenal CCK contracts the gallbladder mostly by acting directly on cholinergic neurons and like with the pancreas, and it may also activate long reflexes through the vagus nerve[17].

Imaging modalities employed in evaluating diseases of the gallbladder include ultrasonography, oral cholescystography, endoscopic retrograde cholangiopancreatography (ERCP), computed tomography (CT), magnetic resonance imaging (MRI) and cholescintigraphy (nuclear medicine HIDA scan)[20]. Ultrasonography is the modality of choice in examining the gallbladder of pregnant women because it is cheap, non-invasive, safe and repeatable without known adverse effects on the pregnant women or the foetus[21]. Furthermore, ultrasonography is usually readily available and does not utilize ionizing radiation. This presents it as a safe imaging examination in pregnancy.

As real-time ultrasonography is a cheap, noninvasive, relatively easy, validated and reproducible technique, it can be repeated over time to document time-related changes of gallbladder motor function. Ultimately, functional ultrasonography estimates gallbladder shape and volume in the fasting state and in response to a test meal (liquid or mixed solid-liquid, provided there is sufficient fat content) or exogenous stimulus (e.g., i.v. cholecystokinin)[17]. Patients are scanned in the supine, right anterior oblique position. Longitudinal and axial cross-sectional images of the gallbladder in its largest dimensions are obtained in triplicate. Average measurements are used for calculation of the gallbladder volume. The volume of the gallbladder (V) is subsequently calculated using the ellipsoid method described as: $V = 0.52 \times L \times W \times H$, where L is the length, W is the width, and H is the height or depth of the gallbladder[22].

All subjects are studied in the morning after an overnight fast. Fasting volume of the gallbladder (ml) represents the mean of three volume measurements taken 5 min apart.

After taking the fasting volume, gallbladder contraction is stimulated by a fatty meal. Gallbladder contraction and refilling are monitored with ultrasonography and images are taken over time to document time related changes of gallbladder volume. The difference between the basal volume and the corresponding residual Volume represents the gallbladder ejected volume (ml). The gallbladder ejection fraction (GBEF) (%) is calculated according to the formula[23]: $GBEF(\%) = 1 - (\text{residual volume}/\text{fasting volume}) \times 100$.

Although functional ultrasonography of the gallbladder has been mainly used for research purposes in specific referral centers, its simplicity makes such a technique appealing in the clinical setting to assess gallbladder motor function both in healthy and diseased subjects[24]. Indications include the study of healthy subjects and patients during pathophysiologically relevant conditions; in particular when subjects are at risk for gallbladder stasis and gallstone disease or during gallstone disease when a decision concerning medical dissolution therapy is required[25]. A decreased emptying rate of the gallbladder has been demonstrated in patients with gallstones, dyspepsia, diabetes mellitus, obesity[25, 26-28], and in patients operated on with Billroth type II for duodenal ulcer[29]. Any of these conditions during pregnancy is most likely to present a greater problem. Pregnancy is a time when the gallbladder is vulnerable to various conditions[29].

Studies have shown that women are more likely than men to develop gallstones[30] and pregnant women are more at risk because their bodies are secreting more estrogen which can lead to an increased amount of cholesterol in the bile, while also reducing gallbladder contractions[31]. This presents a condition known as cholestasis of pregnancy. In this condition, bile does not empty from the gallbladder easily. Complications that could arise from this include premature birth and still birth[31].

There is paucity of data on gallbladder changes during pregnancy in this locality and so this study is focused on exposing the potential for the gallbladder to malfunction during pregnancy. This will make pregnant women watch out for tell-tale signs of such disorders and report to their physicians on time. In addition, it will buttress the need for obstetricians to make sonographic examination of the gallbladder, a routine in caring for pregnant women.

Materials and methods

A prospective cross-sectional study design was adopted to study the relative gallbladder size and motility among apparently healthy pregnant women in Anambra State, Nigeria. The study was carried out at two radiodiagnostic centres: one at Onitsha and one at Awka, both in Anambra State Nigeria. Power analysis software, G* Power 3.0.10 (University of Dusseldorf, Germany) was used to obtain the studied sample of 201 pregnant women of between 19years and 46years. The age matched control group comprised 27 apparently healthy non-pregnant women volunteers.

For the experimental group, inclusion criteria includes being above 18 years, having clinical evidence of pregnancy, having functioning gallbladder and having no evidence of gastrointestinal and/ hepatobiliary diseases, no history of cardiovascular or cerebrovascular disease and consenting to participate in the study. The same inclusion criteria apply to the control group except that there should be no clinical evidence of pregnancy.

A convenience sampling method was used in selecting the desired sample for the study.

Before commencement of the study institutional ethical approval: ERC/FHST/NAU/2018/048 was obtained. Informed consent was also obtained from each participant. Approval was also obtained from the management of the study centres.

Data collection

Data for this study was collected using DC-N3 Mindray ultrasound Scanner with a 3.5MHz convex transducer at each of the centres. For anthropometric measurements, a balanced beam scale was used for measurement of weight while a flexible but non-stretchable insertion tape was used for height measurement.

For anthropometric measurements of body weight and height, subjects were asked to remove their heavy outer garments (jacket, coat, trousers, skirts and hair ornaments) and shoes. In measuring the body weight, a balanced beam scale was placed on a hard- floor surface. The scale was balanced with both sliding weights at zero and the balance bar aligned. The subject was asked to stand on the centre of the beam balance platform, weight evenly distributed on both feet. The weight was moved until the beam balanced.

The body weight (in kg) was read and recorded. For the height measurement, a flexible but non-stretchable insertion tape was attached to the erect wall, close to a horizontal hard-floor surface, with the base of the tape at the floor level. The subject with bare feet, stood next to the wall with her back to the measurement tape inserted to the wall. The subject placed her feet together and the back of the head, back, buttocks, calves of the leg and the heels were touching the wall. The subject was then asked to look straight ahead. The researcher gently grasping the back of the subject's head placed the subject's head into the Frankfort Plane. The Frankfort plane (an imaginary line running from the bottom of the subject's eye orbit to the subject's ear hole) was positioned horizontal - parallel with the floor according to Songra et al[32]. The subject was then asked to maintain the position. The head piece was placed firmly on top of the subject's head, with sufficient pressure to compress the hair and make contact with the skull. Whilst the subject breathed out, a linear height measurement was made from the floor to the top of the subject's head. The height measurement was recorded in centimeters, to the nearest millimeters and later converted to meters. Body mass index (BMI) was calculated by dividing the subject's body weight (in kg) by the square of the subject's height (in metre).

For the measurement of the gallbladder dimensions, the subjects, certified normal by their referral clinicians were provided with adequate information about all the research involves (including the overnight fasting requirement and scanning procedures. The overnight fasting was to ensure maximum distension of the gallbladder making it possible for reliable and reproducible measurements to be obtained.

The subject on coming into the scan room was made to lie supine on the examination couch. The subject bared her abdomen and placed her hands under her head to widen the intercostal spaces. A clear, warm coupling gel was applied over the right upper quadrant of the abdomen, in order to ensure good ultrasound wave coupling and transmission through the abdomen.

The stomach was first scanned to confirm compliance, to the nil per oral instruction. The gallbladder was then scanned both longitudinally and transversely. The neck, fundus and body of the gallbladder were assessed. The cystic duct also, was assessed for stones. Measurements (in cm) of the maximum longitudinal and transverse axes of the gallbladder were taken thrice on a frozen gallbladder image on the oscilloscope screen and the average value for each of the set of measurements was recorded according to Adeyekun et a[33].

The obliquity of the transducer was varied while obtaining the longitudinal view, until the maximum length of the gallbladder was seen. An additional view of the gallbladder was obtained with the subject in the left lateral decubitus position. In this position, the liver was used as an acoustic window for proper visualization of the gallbladder. Measurements of the gallbladder length, width and antero-posterior diameter (height) measurements were obtained on a frozen gallbladder image on the oscilloscope screen (fig.1).

Dimensional measurements of the gallbladder were recorded. Similar scanning procedure and measurement of gallbladder dimensions were repeated after administering fatty meal (liquid tinned milk and boiled egg). Gallbladder motility was determined by assessing the gallbladder ejection fraction after the subject ingested a fatty meal.

The scans were performed by the researcher under the guidance of certified Sonographers (of over 15years of experience). Intra-observer and Inter-observer variability were tested for, before commencement of data collection. Each set of dimensions obtained by the researcher were confirmed by the sonographers and measurements were obtained thrice and the average of each set of measurements were recorded.

Data Analysis
Statistical analysis of the data obtained, was done using the MedCalc Statistical Software for Biomedical Research, version 18.5 (MedCalc Software, Acacialaan 22, b-8400 Ostend, Belgium). The volume of the gallbladder was calculated using the prolate ellipsoid formula[22] given thus: length× height ×width ×0.523. The ejection fraction, which is equivalent to the percentage of gallbladder contraction, was calculated using the formula[34]:

EF = Fasting gallbladder volume – Postprandal gallbladder volume / Fasting gallbladder volume x 100%

The effect of age, BMI and GA on gallbladder size and ejection fraction was assessed using the Analysis of Variance (ANOVA) test. Quantitative variables were assessed using mean values ± standard deviation. Statistical significance was tested for, using the Students *t*-test, with the level of significance (p- value) set at $p \leq 0.05$. Measurement data obtained was presented in tables using descriptive statistics of mean and standard deviation. Test of normality of the data distribution was done using D'Agostino-Pearson test.(table 1). The result revealed that none of the parameters was normally distributed. The age, BMI, parity, fasting gallbladder volume, post-prandial gallbladder volume and ejection fraction of the pregnant subjects were skewed to the right, as opposed to the gestational age which was skewed to the left.

Fig. 1: Measurement axes of the gallbladder (A) sagittal and (B) transverse

Table 1: D'Agostino-Pearson test for normality

Parameters	Skewness	Kurtosis	Standard error of the mean	p-value	Remarks
Age(years)	0.31	- 0.91	0.53	< 0.0001	Non-normal
BMI(kg/m^2)	1.26	2.87	0.29	< 0.0001	Non-normal
GA(weeks)	- 0.38	- 0.45	0.59	0.0232	Non-normal
Parity	0.77	0.48	0.11	0.0001	Non-normal
FGbV(cm^3)	1.67	6.00	0.93	< 0.0001	Non-normal
PGbV(cm^3)	2.96	15.75	0.60	< 0.0001	Non-normal
EjF(%)	0.13	- 0.78	1.24	0.0009	Non-normal

Key: BMI = Body mass index; GA= Gestational age; FGbV = Fasting gallbladder volume;

PGbV = Postprandal gallbladder volume; EjF = Ejection fraction.

Results

As shown in table 1, the mean age was 29.12± 7.52 years, mean BMI was 25.99± 4.23 kg/m^2. mean GA and Parity were 25.81± 8.46 weeks and 2.74 ± 1.69 respectively. The mean Fasting Gallbladder Volume, Post-prandial gallbladder Volume and Ejection Fraction were 26.10 ± 13.32 cm^3, 13.36 ± 8.59 cm^3 and 47.41 ± 17.61% respectively. The test revealed the data as an unsymmetrical distribution. bese and further analyzed(table 3b)..

The ages, BMI, parity, Fasting Gallbladder Volume, Post-prandial gallbladder Volume and Ejection Fraction of the participants were positively skewed to the right as opposed to the gestational age which was skewed negatively to the left (table 1) As a result, the data was divided into four (4) Age groups; A,B,C and D and three (3) BMI groups of Normal weight, Overweight and O

Table 3a: D'Agostino-Pearson test for effect of maternal age on Gallbladder motility

Fasting gallbladder volume(cm^3)	Group A (Ages 19-25 years)	Group B (Ages 26-32 years)	Group C (Ages 33-39 years)	Group D (Ages 40-46 years)
No of subjects	72	63	43	23
Lowest value	8.15	4.41	8.03	9.17
Highest value	106.83	65.40	56.43	54.86
Mean± S.D	24.13±14.25	26.81±12.47	28.46±12.36	25.92±14.27
Median	20.22	26.54	27.19	22.55
p-value	**($p<0.0001$)reject normality**	**($p=0.0224$)reject normality**	**($p=0.1685$)accept normality**	**($p=0.1596$)accept normality**
Ejection Fraction (%)				
No of subjects	72	63	43	23
Lowest value	11.53	17.17	14.78	13.45
Highest value	84.63	86.37	84.49	76.59
Mean± S.D	48.68±18.41	48.66±17.16	44.91±15.91	44.40±19.31
Median	50.48	48.07	40.53	41.72
p-value	**($p=0.0760$)accept normality**	**($p=0.3205$)accept normality**		**($p=0.1582$)accept normality**

The data was divided into four (4) age groups namely- group A (ages 19-25), group B (ages 26-32), group C (ages 33-39) and group D (ages 40-46). Further analysis revealed a mean Fasting gallbladder volume of 24.13 ± 14.25 cm^3, 26.81 ± 12.47 cm^3, 28.46 ± 12.36 cm^3 and 25.92 ± 14.27 cm^3 for Age group A, B, C and D respectively. Their Ejection Fraction also presented a mean value of $48.68 \pm 18.41\%$, $48.66 \pm 17.16\%$, $44.91 \pm 15.91\%$ and $44.40 \pm 19.31\%$ for age group A, B, C and D respectively. D'Agostino-Pearson test for normal distribution presented the Fasting gallbladder volume of Age groups A and B as not normal while it presented the Fasting gallbladder volume of groups C and D and the Ejection fraction of the four (4) groups as a normal distribution as seen in table 3a.

Table 3b: D'Agostino-Pearson test for effect of Body-mass Index on gallbladder motility

Fasting Gallbladder Volume(cm^3/ml)	Normal weight	Overweight	Obese
Sample size	87	87	27
Lowest value	4.41	7.49	9.17
Highest value	58.19	106.83	53.64
Mean± S.D	25.19±11.46	27.55±15.66	24.75±10.39
Median	23.17	23.91	23.21
p-value	**(p=0.0157)reject normality**	**(p<0.0001)reject normality**	**(p=0.0319)reject normality**
Ejection Fraction (%)	51.06±1739%,	45.27±17.90%	42.61±15.66%

Table 4: ANOVA test between Age, BMI, GA and Fasting Gallbladder Volume

ANOVA between Age and Fasting Gallbladder Volume	Sum of squares	DF	Mean Square
Between groups (influence factor)	6552.5638	28	234.0201
Within groups (other fluctuations)	28945.2363	172	168.2863
Total	35497.8001	200	
F-ratio			1.391
Significance level			P=0.105
ANOVA between BMI and Fasting Gallbladder Volume			
Between groups (influence factor)	32364.2481	171	189.2646
Within groups (other fluctuations)	3133.5520	29	108.0535
Total	35497.8001	200	
F-ratio			1.752
Significance level			P=0.038
ANOVA between GA and Fasting Gallbladder Volume			
Between groups (influence factor)	7343.0034	33	222.5153
Within groups (other fluctuations)	28154.7967	167	168.5916
Total	35497.8001	200	
F-ratio			1.320
Significance level			P=0.132

Given that Ejection Fraction is a measure of gallbladder motility, variation between the Ejection Fraction and the independent factors of Age, Body Mass Index (BMI) and Gestational Age (GA) was analyzed to ascertain if the factors had

any effect on gallbladder motility. The analysis revealed a no statistically significant relationship between FGbV/EjF and maternal age (p = 0.595), FGbV/EjF and BMI (p = 0.489), and FGbV/EjF and foetal GA (p = 0.600)(table 5).

Table 5 comparison among Age, BMI, GA and Ejection Fraction using the One-way Analysis of Variance (ANOVA)ANOVA between Age and Ejection FractionSum of squaresDFMean Square

Between groups (influence factor) 8003.2090 28285.8289 Within groups (other fluctuations) 53832.8966172312.9820 Total61836.1056200

F-ratio 0.913

Significance level P=0.595

ANOVA between BMI and Ejection Fraction

Table 5 comparison among Age, BMI, GA and Ejection Fraction using the One-way Analysis of Variance (ANOVA)ANOVA between Age and Ejection FractionSum of squaresDFMean Square

Between groups (influence factor) 8003.2090 28285.8289 Within groups

(other fluctuations) 53832.89661723 12.9820Total61836.1056200

F-ratio

0.913Significance level P=0.595

ANOVA between BMI and Ejection Fraction

Between groups (influence factor)53075. 3414171310. 821Within groups

(other fluctuations) 8760.764229302. 0953 Total 61836.1056200 F-ratio 1.027

Significance level P=0.489

ANOVA between GA and Ejection Fraction

Between groups (influence factor) 9496.2294 33287.7645Within groups (other fluctuations) 52339.8763167313.4124Total61836.1056200

F-ratio

0.918Significance level P=0.600

ANOVA between Age and Ejection Fraction	Sum of squares	DF	Mean Square
Between groups (influence factor)	8003.2090	28	285.8289
Within groups (other fluctuations)	53832.8966	172	312.9820
Total	61836.1056	200	
F-ratio			0.913
Significance level			P=0.595
ANOVA between BMI and Ejection Fraction			
Between groups (influence factor)	53075.3414	171	310.3821
Within groups (other fluctuations)	8760.7642	29	302.0953
Total	61836.1056	200	
F-ratio			1.027
Significance level			P=0.489
ANOVA between GA and Ejection Fraction			
Between groups (influence factor)	9496.2294	33	287.7645
Within groups (other fluctuations)	52339.8763	167	313.4124
Total	61836.1056	200	
F-ratio			0.918
Significance level			P=0.600

Independent sample t- test showed no statistically significant difference between the pregnant and non-pregnant subjects in terms of the mean age, mean BMI, mean FGbV, mean PGbV, and mean EjF(table 6).

Table 6: Sample t-test for difference in the measured variables between the subject groups

Subject groups	Parameters	Mean ± SD	Calculate t-values
Pregnant (n= 200)	FGbV (cm^3)	26.12 ± 13.35	-0.127
Non-pregnant (n=27)		74.15 ± 28.91	
Pregnant (n= 200)	PGbV (cm^3)	13.35 ± 8.61	
Non-pregnant (n=27)		15.17 ± 7.13	-0.009
Pregnant (n= 200)	EjF (%)	47.41 ± 17.61	
Non-pregnant (n=27)		77.58 ± 9.74	-0.104
Pregnant (n= 200)	Age (years)	29.17 ± 7.62	
Non-pregnant (n=27)		30.51 ± 7.25	-0.007
Pregnant (n= 200)		25.75 ± 4.47	
Non-pregnant (n=27)	BMI(kg/m^2)	24.50 ± 4.93	0.012

Key: FGbV= Fasting Gallbladder volume; PGbV = Postprandial gallbladder volume;

EjF = Ejection fraction. BMI = Body mass index.

Discussion

A total of 201 pregnant subjects and 27 non-pregnant subjects were studied. The age ranged from 19-46years with a mean of 29.17 ± 7.62years. The BMI ranged from $18.21 – 45.97$kg/m^2 with a mean of 25.99 ± 4.23kg/m^2 . The mean fasting gallbladder volume in pregnant women was 26.12 ± 13.35cm^3 , mean postprandial gallbladder volume, 13.35 ± 8.61cm^3 and the mean ejection fraction was 47.41 ± 17.61cm3. No statistically significant difference existed in the fasting gallbladder volume, the postprandial gallbladder volume and the ejection fraction between the pregnant subjects and the non-pregnant control group.

Fasting gallbladder volume was used as a measure of gallbladder size in this study. Our study showed average fasting gallbladder volume (FGbV) of 26.12cm^3 in the pregnant subjects. This is similar to the results obtained independently by[30, 35-36]. However, contrary to the higher value of FGbV in the non-pregnant subjects than the pregnant group in our result, the result obtained by each of the authors was higher in the pregnant group than the non-pregnant group. This may be due to some physiological processes or even due to differences among individuals[7]. Other possible cause of the observed lower FGbV in the pregnant group in our study could be non-proper observation of the fasting period especially as pregnant women often feel hungry and might not withstand the temptation of taking small quantities of food before coming for the scan. Statistically, the difference in FGbV between the two groups was non-significant (t = -0.127).

In our study, both the postprandal gallbladder volume (PGbV) and the ejection fraction/motility (EjF) were higher in the non-pregnant(control group) than in the pregnant group. These findings agree with findings by Kapicioglu et al[36]. The lower EjF in the pregnant subjects could be due to secretion of estrogen during pregnancy. The estrogen reduces the contractility and predisposes to bile stasis and cholecystitis[9] and gallbladder stone formation and the condition can cause complications of pregnancy such as premature birth or stillbirth[31].

Our study also revealed that maternal age and BMI affects gallbladder contractility/ejection fraction. The FGbV and the EjF were higher in the younger age group. The higher EjF in the younger pregnant subjects may be due high contractility due to lower estrogen secretion in the age group in accordance with the report by Panagiotopoulou et al[37] which said that estrogen secretion during pregnancy is lowest in young people. The implication is that the younger pregnant women have lower probability of having bile stasis and the pregnancy complications with it. The gallbladder motility/EjF from our result decreases with increase in BMI. This agrees with the findings by researchers[38-39] . The implication is that obese pregnant women have greater probability of pregnancy complications related to gallbladder diseases.

Conclusion

A total of 201 pregnant subjects and 27 non-pregnant subjects were studied. The age ranged from 19-46years with a mean of 29.17 ± 7.62years. The BMI ranged from $18.21 – 45.97$kg/m^2 with a mean of 25.99 ± 4.23kg/m^2 . The mean fasting gallbladder volume in pregnant women was 26.12 ± 13.35cm^3 , mean postprandial gallbladder volume, 13.35 ± 8.61cm^3 and the mean ejection fraction was 47.41 ± 17.61cm3. No statistically significant difference existed in the fasting gallbladder volume, the postprandial gallbladder volume and the ejection fraction between the pregnant subjects and the non-pregnant control group. The age and BMI affected the fasting gallbladder volume and the ejection fraction. Both the FGbV and EjF decreased as both the age and BMI decreased. Foetal gestational age (GA) did not significantly affect any of the parameters apart from BMI.

Limitations of the study

A major limitation of this study is the likelihood that some of the pregnant subjects did not properly observe the fasting requirements. Hence the group had lower FGbV compared to the non-pregnant control group.

Conflict of interest

Authors declare no conflict of interest.

157

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CEFTRIAXONE RESISTANCE IN TERTIARY HOSPITAL SOUTH EASTERN NIGERIA: A RETROSPECTIVE STUDY

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Abstract

Background: Amid the global crisis of antibiotic resistance, including ceftriaxone resistance, physicians continue to prescribe ceftriaxone as an empiric first line treatment for both community acquired and hospital acquired infections. The study aimed at detecting the rate of ceftriaxone resistance to isolated bacteria in Nnamdi Azikiwe University Teaching Hospital, Nnewi.

Methods: A check list was used to extract information from the Antimicrobial Susceptibility testing records in the Medical Microbiology and Parasitology Laboratory of the hospital, over a period of one year. Information including patient's sex, ward, specimen type, bacteria isolated, and their ceftriaxone susceptibility profile were documented on a proforma. Statistical analysis of the data was done using STATA version 13 statistical package.

Results: A total of 225 isolates were subjected to ceftriaxone sensitivity testing. The prevalence of ceftriaxone resistance in the total bacteria population was 110/225(48.89%), while resistance rates for *Staphylococcus aureus, Klebsiella species, Escherichia coli* and *Pseudomonas aeruginosa,* the commonest pathogens implicated in health-care associated infections were 12/19(63.2%), 19/35(54.3%), 43/81(53.1%), and 13/25(52.0%) respectively. The specimen from which isolated organisms showed the most resistance was wound swabs 33/44(75.0%). There were statistically significant relationships between isolated bacteria and ceftriaxone resistance ($P= 0.034$), as well as cultured specimen and ceftriaxone resistance ($P= 0.001$).

Conclusion: The rate of ceftriaxone resistance in this setting is high, hence, there is a need to review the antibiogram of several pathogens in the hospital and come up with a new antibiotic for empirical use.

Key words: ceftriaxone, resistance, cephalosporin, Nigeria

INTRODUCTION

Ceftriaxone is an extended spectrum cephalosporin belonging to the beta-lactam group of antibiotics.[1][2] Although ceftriaxone was developed mainly for the treatment of invasive and probably severe life threatening infections, its inappropriate and irrational use as well as that of most other beta lactam agents in developing countries remain the major factors that promote the spread of antimicrobial resistance. [3][4][5]

Resistance to extended-spectrum cephalosporins requires sequential and multiple mutations of target genes, but the commonest mechanisms of resistance to ceftriaxone are by enzymatic degradation with extended-spectrum ß-lactamases (ESBLs) and AmpC ß-lactamases.[1][2][3] Furthermore, genes responsible for the development of these resistance enzymes are transmitted horizontally between bacteria, hence when these antibiotics are used empirically in frequent proportions in the treatment of non-specific infections or other disease states, the spread of resistance is facilitated.[1][6]

Globally, there has been an increase in the prevalence of antimicrobial resistance (AMR), especially among the *Enterobacteriaceae,*[6] with ceftriaxone resistance almost reaching the limits. This has resulted in increased patient morbidity and mortality, increased health-care costs, and increased use of last-line antibiotics[3][6]. It is these deleterious effects that ceftriaxone resistance poses on the society that has made major health organizations to label ceftriaxone resistant *Enterobacteriaceae* as priority pathogens of critical importance.[7]

In Nigeria, ceftriaxone is notably one of the commonest drugs used as first line empirical parenteral therapy for most infectious disease conditions as well as surgical prophylaxis, hence, strengthening regulatory bodies with information on its resistance profile will go a long way in restructuring antibiotic prescribing patterns as well as curbing further antibiotics resistance in the country. This audit was a surveillance on ceftriaxone resistance in Nnamdi Azikiwe University Teaching Hospital over a period of one year.

METHODS

Study Design: It was a retrospective study which assessed the antimicrobial susceptibility testing records in the Medical Microbiology laboratory of Nnamdi Azikiwe University Teaching Hospital, Nnewi, to determine the ceftriaxone resistance patterns of different bacterial isolates over a period of one year spanning from 1st January, 2019 to 31st December, 2021. The work was conducted as part of the routine antimicrobial resistance surveillance of the Infection Prevention and Control Committee (IPC), in collaboration with the Infectious Diseases Group of Nnamdi Azikiwe University Teaching Hospital Research Society of the institution. A check list was used to extract information from the Antimicrobial Susceptibility testing records, wherein information including patient's sex, ward, specimen type, bacteria isolated, and their susceptibility profile to ceftriaxone were documented.

Ethical Consideration

All information for this study were obtained from the record books in the Medical Microbiology laboratory of the institution, by the Infectious Disease Research Group of Nnamdi Azikiwe University Research Society and the Infection Prevention and Control Committee of the institution. Hence, ethical approval was waived.

Statistical Analysis

Data obtained in the course of the research, was summarized and presented using Frequency distribution tables, while chi square was used to test for associations between categorical variables at level of significance <0.05.

RESULTS

A total of 225 test records were retrieved with ceftriaxone antibiogram documented, and these records revealed that specimens were collected from individuals with a female:male ratio of 1.05:1. Also, majority of the tests done were referred from the general out patient department 52(23.1%), followed by the accident and emergency ward 33(14.7%). The most frequently requested investigation yielding the isolates was urine culture and sensitivity 74/225(32.9%), while the most frequently isolated organism was *Escherichia coli* 81/225(36.0%) (Table 1).

The prevalence of ceftriaxone resistance in the total bacteria population was 110/225(48.9%), while resistance rates for *Staphylococcus aureus, Klebsiella species, Escherichia coli* and *Pseudomonas aeruginosa,* the commonest pathogens implicated in health-care associated infections were 12/19(63.2%), 19/35(54.3%), 43/81(53.1%), and 13/25(52.0%) respectively. There was statistically significant relationships between isolated bacteria and ceftriaxone resistance (P= 0.034) (Table 2).

The specimen from which isolated organisms showed the most resistance was wound swab 33/44(75.0%), and there was a statistically significant relationship between specimen type and ceftriaxone resistance (P= 0.001) (Table 3). The relationship between ward/clinics and ceftriaxone resistance was not statistically significant (P= 0.250). (Table 4).

Table 1: Distribution of several socio-demographic parameters

Parameter	Frequency (n)	Percent
Gender		
Female	115	51.1
Male	110	48.9
Total	225	100.0
Ward/Clinic		
General Out Patient Department	52	23.1
Accident and Emergency	33	14.7
Surgical Out Patient	21	9.3
Gynaecology	21	9.3
Medical Out Patient	18	8.0
Female Medical Ward	14	6.2
Retro viral Disease	9	4.0
Paediatrics Medical Ward	7	3.1
Male Surgical Ward	6	2.7
Female Surgical Ward	5	2.2
Paediatrics Surgical Out Patient	5	2.2
Ear/Nose/Throat	5	2.2
National Health Insurance Scheme	5	2.2
Lying in Ward	4	1.8
Male Medical Ward	3	1.3
Antenatal Care	3	1.3
Paediartics Surgical Ward	3	1.3
Children Emergency Room	2	0.9
Children Out Patient	2	0.9
Special Care Baby Unit	2	0.9
Intensive Care Unit	2	0.9
Respiratory	2	0.9
Orthopaedics	1	0.4
Total	225	100.0
Specimen		
Urine	74	32.9
Sputum	49	21.8
HVS	16	7.1
Semen	12	5.3
Ear Swab	7	3.1
Throat Swab	6	2.7
Blood	6	2.7
Stool	4	1.8
Pus Aspirates	3	1.3
Catheter Tip	2	0.9
Wound Swab	2	0.9
Pleural Fluid	1	0.4
ECS	1	0.4
Total	225	100.0

Isolated Organisms		
Escherichia coli	81	36.0
Klebsiella species	35	15.6
Coagulase negative Staphylococcus	33	14.7
Pseudomonas aeruginosa	25	11.1
Staphylococcus aureus	19	8.4
β- haemolytic Streptococcus	17	7.6
α- haemolytic Streptococcus	7	3.1
Proteus species	3	1.3
γ- haemolytic Streptococcus	2	0.9
Enterococcus species	1	0.4
Citrobacter species	1	0.4
Salmonella species	1	0.4
Total	225	100.0

n= Frequency; %= Percentage; *P*-value= Probability

Table 2: Relationship between isolated bacteria and ceftriaxone resistance

	Ceftriaxone Resistance		
Isolate (n)	**Yes, n(%)**	**No, n(%)**	*P*-value
Escherichia coli (81)	43(53.1)	38(46.9)	0.034
Klebsiella species (35)	19(54.3)	16(45.7)	
Coagulase negative *Staphylococci (33)*	15(45.5)	18(54.6)	
Pseudomonas aeruginosa (25)	13(52.0)	12(48.0)	
Staphylococcus aureus (19)	12(63.2)	7(36.8)	
β- haemolytic Streptococci (17)	2(11.7)	15(88.2)	
α- haemolytic Streptococci (7)	1(14.3)	6(85.7)	
Proteus species (3)	1(33.3)	2(66.7)	
γ- haemolytic Streptococci (2)	2(100.0)	0(0.0)	
Citrobacter species (1)	1(100.0)	0(0.0)	
Enterococcus species (1)	1(100.0)	0(0.0)	
Salmonella species (1)	0(0.0)	1(100.0)	
Total (225)	110(48.9)	115(51.1)	

n= Frequency; %= Percentage; *P*-value= Probability

Table 3: Relationship between cultured specimen and ceftriaxone resistance

Specimen	Ceftriaxone Resistance		*P*-value
	Yes, n(%)	No, n(%)	
Urine (74)	45(60.8)	29(39.2)	0.001
Sputum (49)	15(30.6)	34(69.4)	
Wound Swab (44)	33(75.0)	11(25.0)	
HVS (16)	4(25.0)	12(75.0)	
Semen (12)	3(25.0)	9(75.0)	
Ear Swab (7)	2(28.6)	5(71.4)	
Blood (6)	3(50.0)	3(50.0)	
Throat Swab (6)	1(16.7)	5(83.3)	
Stool (4)	1(25.0)	3(75.0)	
Pus Aspirates (3)	1(33.3)`	2(66.7)	
Catheter Tip (2)	1(50.0)	1(50.0)	
Pleural Fluid (1)	0(0.0)	1(100.0)	
ECS (1)	1(100.0)	0(0.0)	
Total (225)	110(48.9)	115(51.1)	

n= Frequency; %= Percentage; *P*-value= Probability

Table 4: Relationship between ward/clinic and ceftriaxone resistance

Ward Clinic (n)	Ceftriaxone Resistance		P-value
	Yes, n(%)	No, n(%)	
General Out Patient Department (52)	20(38.46)	32(61.54)	0.250
Accident and Emergency (33)	15(45.45)	18(54.55)	
Surgical Out Patient (21)	14(66.67)	7(33.33)	
Gynaecology (21)	7(33.33)	14(66.67)	
Medical Out Patient (18)	9(50.00)	9(50.00)	
Female Medical Ward (14)	8(57.14)	6(42.86)	
Retro-viral Disease (9)	4(44.44)	5(55.56)	
Paediatrics Medical Ward (7)	5(71.43)	2(28.57)	
Male Surgical Ward (6)	4(66.67)	2(33.33)	
Female Surgical Ward (5)	5(100.00)	0(0.00)	
Paediatric Surgery Out Patient (5)	2(40.00)	3(60.00)	
Ear Nose and Throat (5)	1(20.00)	4(80.00)	
National Health Insurance (5)	1(20.00)	4(80.00	
Lying in Ward (4)	2(50.00)	2(50.00)	
Male Medical Ward (3)	2(66.67)	1(33.33)	
Antenatal Care (3)	2(66.67)	1(33.33)	
Paediatric Surgical Ward (3)	1(33.33)	2(66.67)	
Special Care Baby Unit (2)	2(100.00)	0(0.00)	
Intensive Care Unit (2)	2(100.00)	0(0.00)	
Children Emergency Room (2)	1(50.00)	1(50.00)	
Children Out Patient (2)	1(50.00)	1(50.00)	
Respiratory (2)	1(50.00)	1(50.00)	
Orthopaedics (1)	1(100.00)	0(0.00)	
Total (225)	110(48.89)	115(51.11)	

n= Frequency; %= Percentage; *P*-value= Probability

DISCUSSION

Ceftriaxone, a third-generation cephalosporin antibiotic frequently used to treat invasive infections caused by *Enterobacteriaceae*, as well as other bacterial pathogens has increasingly been abused in most countries of the world.[8][9][10] This has resulted to bacterial pathogens developing high level resistance to this antibiotic, thus leading to increased morbidity, mortality, prolonged hospital stay, increased health-care costs, and increased use of last-line antibiotics in patients who would have otherwise recovered from their illnessses without much difficulties or complications.[8][9][11] Till date, most African health-care institutions use ceftriaxone as first-line empiric antibiotic for invasive infections.[12][13]

In this study, a large proportion of the requested investigations were referred from the general out patient department 52(23.1%), thus, implying that in addition to the health-care settings, ceftriaxone resistance is also present in the community. The situation could be explained by the fact that in Nigeria antibiotics are sold as over the counter medication which are easily accessible to the community.[14]

The prevalence of ceftriaxone resistance in the total bacteria population was 110/225(48.9%). Similar findings were observed in studies done in Ethiopia 140/248(56.5%)[15] and Yemen 107/172(62.2%).[16] The observation also agrees with statements by the WHO that ceftriaxone and other 3rd generation cephalosporin resistance in common bacterial populations have reached the 50% mark.[17]

Staphylococcus aureus had the highest resistance rate 12/19(63.2%), followed by *Klebsiella species* 19/35(54.3%), *Escherichia coli* 43/81(53.1%), and *Pseudomonas aeruginosa* 13/25(52.0%), which was consistent with a previous study in which most of the strains of *Staphylococcus aureus* were resistant.[18] These observations also agree with the 2014 WHO global antibiotic resistance reports.[17] In contrast, other research finding reported that *Escherichia coli* exhibited the highest resistance to the 3rd generation cephalosporins.[19][20] Varying observations were also seen in Ethiopia with 73% resistance to ceftriaxone in *Escherichia coli* and 23.4% in *Staphylococcus aureus*.[15]

These variations may be as a result of different antibiotic prescribing patterns in the different regions as well as different levels of implementation of antimicrobial stewardship. It could also be as a result of different proportions of the sample populations used in the different studies. The fact that these bacteria are commonest pathogens implicated in health-care associated infections is worrisome, because it will further limit treatment options of these infections.

The specimen from which isolated organisms showed the most resistance was wound swab 33/44(75.0%). This was similar to a study done in Zambia with 60% of the bacteria isolates from wounds being resistant to a 3rd generation cephalosporin,[21] but a lower rate (47.4%) was observed in Ethiopia.[15] The discovery of a high ceftriaxone resistance rate in this study could be attributed to the empirical use of the drug for most wounds treatment, as well as surgical prophylaxis.

There were significant relationships between isolated bacteria (P= 0.034) and specimen type (P= 0.001) with ceftriaxone resistance. This was similar to previous studies in Ethiopia where significant differences were observed in specimen types from which the strains were isolated.[15]

CONCLUSION

Observations from this study has revealed a high prevalence of ceftriaxone resistant bacteria in Nnamdi Azikiwe University Teaching Hospital and its surrounding community, which will ultimately result in treatment failure and higher cost of eradicating these resistant pathogens. An extensive effort to decrease inappropriate use of antibiotic and to raise awareness of health-care providers through implementation of antimicrobial stewardship programs is recommended. Other options for empiric antibiotics should be sort through proper antimicrobial surveillance and testing in each locality.

Limitations

This study was limited by the fact that the specific genes responsible for resistance to ceftriaxone and other 3rd generation cephalosporins were not determined, thus, the work would have benefited from a more robust prospective determination of specific genes responsible for the observed resistance. Also, a larger sample size may have given a clearer representation of the ceftriaxone resistance profile in the study location.

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EFFECTS OF AQUEOUS LEAF EXTRACT OF *SANSEVIERIA TRIFASCIATA* ON FORMALDEHYDE-INDUCED LUNG INJURY IN THE ADULT WISTER RAT

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ABSTRACT

Background: Formaldehyde poisoning is the most important cause of respiratory diseases among people with formaldehyde-related occupations such as laboratory scientists, nurses, medical technicians et cetera.

Aim: This study aimed to investigate the effects of aqueous leaf extract of *Sansevieria trifasciata* on formaldehyde-induced injury in the lungs of the adult Wistar rat.

Methods: The 36 adult Wistar rats weighing between 250g and 280g that were used in this research were divided into 6 groups of 6 rats per group. The haematological outcome showed that formaldehyde caused some derangements in haematological parameters especially lymphocytes and basophils, haemoglobin and haematocrit, red blood cells and their indices with associated reticulocytosis. Histologically, severe bronchiolar mucosal ulceration with erosion of the cilia leading to blunting, severe interstitial infiltrates of inflammatory cells and severe vascular ulceration were observed in the rats exposed to formaldehyde only. *Sansevieria trifasciata* shrunk the local activated immune system and the florid-activated bronchioloalveolar aggregates of the immune system in the *Sansevieria trifasciata* treated rats.

Conclusion: *Sansevieria trifasciata* has ameliorative effects against formaldehyde-induced injury in the lung of Wistar rats and its effect is inversely proportional to dosage. It is more potent at low doses.

KEYWORDS: *Sansevieria trifasciata*; formaldehyde exposure; formaldehyde poisoning

Introduction

Sansevieria trifasciata is a member of the *Asparagaceae* family. It is a species of flowering plant that is cultivated in West and equatorial Africa as.[1] *Sansevieria trifasciata* is commonly called snake plant (because of the shape and sharp margins of its leaves that resemble snakes) or mother-in-law's tongue due to its sharply pointed leaves.[2] *Sansevieria trifasciata* plant has up to 6 leaves per rosette.[3] Mature leaves are dark green with light grey-green cross-banding and usually range between 30 and 35cm in length and 5 to 7cm in width.[1]

Sansevieria trifasciata contains the toxic alkaloid sansevesine, which has been found to also have anti-allergenic and antipyretic effects.[4] Phytochemical constituents of *Sansevieria trifasciata* include: flavonoids, saponins, phenols, steroid, coumarine, and fatty acid.[5] Literature *reports that Sansevieria trifasciata* leaves can be utilized in the therapy of fever, asthma, chest pain, cough, and catarrha. Scientists have opined that the active principles which confer antipyretic, antitussive and soothing effects on the plant are the flavonoids and its saponins.

Formaldehyde is an organic chemical reagent commonly used in disinfectants, embalming and medical laboratories.[6,7,8] Nurses, medical technicians, and laboratory scientists are often exposed to formaldehyde daily for hours during the course of their work. Breathing the fumes of formaldehyde can occur while working directly with formaldehyde, or using equipment cleaned with formaldehyde. Formaldehyde contains an organic chemical, methanol as the active ingredient which is toxic to humans with significant morbidity and mortality if left untreated.[9,10]

Previous studies have shown that exposure to formaldehyde fumes causes respiratory allergy and shortness of breath in experimental animals.[11,12] Formaldehyde vapor is a severe respiratory and skin irritant.[13,14,15] Signs and symptoms of formaldehyde poisoning include coughing, wheezing, tachypnea and inflammatory reaction.[16,17] Hence, the objective of this paper was to evaluate the effects of aqueous leaf extract of *Sansevieria trifasciata* on formaldehyde-induced damage in the lungs of adult Wistar rats.

Materials And Method

Plant Materials: *Sansevieria trifasciata* leaves were harvested from the University of Benin Farm Project, Benin City. The plant was identified at the herbarium of the Department of Plant Biology and Biotechnology, Faculty of Life Sciences, University of Benin, Benin City, Edo State, Nigeria. The leaves were thoroughly washed to remove sand particles after which they were taken to the Pharmacology Department for preparation of the extract.

 Sansevieria trifasciata leaves were chopped into little bits and allowed to dry at room temperature. The dried leaves were pounded using wooden mortar and pestle and milled into fine powder in an electric blender. Five hundred grams (500g) of the powder was soaked in 2litres of distilled water for 24 hours. The mixture was filtered with white filter paper and the residue was separated from the filtrate. The filtrate was concentrated using rotary evaporator at the department of Pharmacognosy, University of Benin, Benin City, Nigeria. The crude extract was then preserved in plain specimen bottles.

Phytochemical Analysis: Qualitative analysis of each Phytochemical constituent of *Sansevieria trifasciata* was done using Gas chromatography. Phytochemical constituents of *Sansevieria trifasciata* include: flavonoids, saponins, dicarboxylic acids, phenols, steroid, coumarine, homoisoflavanone and fatty acid.[5]

Acute oral toxicity of the extract was evaluated. Appropriate doses of the extract were made by diluting with distilled water into 900mg/kg body weight and 1800mg/kg body weight which were administered to the rats orally.

Experimental Animals: Thirty (36) adult Wistar rats of either sex weighing between 250g and 280g were used for this study. The animals were allowed to acclimatize for a period of 2 weeks before commencement of the experiment. During this period they were allowed access to standard animal feeds (Vital Growers' Feed, manufactured by Bendel Flour Mll, Ewu, Edo state Nigeria) and clean water *ad libitum.*

Ethical Consideration: Ethical approval was obtained from Research Ethics Committee of the College of Medical Sciences, University of Benin, Nigeria. Each animal procedure was carried out in accordance with approved protocols and in compliance with the recommendations for the proper management and utilization of laboratory animals used for research.[18]

Induction of Formaldehyde Poisoning:

Formaldehyde poisoning was induced by exposing the test animals to 40% formaldehyde via fume distributor glass-chamber (FDC) for 1hour daily for 30 consecutive days.[16] A pilot study was done on the 28th day of the experiment which confirmed formaldehyde toxicity.

Experimental Design: 36 adult Wistar rats weighing between 250g and 280g were randomly assigned into a control group **(Group A)** and five treatment groups **(B, C, D, E and F)** comprising of six (6) rats per group. **Group A** rats which served as control received 1ml of distilled water daily to compensate for the stress of administration procured in the test groups. **Group B** rats were exposed to 40% formaldehyde for 1hour daily via inhalation. **Group C** rats were treated with 900mg/kg body weight per day (BWT/D) of *Sansenieria trifasciata* leaf extract. **Group D** rats were treated with 1800mg/kg BWT/D of *Sansenieria trifasciata* leaf extract **Group E** rats were treated with 900mg/kg BWT/D of *Sansenieria trifasciata* leaf extract and were exposed to 40% formaldehyde via inhalation. **Group F** rats were treated with 1800mg/kg BWT/D of *Sansenieria trifasciata* and were exposed to 40% formaldehyde via inhalation. The dosages were given for 56 consecutive days via orogastric method. The weights of the experimental animals were taken after 30 days and the difference between them and previous weights were noted. The data were subjected to statistical analysis and P value calculated using the students' t-test.

Method of Sacrifice and Sample Collection: At the end of the 8th week, the animals were sacrificed under chloroform anaesthesia; a midline incision was made through the ventral wall of the thorax of the rats to access the lungs. The lungs were harvested and immediately fixed in 10% formal saline for24 hours before the histological analysis.

The tissues were trimmed to about 3-5mm thick sections and processed according to the method of Drury and Wallington (1980)[19] And then histologically assessed using the following methods: fixation, embedding and tissue staining for microscopy. Histological sections were examined under Leica DM750 research microscope with a digital camera (Leica ICC50) attached. Photomicrographs of the tissue sections were taken at various magnifications i.e. x40 and x100.

White blood cells, lymphocytes, red blood cells, haemoglobin, haematocrit, mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, basophils and reticulocytes were analysed using an auto-analyzer (2006 model, manufactured by Hoddlier and Stoughton Group of company, London with a recognized biochemical kit (2010 model, Diagnostic Merck, London).

Statistical Analysis: The results were summarized as Mean and Standard Error of Mean. The data were subjected to using the students't-test. Level of significance was set at $P \leq 0.05$.

Results

Table 1: Change In Body Weights of the Rats in all the Experimental Groups

Groups	Initialbody weight		Final body weight		P-value
Control (Group A)	168.00	19.90	195.00	19.22	0.158
Formaldeh. exposure only (Group B)	214.67	13.30	211.67	17.46	0.580
Extract only (low dose) (Group C)	184.00	18.04	192.00	16.70	0.062
Extract only (high dose) (Group D)	186.00	18.77	192.33	17.61	0.134
Extract (low dose) + Formaldehyde exposure (Group E)	176.67	11.86	179.67	16.75	0.605
Extract (high dose) + Formaldehyde exposure (Group F)	143.67	8.41	158.33	7.45	0.137

Values are Mean ± S.E.M

Table 2: Comparison of Haematological Parameters in all the Experimental Groups

	(Group A) (Control)	Group B (Formaldehyde exposure only)	Group C Extract only (low dose)	Group D Extract only (high dose)	Group E Extract (low dose) + Formaldehyde exposure	Group F Extract (high dose) + Formaldehyde exposure	P-value
WBC ($10^3/\mu L$)	7.40±1.36	13.32±2.61	9.10±1.14	8.76±1.13	8.72±0.56	11.20±2.74	0.313
Lymphocytes ($10^3/\mu L$)	6.40±1.13	9.74±1.51	8.04±1.12	7.30±1.00	7.58±0.60*	9.78±2.50	0.006
Reticulocytes (%)	0.73±0.15	1.30±0.28*	0.76±0.09	1.06±0.07	0.86±0.08	0.98±0.15	0.008
Basophils (%)	9.20 ± 0.06	8.40±0.11	7.30±0.07	6.44±0.10	5.28±0.06*	4.44±0.11	0.022
RBC ($10^6/\mu L$)	5.66±0.07	5.71±0.54	5.16±0.5	5.97±0.13	6.42±0.12*	6.33±0.15	0.016
MCV(μm^3)	61.53±1.07	58.42±2.11	56.04±1.44*	57.62±1.27	56.44±0.76*	56.50±0.69*	0.003
Mean Cell Haemoglobin (pg)	24.80±2.35	21.62±0.90*	20.64±0.76*	21.82 ±0.56*	21.58±0.13*	21.62±0.38*	0.002
MCHC (g/dL)	35.83±0.81	36.96±0.43	36.80±0.77	37.84±0.55*	38.32±0.38*	38.46±0.17*	0.012
Haemoglobin (g/dl)	13.33±65.86	12.40±47.12	11.80±57.48	101.80±68.74	95.80±36.73 *	8.40±63.61	0.006
Haematocrit (%)	43.83±0.15	42.64±0.12	41.30±0.19	40.12±0.27*	39.36±0.17	38.14±0.16*	0.004

Values are Mean ± S.E.M

*Significantly different from the control group
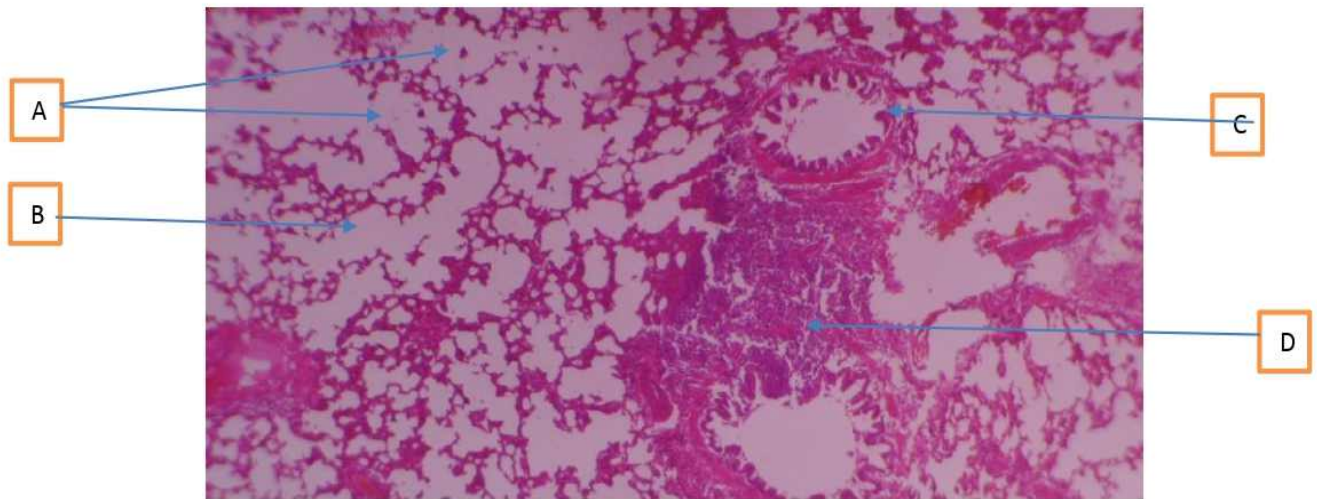
PHOTOMICROGRAPHS:

Plate 1. Lungs. Control. Composed of A: alveola sacs, B, interstitial space,

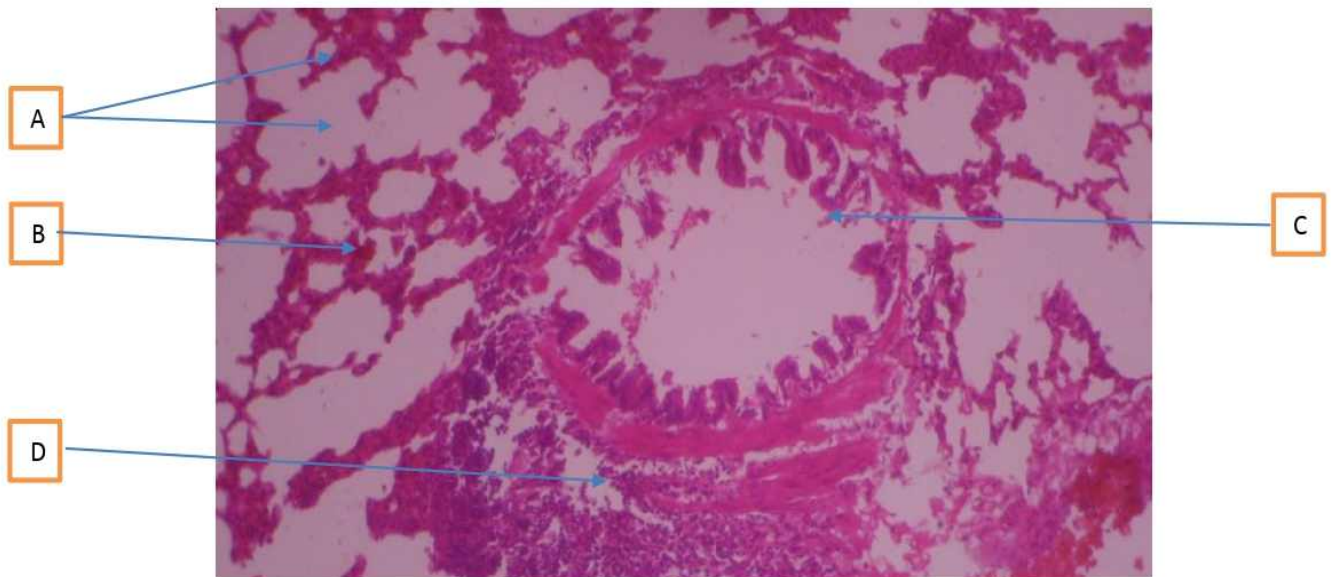C, terminal bronchiole and D, lymphoid tissue (H&E x 40)

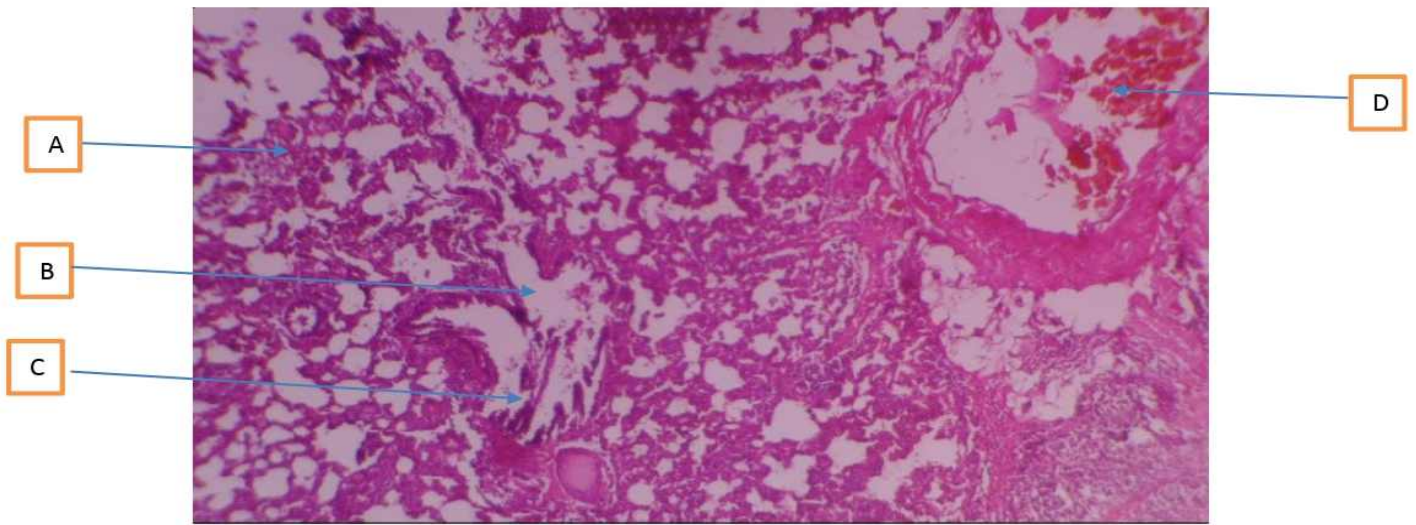Plate 2. Higher magnification of the above: A, B, C, D (H&E x 100)

Plate 3. Rat exposed to Formaldehyde only showing A: severe interstitial infiltrates of inflammatory cells, B, bronchiolar mucosal ulceration with C,erosion of cilia and D, vascular ulceration (H&E x 40)
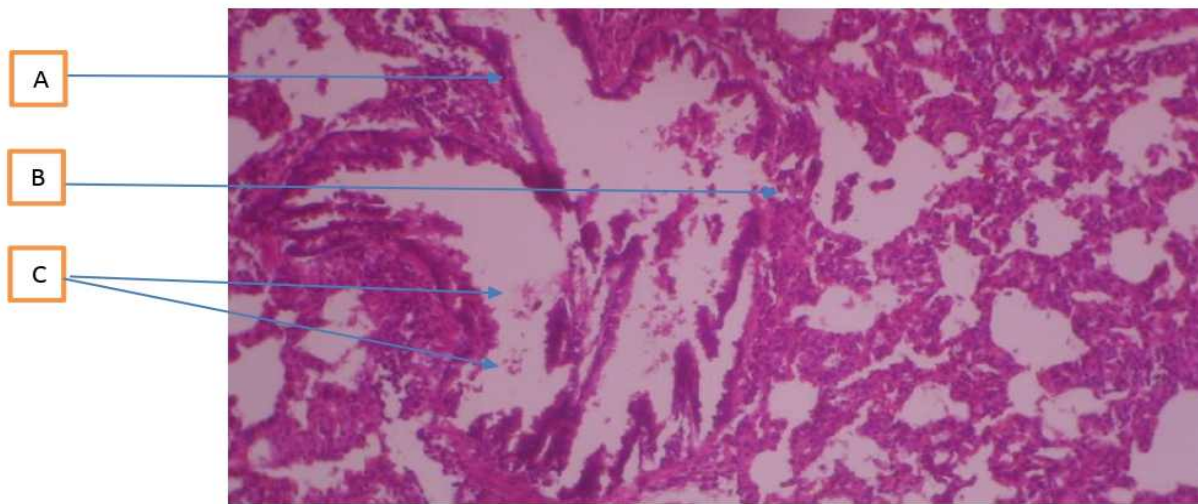

Plate 4. Higher magnification of the above: A, B, C, (H&E x 100)
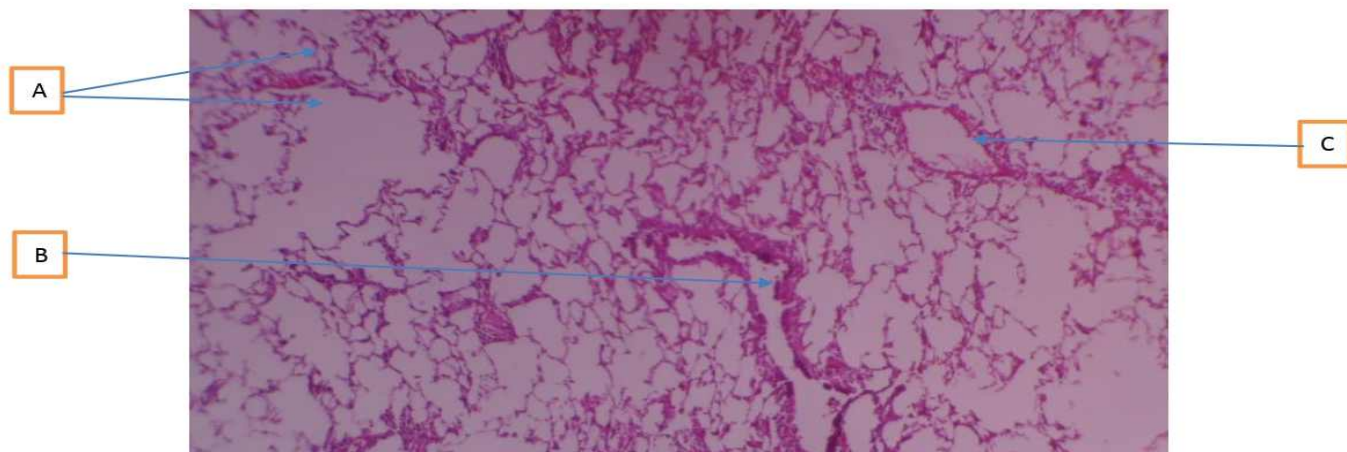
Plate 5. Rat given 900mg extract only showing A: normal alveoli, B, normal bronchiolar mucosa and C, vasodilatation (H&E x 40)
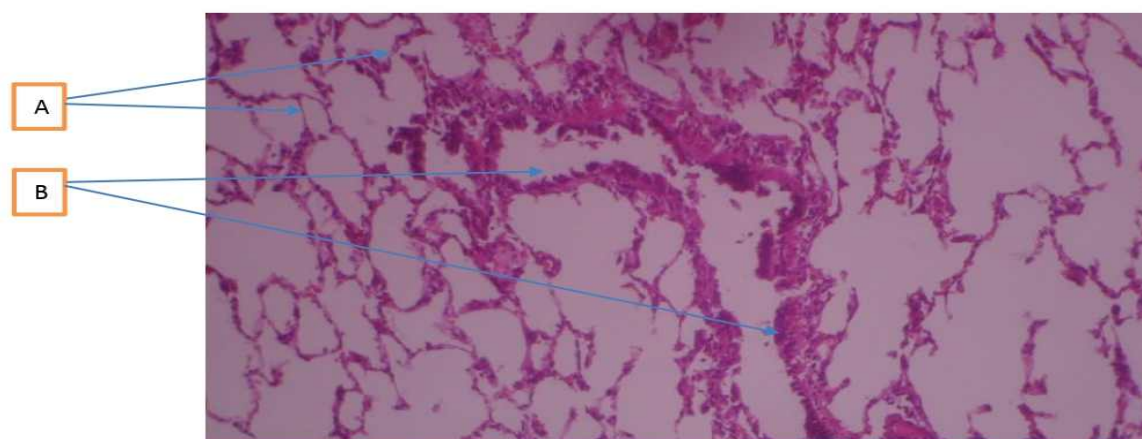

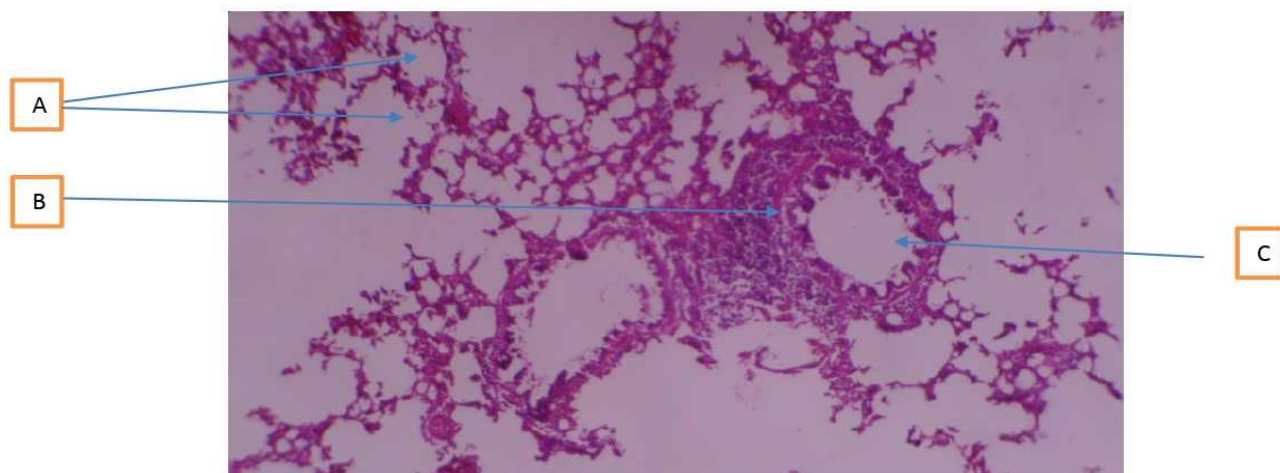Plate 6. Higher magnification of the above: A, B, (H&E x 100)

Plate 7. Rat given 1800mg Extract only showing A: normal alveoli, B, normal lymphoid tissue and C, normal bronchiolar mucosa (H&E x 40)
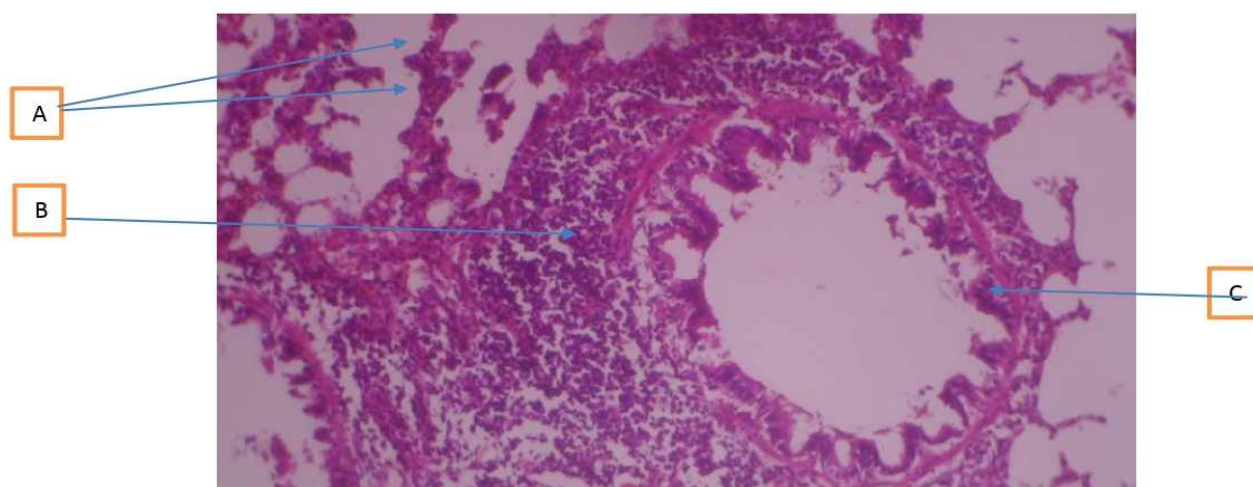

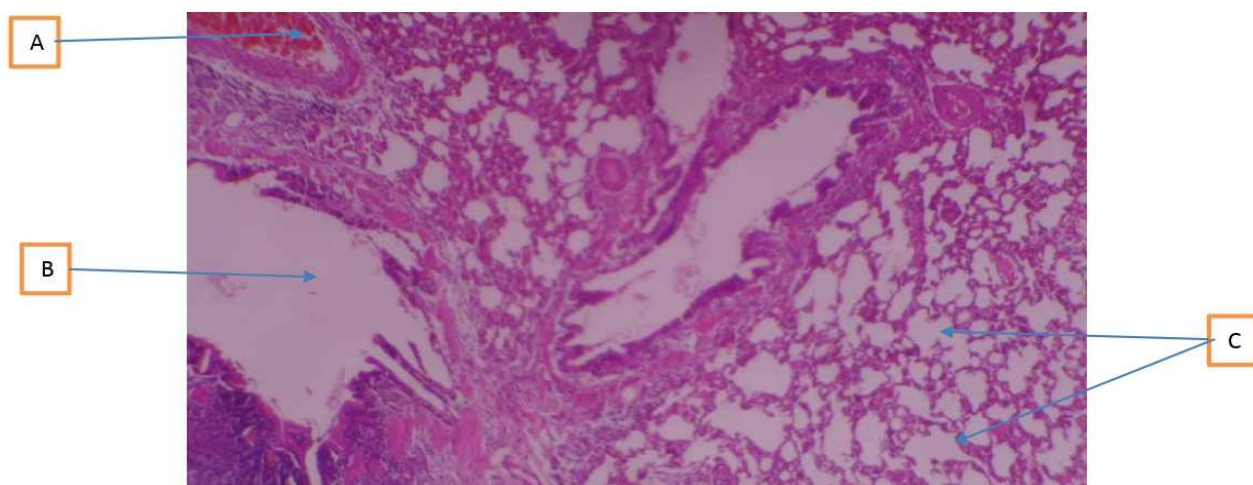Plate 8. Higher magnification of the above: A, B, C (H&E x 100)

Plate 9. Rat exposed to Formaldehyde + given 900mg extract showing A: normal vascular architecture, B, bronchiolar dilation and C, normal alveoli (H&E x 40)
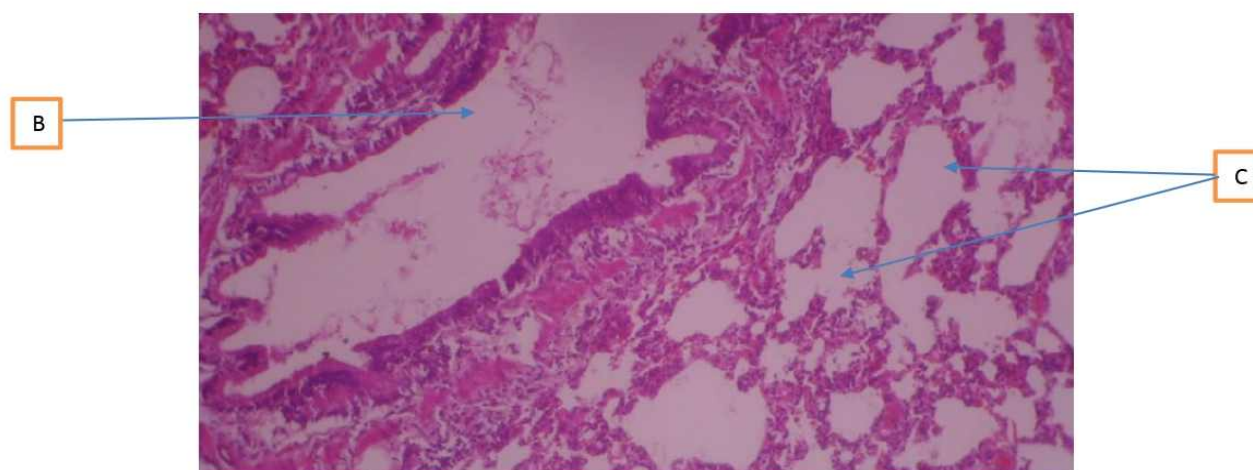

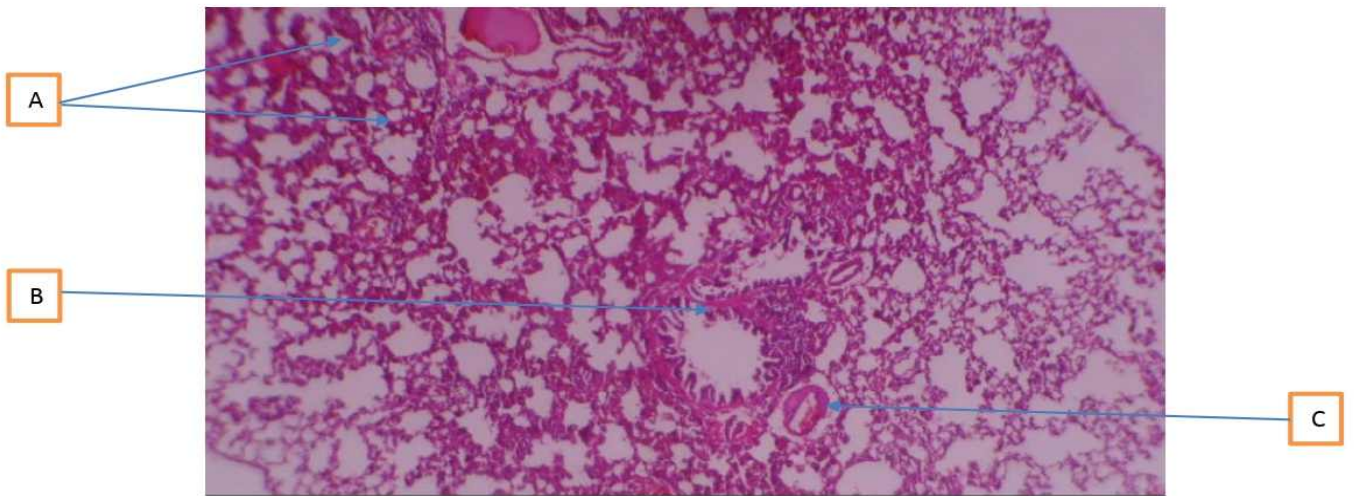Plate 10. Higher magnification of the above: A, B, (H&E x 100)

Plate 11. Rat exposed to Formaldehyde + 1800mg extract showing A: normal alveoli, B, focal bronchiolar ulceration and C, vascular ulceration (H&E x 40)
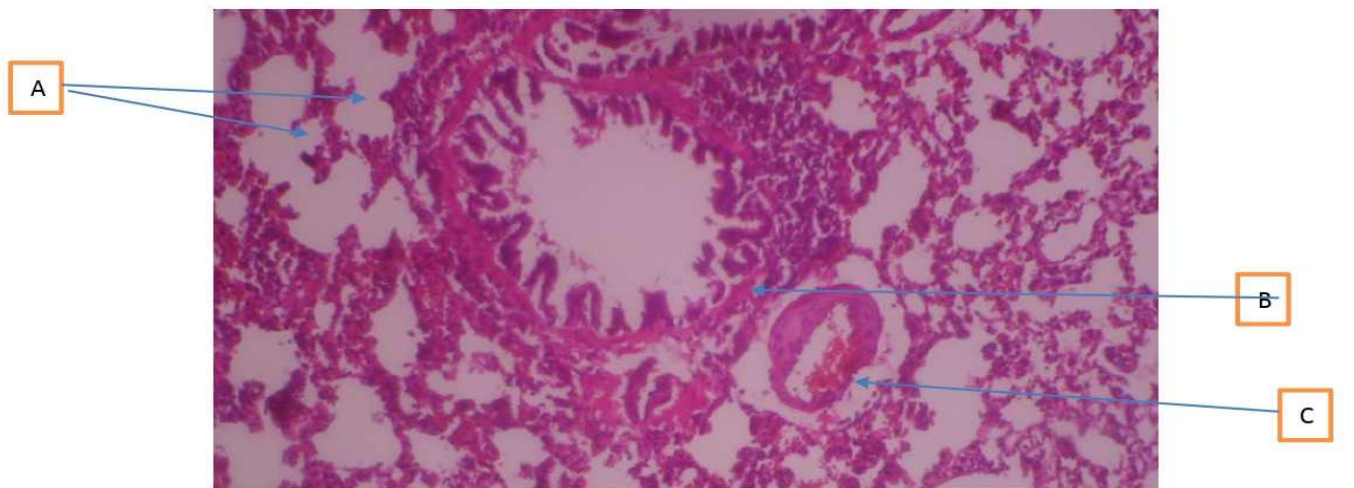

Plate 12. Higher magnification of the above: A, B, C (H&E x 100)

As shown in the table above **(Table 1),** there was no significant difference in body weight of the rats in the various groups exposed to formaldehyde (though there was a slight decrease) which concurs with previous work.[16]

As shown above in **Table 2,** haematological analysis for serum levels shows that formaldehyde decreased some hematological parameters such as lymphocytes and basophils, haemoglobin and haematocrit, red blood cells and other red cell indices with associated reticulocytosis which agrees with previous studies.[17]

As shown in **Plate 1 and 2,** the histological sections of the lung of control **(Group A)** showed normal histoarchitecture of the lung, viz., normal alveolar sacs, interstitial spaces, terminal bronchiole and lymphoid tissue. As shown in **Plate 3 and 4,** there were observable histological variations, viz., severe interstitial infiltrates of inflammatory cells, bronchiolar mucosal ulceration with erosion of cilia and vascular ulceration in the lung histoarchitecture of rats exposed to formaldehyde only **(Group B).**

As shown above in **Plate 5 and 6,** photomicrographs of lung of rats treated with 900mg/kg body weight (low dose) of *Sansevieria trifasciata* leaf extract only (**Group C**) shows normal alveoli, normal bronchiolar mucosa and vasodilatation. **Plate 7 and 8** photomicrographs of the lungs of rats treated with 1800mg/kg body weight (high dose) of *Sansevieria trifasciata* leaf extract only (**Group D**) shows normal alveoli, normal lymphoid tissue and nirmal bronchiolar mucosa.

As shown in **Plate 9 and 10,** histological sections of the lung of **Group E** rats exposed to 40% formaldehyde fumes and treated with 900mg/kg BWT/D of *S. trifasciata* (low dose) shows normal vascular architecture, bronchiolar dilation and normal alveoli. **Plate 11 and 12** histological sections of the lungs of **Group F** rats exposed to 40% formaldehyde fumes and treated with 1800mg/kg BWT/D of *Sansevieria trifasciata* (high dose) shows normal alveoli, focal bronchiolar ulceration and vascular ulceration.

Hematological analysis for serum levels showed that formaldehyde caused increase in the reticulocytes and decrease in some hematological parameters such as lymphocytes, basophils, haemoglobin, haematocrit, red blood cells and other red cell indices **(Table 2).** The increase in reticulocytes corresponds with the decrease in red blood cells, indicating an effective erythropoietic response.

The histological findings from this study were almost consistent throughout the lung tissue. They include inflammation of the lung interstitial space, activation of bronchial and bronchiolo-alveolar lymphoid aggregates, pulmonary oedema and focal bronchiolar ulceration. These histomorphological changes indicate diseases and pathological symptoms of a variety of maladies including bronchiolitis, alveolitis, bronchiectasis, and pneumonia. *Sansevieria trifasciata* aqueous leaf extract ameliorated all these formaldehyde-induced haematological derangements and histopathological injuries **(Fig. 9-12).**

Discussion

Lymphocytes are white blood cells that are uniform in appearance but vary in function and they include T, B and natural killer cells. These cells are responsible for antibody production, direct cell mediated killing of virus-infected and tumor cells and regulation of the immune response. The lymphopenia observed in this study may have been due to the immune response to the inhaled formaldehyde fumes in the lungs as observed in the histopathological slides (Plates 3 and 4).

Basophils are a component of the granulocytes. They are fewer in number but the largest in size. They also function to defend the body against allergens, pathogens, parasites and are involved in blood clotting. The basopenia observed in this study may have resulted from the defense against the inhaled formaldehyde fumes (an allergen), which may have resulted in the depletion of their numbers. Therefore, the deranged haematological parameters observed in this study may lead to increased susceptibility to infections and anaemia in the exposed experimental animals which are capable of compromising their health and may ultimately lead to mortality.

Observations based on photomicrography show that formaldehyde caused severe interstitial infiltrates of inflammatory cells, bronchiolar mucosal ulceration with erosion of cilia and vascular ulceration (Plate 3 and 4). *Sansevieria trifasciata* had no negative effects on the histology of the lungs. Low doses of *Sansevieria trifasciata* caused an expanded lumen of the bronchioles, vasodilatation, normal bronchiolar mucosa and alveoli (Plates 5 and 6). *Sansevieria trifasciata* shrunk the local activated immune system and also the florid activated bronchio-alveolar aggregates of the immune system (Plate 9 and 10). At high doses, *Sansevieria trifasciata* showed normal alveoli, normal lymphoid tissue (Plate 7 and 8), focal bronchiolar ulceration and vascular ulceration (Plate 11 and 12) which is indicative of having a less ameliorative effect when compared to the low dose.

Conclusion

Sansevieria trifasciata had ameliorative effects against formaldehyde-induced bronchiolar mucosal and vascular ulceration, alveolar interstitial haemorrhage, erosion of cilia and activation of lymphoid tissue Therefore, it can be used as a substitute to combat formaldehyde poisoning and other lung diseases.

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KNOWLEDGE AND PRACTICE OF EXERCISES AMONG PATIENTS WITH TYPE II DIABETES MELLITUS IN LAGOS, NIGERIA

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ABSTRACT

Background: Exercise has been proven to be an effective means of glycemic control. However, the knowledge and the practice of exercises among patients with Type II diabetes mellitus is uncertain.

Aim of study: The aim of this study was to investigate the knowledge and practice of exercises for glycemic control among patients with Type II diabetes mellitus in Lagos, Nigeria.

Materials and Methods: This cross-sectional analytical survey was carried out involving 140 (90 females and 50 males) patients with Type II diabetes mellitus. They were recruited from selected hospitals in Lagos State, Nigeria. A questionnaire was used to obtain information on the knowledge and pattern of practice of exercises among these patients. Spearman's rank order correlation was used to determine the relationship between selected socio-demographic characteristics and knowledge and practice of exercises. The level of significance was set at $p \leq 0.05$.

Results: The knowledge of exercise among respondents was good (mean score of 55.45 ± 8.79 out of a maximum score of 72). A good number (72.1%) of the respondents indicated regular practice of exercises. There was a significant correlation between age, level of educational attainment and knowledge and practice of exercise ($p < 0.05$). There was also a significant correlations between monthly income and practice of exercise ($p = 0.001$) but there was none between monthly income and knowledge of exercise by the patients.

Conclusion: There was a high level of knowledge and practice of exercise among patients with Type II diabetes mellitus and these were influenced by their age and level of educational attainment.

Keywords: Knowledge, Practice, Exercise, Glycemic control, Diabetes

INTRODUCTION

Diabetes has become a widespread epidemic, primarily because of the increasing prevalence especially Type II diabetes.[1] Its major contributing factors are rising physical inactivity and obesity.[1] It was estimated that the world prevalence of diabetes among adults (aged 20 to 79 years) would be 6.4%, affecting 285 million adults, in 2010, and will increase to 7.7%, and 439 million adults by 2030.[2] Type II diabetes mellitus (T2DM) which is characterized by improper utilization of insulin by target cells and tissues accounts for 85 to 95% of all diabetes in high-income countries with higher dominance in developing countries. Hence, the cause of serious global health concern.[3]

People living with T2DM are vulnerable to various forms of short and long-term complications, which often lead to their premature death. This tendency of increased morbidity and mortality seen in these patients with T2DM may be because of its insidious onset and late recognition, especially in resource-poor developing countries like Africa.[4]

Regarding the management of T2DM, exercise has been considered as one of the cornerstones in the treatment along with nutrition and medication.[5-7] As evidenced by a study carried out by Osho et al.[8], progressive aerobic and resistance exercises have positive effects on the pulmonary functions of individuals with T2DM in Nigeria.

Similarly, general findings of the study carried out by Bagheri et al.[9] indicated the positive effects of aerobic exercise on glycemic control with significant decrease in fasting blood sugar (FBS) in men with T2DM.

Even though pharmacological approaches in the management of T2DM are necessary, the high cost of these drugs makes affordability difficult over time. This is because most of the population affected by this disease reside in the low and middle income countries. Therefore, the fact that exercise may be cheap, affordable and highly effective in the prevention or delay in development of T2DM as well as in the control of blood glucose, should make it a motivating factor for patients with T2DM to practise it.[10,11]

Despite having enough evidence to support the benefits of exercise, initiating and adhering to regular practice of exercise has become difficult. In various communities, factors such as individual differences, socio-cultural and environmental reasons and barriers may hinder the adherence to regular exercise.[12] Studies on the level of knowledge, attitude and practise of exercise among patients with T2DM in Nigeria are few, hence, the need to evaluate the knowledge and practice of exercises among patients with T2DM in Lagos, Nigeria.

METHODS

Prior to the commencement of the study, ethical approval was sought and obtained from the Health Research and Ethics Committee of the College of Medicine University of Lagos, Idi-Araba, Lagos (CMUL/HREC/05/17/141). This cross sectional survey involved 140 individuals who were already diagnosed with T2DM and were being managed at the outpatient clinics of the Lagos University Teaching Hospital (LUTH), Lagos State University Teaching Hospital (LASUTH) and Nigerian Air Force Hospital (NAFH), Lagos. This sample size was calculated using the formula developed by Cochran[13] which is:

$$n = \frac{Z^2 PQ}{d^2}$$

where;

n = sample size

Z = confidence interval set at 1.96 for 95% confidence rate

P = prevalence rate (proportion in target population estimated) based on the previous studies or pilot studies. Using the prevalence of T2DM (10.5%)[14]

P = 10.5% = 0.105

Q = (1- P) = 1- 0.105= 0.895

d = precision value set at 0.05

Hence, sample size (n) = 144.406 = 144.

Individuals included in this study were patients already diagnosed with T2DM who were receiving treatment at LUTH, LASUTH and NAFH, those with T2DM who did not have

cognitive impairments and those who were still able to carry on with activities of daily living (ADL). Patients excluded from this study were patients diagnosed with T2DM who were critically ill, who presented with one or more forms of disability and with severe complications of Diabetes Mellitus (DM), such as grade 2 or 3 neuropathy, nephropathy, and retinopathy.

The socio-demographic characteristics (age, gender, height, weight, body mass index, level of education and monthly income) and duration of diabetes from diagnosis were obtained and recorded for each participant. A questionnaire adapted from the study of Chadchavalpanichaya and Intaratep[15] on "Exercise behaviour and knowledge among DM type II patients" was used to obtain information on the knowledge and practice of exercise from the participants. It is a 30 item questionnaire which consisted of three sections namely:

It consisted of three sections;

Section 1: socio-demographic status which includes age, gender, marital status, highest educational attainment and average income of the patient,

Section 2: Knowledge of the patient on exercises,

Section 3:   Practice pattern of exercises.

The knowledge section of the questionnaire was scored on a scale of 0 to 72. Total scale score was calculated by summing the total number of correct answers. Higher scores indicate a higher level of knowledge of exercise.

The practice pattern section had a combination of if they were referred for physiotherapy for proper supervision of their exercise periods, what was the frequency and duration of their exercises and hinderances to regularly performance of exercises etc. The questionnaires were collected after completion.

Data Analysis

Data were summarized using descriptive statistics of mean, standard deviation, frequency, and percentage and the results were presented on tables and charts. Spearman's rank order correlation coefficient was used to determine the relationship between age, educational attainment, economic status, and knowledge as well as practice of exercises.

RESULTS

A total of 144 questionnaires were given out. However, four individuals with T2DM declined being interviewed while 140 individuals gave their consents to participate in this study. The participants comprised of 90 (64.3%) females and 50 (35.7%) males. They had a mean age of 58.86 ± 14.79 years (males: 54.36 ±14.94 years and females: 61.36 ± 14.17 years). The mean BMI of the participants was 23.61 ±3.49 (male 23.70 ±3.59, female 23.57 ±3.45) (Table 1).

Forty-three (30.7%) participants had primary school as their highest level of educational attainment while 25 (17.9%) had tertiary education as their highest educational attainment. About half of the respondents were maimed (76, 54.3%) while (34, 24.3%) were widowed (Table I). About a third (51, 36.4%) of the respondents were self-employed while 42 (30.0%) were unemployed (Table 2). The monthly income of the respondents was grouped into three as classified by Chukwuonye et al.[16] Many [87 (62.1%)] of the respondents were earning between the Nigerian minimum wage and 85,000 naira while 16 (I I .4%) respondents earned less than the minimum wage (Table 2).

Overall Assessment of the Knowledge of Exercise among the Respondents

The knowledge score of the respondents ranged from 32 to 70 with overall mean score of

55.45 ± 8.79. The male respondents had a mean score of 55.34 ± 8.69 which is similar to the female respondents who had a mean score of 55.52 ± 8.89.

Knowledge of the Respondents on the Benefits of Exercise

It was observed that almost all (136, 97.1%) the respondents stated that exercise is effective for weight reduction, similarly most (128, 91.4%) stated that exercise enhances diabetes mellitus (DM) control. However, only some 56 (40.0%) respondents reported that exercise can improve vision (Table 3). It was also observed that only about half (77, 55.0%) of the respondents acquired their exercise knowledge from a health care provider (Table 3).

Knowledge of the Respondents on how Exercise should be carried out

Half (70, 50.0%) of the respondents stated that the proper frequency of exercise should be 3-5 days per week and 76 (54.3%) of the respondents stated that the proper duration of exercise should be 20-30 minutes per day. Additionally, more than half (79, 56.4%) of the respondents did not know of the necessity of a warm up prior to main exercise, meanwhile, more than two-third (107, 76.4%) of the respondents stated their cognizance of a cool down being necessary after exercising (Table 3).

Knowledge of precautionary measures while carrying out exercise(s)

Concerning precautionary measures while exercising, it was observed that 53, (37.9%) of the respondents agreed that patients with T2DM should not exercise in extreme weather conditions while majority of the respondents (120, 85.7%) stated that patients with T2DM should stop exercising when having abnormal symptoms (Table 4).

Knowledge of respondents on symptoms of extreme blood sugar reduction and factors for discontinuation of exercise

Just below half (68, 48.6%) of the respondents were aware of the possibility of extreme blood sugar reduction occurring while exercising. It was thus observed that 58 (41.4%) knew sweating as a symptom of extreme blood sugar reduction (Table 5).

It was also observed that chest discomfort was indicated by 86 (61.4%) respondents as a factor to discontinue exercise while loss of balance had the least (48, 34.3%) indication by respondents as a factor to discontinue exercise (Table 5).

Assessment of the Practice level of Exercise among the Respondents

Of the 140 respondents, 101 (72.1%) respondents said they engaged in one or more exercise(s) regularly, while 39 (27.9%) respondents stated that they do not engage in any form of exercise (Figure 1).

Pattern of Practice of Exercise(s)

Of the 101 respondents who exercise, 38 (27.1%) of the respondents engaged in exercises every day while a few (7, 5.0%) of the respondents engaged in exercises less than once per month (Table 6). It was observed that more than two-thirds (69, 49.3%) of the respondents who exercised engaged in it for a duration of less than 30 minutes. Sixty-six (47.1%) engaged in walking as a form of exercise while 15 (10.7%) respondents engaged in swimming. Other forms of exercises adopted by respondents included stretching, skipping and the use of a treadmill. Also fifty-nine (42.1%) respondents do not monitor their pulse rate while exercising. Only 6 (4.3%) respondents always monitor their pulse rate while exercising (Table 6).

It was also observed that more than two-thirds (106, 75.7%) of the respondents stated that they were not referred to the Physiotherapy Department for exercise prescription and training, and on the other hand, only 34 (24.3%) respondents were referred to the Physiotherapy Department for an exercise programme.

Among the various reasons given by respondents who do not exercise, the lack of motivation (19, 13.6%) was the highest reason (Figure 2).

Correlations between knowledge of the benefits of exercise and selected socio-demographic characteristics (age, level of educational attainment and monthly income)

There was a significant correlation (p = 0.003) between age and knowledge of the benefits of exercise among respondents with T2DM.

There was a significant correlation (p = 0.001) between educational attainment and knowledge of the benefits of exercises among respondents with T2DM. However, there was no significant correlation (p = 0.368) between the monthly income and knowledge of the benefits of exercise among respondents with T2DM (Table 7).

Correlation between practice of exercises and selected socio-demographic characteristics (age, level of educational attainment and monthly income)

There was a significant relationship (p = 0.001) between age and the level of practice of exercises among respondents with T2DM. There was a significant relationship (p = 0.002) between educational attainment and the level of practice of exercises among respondents with T2DM. Similarly, there was a significant relationship (p=0.001) between the monthly income and the level of practice of exercises among respondents with T2DM (Table 8).

Table 1: Age and Physical Characteristics of the Respondents (n=140)

Variable	Male	SD	Female	SD	Total	SD
Age (years)	54.36	14.94	61.36	14.17	58.86	14.79
Weight (Kg)	71.44	10.31	70.04	10.41	70.54	10.36
Height (m)	1.74	0.08	1.73	0.08	1.96	0.08
BMI (Kgm^{-2})	23.70	3.59	23.57	3.45	23.61	3.49

Key: Kg – Kilogram, m – Meters, SD - Standard deviation

Table 2: Socio-demographic Characteristics of the Respondents

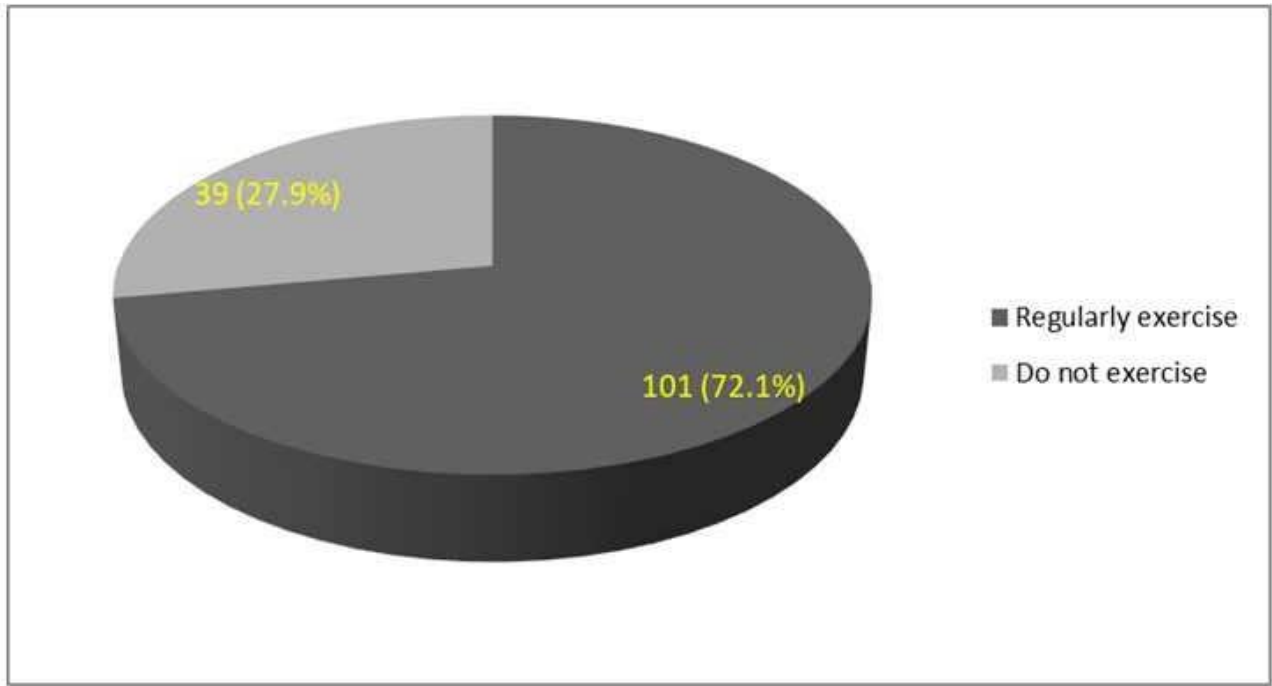|	Variables	Frequency (n)	Percentage (%)
Marital Status	Married	76	54.3
	Single	12	8.6
	Widowed	34	24.3
	Cohabiting	2	1.4
	Separated	9	6.4
	Divorced	7	5.0
Educational attainment	No formal education	8	5.7
	Incomplete primary education	13	9.3
	Primary education	43	30.7
	Secondary education	19	13.6
	Diploma	17	12.1
	Tertiary education	25	17.9
	Postgraduate studies	15	10.7
Occupational status	Student	5	3.6
	Unemployed	42	30.0
	Self employed	51	36.4
	Government employed	23	16.4
	Employed in Private company	18	12.9
	Others	1	0.7
Income status (naira)	< 18,500	16	11.4
	18,500 – 85,000	87	62.1
	> 85,000	27	19.3
	Didn't respond	10	7.14

Table 3: Knowledge of Respondents on Exercise

	Variables	Frequency (n)	Percentage (%)
Benefits of Exercise	Increase endorphin release	98	70.0
	Prevent osteoporosis	128	91.4
	Enhance lipid control	98	70.0
	Enhance BP control	117	83.6
	Enhance DM control	128	91.4
	Improve GI function	66	47.1
	Strengthen muscles	130	92.9
	Reduce stress	79	56.4
	Increase cardiopulmonary fitness	135	96.4
	Reduce weight	136	97.1
	Clearer vision	56	40.0
The acquisition of knowledge	Health care provider	77	55.0
	Mass media (TV, Radio)	14	10.0
	Internet	24	17.1
	Reading	32	22.9
	Attending a course	15	10.7
	Others	22	
Proper exercise frequency	Never	4	2.9
	1 day a week	19	13.6
	2 days a week	47	33.6
	3 – 5 days a week	70	50.0
Proper duration	Less than 10 minutes per day	14	10.0
	10 – 15 minutes per day	13	9.3
	15 – 20 minutes per day	37	26.4
	20 – 30 minutes per day	76	54.3
Warm up	Yes	41	29.3
	No	20	14.3
	I don't know	79	56.4
Cool down	Yes	107	76.4
	No	5	3.6
	I don't know	28	20.0

Table 4:   Knowledge of Precautionary Measures while carrying out Exercises

Variables	Yes n (%)	No n (%)	I don't know n (%)
T2DM should consult their health care provider for proper program	121 (86.4)	6 (4.3)	13 (9.3)
T2DM should have their BP checked before exercise	119 (85.0)	2 (1.4)	19 (13.6)
T2DM should not exercise in extreme weather conditions	53 (37.9)	18 (12.9)	69 (49.3)
T2DM should not do heavy exercise alone	101 (72.1)	12 (8.6)	27 (19.3)
T2DM should practice aerobic exercise	126 (90.0)	1 (0.7)	13 (9.3)
T2DM should wear proper shoe	78 (55.7)	5 (3.6)	57 (40.7)
T2DM should stop exercise when having abnormal symptom	120 (85.7)	7 (5.0)	13 (9.3)

Table 5: Knowledge of Respondents on Symptoms of Extreme Blood Sugar Reduction and Factors for Discontinuation of Exercise

|	Variables	Frequency (n)	Percentage (%)
Symptoms of extreme blood sugar reduction	Dizziness	46	32.9
	Hungry	44	31.4
	Sweating	58	41.4
	Fainting spell	55	39.3
	Rapid heart rate	53	37.9
Factors for discontinuation of exercise	Severe leg pain	65	46.4
	Difficulty in	81	57.9
	breathing	57	40.7
	Nausea and vomiting	74	52.9
	Dizziness	48	34.3
	Loss of balance	86	61.4
	Chest discomfort		

Figure 1: Respondents who engaged in exercise(s).

Table 6:   Practice Pattern of Exercise by Respondents

	Variables	Frequency (n)	Percentage (%)
Frequency	Every day	38	27.1
	3-5 times per week	25	17.9
	1-2 times per week	26	18.6
	1-2 times per month	5	3.6
	Less than 1 time per month	7	5.0
Duration	Less than 30 minutes	69	49.3
	30-60 minutes	23	16.4
	More than 60 minutes	1	0.7
	Uncertain	8	5.7
Continuation of exercise	Less than 3 months	30	21.4
	3-6 months	44	31.4
	More than 6 months-1 year	18	12.9
	More than 1 year	9	6.4
Time of the day			
	Morning	52	37.1
	Late morning	6	4.3
	Afternoon	3	2.1
	Evening	14	10.0
	Before bedtime	7	5.0
	Uncertain	19	13.6
Place	House	68	48.6
	Nearby the house	15	10.7
	Park	7	5.0
	Sport club	5	3.6
	Stadium	13	9.3
	Uncertain	7	5.0
Companions	None	52	37.1
	1-2	43	30.7
	3-5	3	2.1
	More than 5	3	2.1
Type of exercise	Walking	66	47.1
	Swimming	15	10.7
	Jogging	30	21.4
	Attending aerobic exercise class	16	11.4
	Using exercise machine	20	14.3
	Others	18	12.8
Self-pulse monitoring	No	59	42.1
	Yes-some times	26	18.6
	Yes-every times	6	4.3
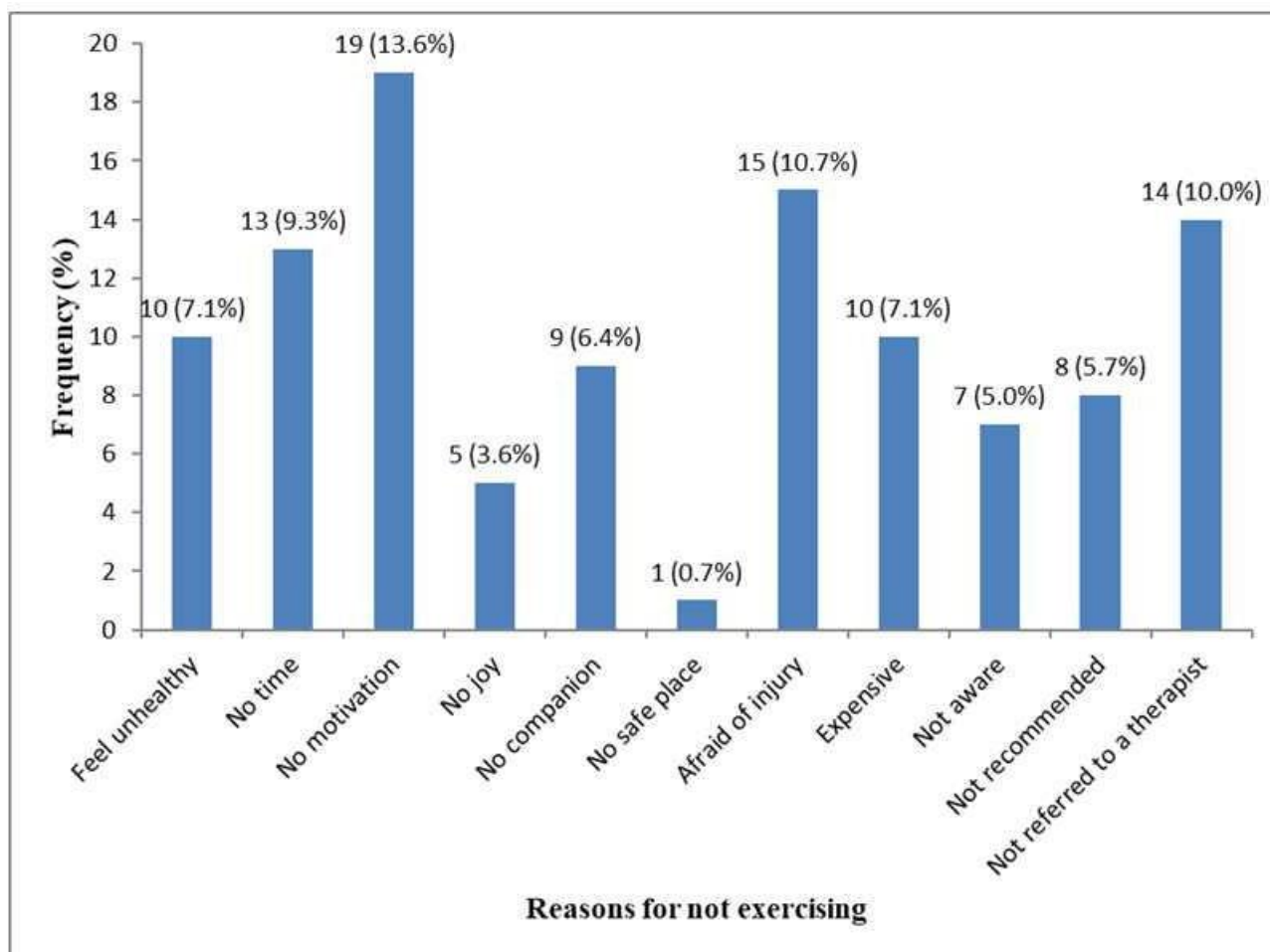
Figure 2: Reasons for not engaging in Exercise by the Respondents.

Table 7: Correlations between Selected Socio-Demographic Status and Knowledge of the Benefits of Exercise of the Respondents using the Spearman's Rank Order correlation

Variables	r_s value	p-value
Age	-0.249	0.003*
Educational attainment	0.293	0.001*
Monthly income	0.080	0.368

*Significance at p= 0.05

Key: r_s – Spearman's rho

Table 8: Correlations between Selected Socio-Demographic Status and Practice Level of Exercise of the Respondents using the Spearman's Rank Order correlation

Variables	r_s value	p-value
Age	0.466	0.001*
Educational attainment	-0.265	0.002*
Monthly income	-0.298	0.001*

*Significance at p= 0.05

Key: r_s – Spearman's rho

DISCUSSION

The aim of this study was to investigate the knowledge and practice of exercises for glycemic control among patients with T2DM. The respondents had good knowledge (55.45 ± 8.79 out of a total score of 72) of exercise in diabetes mellitus (DM) with male and female respondents having almost equal scores (55.34 ± 8.79 out of a total score of 72) of exercise in diabetes mellitus (DM) with male and female respondents having almost equal scores (55.34 ± 8.69 and 55.52 ± 8.89 respectively).

This implies that both genders knew the importance of exercise in DM. This corroborates a study conducted by Awotidebe et al.[17] which reported that patients demonstrated good knowledge of exercise for plasma blood glucose control.

Despite the overall good knowledge of the effect of exercise in glycemic control, many respondents (87, 62.1%) did not know that exercises should not be carried out in extreme weather. Exercising in extreme weather puts extra stress on the body and increases the core body temperature. Many of respondents thought that exercising was only beneficial for their weight reduction thus highlighting their knowledge of the importance of weight control in the treatment of T2DM. Even though most knew the proper frequency and duration of exercise, many did not know the benefits of a warm up session as an integral component of conditioning the body prior to exercising. Warm-up gently prepares the body for exercises by gradually increasing the heart rate and circulation. This will loosen the joints and increase blood flow to the muscles.

Many did not know the importance of wearing proper shoes while exercising as this is necessary considering the fact that diabetic patients are prone to foot injuries especially diabetic foot ulcer.[18]

It is intriguing that majority of the respondents knew they should stop exercising when they have abnormal symptoms, although most of them thought more of sweating as an abnormal symptom. Other abnormal symptoms such as dizziness and hunger should have been considered. A good number of the respondents were aware of factors for discontinuing exercise such as dizziness, difficulty in breathing, chest discomfort and severe leg pain but only a few knew about loss of balance.

On the assessment of actual practice of exercise, a satisfactory number of respondents responded positively to practice of exercise, with more than two-third (101, 72.1%) stating that they regularly engaged in one or more forms of exercises for an average of 30 minutes every day. This report differs from the report by Awotidebe et al.[17] which stated that there was negative attitude and poor practice of exercise among patients with T2DM. Most of them carried out walking which was often done in the morning in their residence. Evidently a number of them engaged in exercise more than three times a week thus corroborating their knowledge of how exercises should be carried out. It is worth noting that many (59, 42.1%) of the respondents stated their non-adherence to

monitoring their heart rate while exercising. Monitoring the heart rate is essential in order to detect any change in the heart rate while exercising as early as possible. Exercising with the calculated target heart rate range is essential. Among those who indicated not exercising, lack of motivation, fear of injury and not being referred to an exercise expert were the most reported reasons. This implies that the patients must be adequately educated, referred to the physiotherapist and motivated to engage in exercise.

Concerning the relationship between age and knowledge of the benefits of exercise as well as level of practice of exercise among patients with T2DM, there was an inverse significant relationship between the age and knowledge. This implies that with increasing age, knowledge of effects of exercise decreases. This may be brought about by the younger population having higher thirst for knowledge on the various available ways for managing their condition than the older population.[19] It was however also noted that there was a significant positive correlation between age and the level of practice of exercise. This implies that with increase in age, the practice of exercise may increase.

This shows that despite the higher knowledge among the younger population, they do not practice exercise as they ought to. They may be busy with various time consuming activities of daily living when compared with the elderly people who have the time to practice it.

The strong positive correlation between the level of educational attainment and knowledge was not unexpected as the higher the level of educational attainment, the higher the knowledge on the benefits of exercises. This is consistent with the study of Hui et al.[20] where education level attainment was found to positively associated with knowledge of physical activity among patients with diabetes mellitus. However, there was an inverse relationship between the level of educational attainment and level of practice of exercise. This implies that many of the respondents with higher level of education, who also have higher knowledge of the benefits of exercise, rarely practice it. This may also be as a result of busy schedules, as the higher the level of educational attainment, the more likelihood for such individuals to be involved in highly demanding and time consuming jobs which may not afford them the needed time for exercise.

Concerning the relationship between monthly income of the respondents and knowledge of the benefits of exercise as well as level of practice of exercise among patients with T2DM, there was no significant relationship between the income and knowledge; however, there was an inverse relationship between income and the level of practice of exercise. This suggests that the level of income may not influence how knowledgeable an individual is about exercise however it may influence the practice of exercise as many with high monthly income rarely practice exercising. The reason may be that those with high monthly income have high economic power to afford the luxurious things of life that make them live sedentary lifestyles while the reverse is the case with those with lower monthly incomes.

It was observed that there was a poor level of awareness of the importance of physiotherapy in the prescription and supervision of exercise which is a key component of the management of T2DM by physicians. This was evident as almost three quarters of the respondents stated that they were not informed on the importance physiotherapy for exercise prescription.

The findings from this study therefore necessitates the need for strong advocacy for better education of patients with T2DM on the importance of exercise, the precautionary measures for safe exercising such as proper warm up and cool down, regular heart rate and blood sugar monitoring, wearing of protective shoes, not exercising in extreme weather conditions and others as well as ensuring adherence to practice of exercise. In order to ensure adherence and safe practice of exercise, it is necessary for these patients to be appropriately referred for physiotherapy by physicians where exercise can be appropriately prescribed and supervised.

CONCLUSION

There was good knowledge of the benefits of exercise by patients with T2DM but poor knowledge of the precautionary measures to be taken while exercising. Also, a good number of the patients indicated regular practice of exercise but the number could be more. It is noteworthy that most exercises carried out by these patients were not prescribed and supervised by the physiotherapist.

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KNOWLEDGE AND PRACTICE OF EXERCISE AMONG PATIENTS WITH TYPE II DIABETES

SECTION A: SOCIO-DEMOGRAPHIC AND PHYSICAL CHARACTERISTICS (Please tick as appropriate)

1. Age as at last birthday _____ (years)

2. Sex: (a) Male { }   (b) Female { }

3. Height: _____ meters

4. Weight: _____ kilograms

5. Marital Status: (a) Single { }   (b) Married { }   (c) Cohabiting { } (d) Separated { }   (e) Divorced { }   (f) Widowed { }

6. Highest level of Educational attainment: (a) No formal education { }

   (b) Incomplete primary education { }   (c) Primary education { }

   (d) Secondary education { }   (e) Diploma { }   (f) Tertiary education { }

   (g) Post graduate education { }

7. Occupation: (a) Students { }   (b) Unemployed { }   (c) Self-employed { }   (d) Government employed { }   (e) Employed in private company { }   (f) Others please specify _____

8. Monthly income (Naira):   (a) ≤ 18,500 { }   (b) ≤ 85,000 { }

   (c) > 85,000 { }

9. Presence of associated disease: (a) No { }   (b) Yes { }

10. If "yes" to question 9, which associated disease(s) is/are present?

Hypertension   { }
Hyperlipidemia   { }
Heart disease   { }
Musculoskeletal problems { }
Asthma/pulmonary problems { }
Others please specify   _____

SECTION B: KNOWLEDGE OF PATIENTS ON EXERCISE (Please tick as appropriate)

11. Which of the following are the benefits of exercise?

It makes someone feel good   Yes { }   No { }   I don't know { }

It makes bones stronger   Yes { }   No { }   I don't know { }

It controls blood cholesterol level   Yes { }   No { }   I don't know { }

It enhances blood pressure control   Yes { }   No { }   I don't know { }

It enhances blood sugar control   Yes { }   No { }   I don't know { }

It aids digestion   Yes { }   No { }   I don't know { }

It strengthens the muscles   Yes { }   No { }   I don't know { }

It reduces stress   Yes { }   No { }   I don't know { }

It makes someone physically fit   Yes { }   No { }   I don't know { }

It helps to reduce ones weight Yes { }   No { }   I don't know { }

It makes someone vision clearer   Yes { }   No { }   I don't know { }

1. How did you become aware of the benefits of exercise in Diabetes Mellitus (DM)?

Health care provider   { }

Mass media (TV, Radio)   { }

Internet   { }

Reading (Newspaper, Print media) { }

Attending a course   { }

Others please specify   ……………………………

2. How should aerobic exercise such as walking, jogging, running be carried out?

i.   Proper frequency of exercise is?

Never   {   }

1 day a week   { }

2 days a week   { }

3 – 5 days a week   { }

ii.   How much time did you usually spend doing moderate physical activities like gardening, cleaning, bicycling at a regular pace, swimming or other fitness activities?   _____hours_____minutes

iii. How much time did you usually spend doing vigorous physical activities like heavy lifting, heavier garden or construction work, chopping woods, aerobics, jogging/running or fast bicycling?   _____hours_____minutes

iv.   Proper duration of exercise is?

Less than 10 minutes per day {   }

10 – 15 minutes per day   {   }

15 – 20 minutes per day   {   }

20 – 30 minutes per day   {   }

iii.   Warm up is important before exercise

Yes {   }   No {   }   I don't know   {   }

iv.   Cool down is important after exercise

Yes {   }   No {   }   I don't know   {   }

14. Knowledge of precautionary measures while carrying out exercise

Patient with diabetes mellitus should consult their health care provider for proper program

Yes {   }   No {   }   I don't know {   }

Patients with diabetes mellitus should have their blood pressure checked before exercising

Yes {   }   No {   }   I don't know {   }

Patient with diabetes mellitus should not exercise in extreme weather conditions (too cold, too hot)   Yes {   }   No {   }   I don't know {   }

Patient with diabetes mellitus should not do heavy exercise   alone   Yes {   }   No {   }   I don't know {   }

Patient with diabetes mellitus should practice aerobic exercise such as walking, jogging, running etc   Yes {   }   No {   }   I don't know {   }

Patient with diabetes mellitus should wear proper shoes while exercising   `

Yes {   }   No {   }   I don't know {   }

Patient with diabetes mellitus should stop exercise when having abnormal symptom Yes {   }   No {   }   I don't know {   }

15. Can patients with diabetes mellitus have extreme blood sugar reduction while exercising?   Yes {   }   No {   }   I don't know {   }

16. If yes to question 15, which of the following symptoms of extreme blood sugar reduction are you aware of?

Dizziness	Yes { }	No { }	I don't know { }
Hungry	Yes { }	No { }	I don't know { }
Sweating	Yes { }	No { }	I don't know { }
Fainting spell	Yes { }	No { }	I don't know { }
Rapid heart rate	Yes { }	No { }	I don't know { }

17. Which of the following symptoms would a patient with diabetes mellitus observe while exercising to discontinue exercise?

Severe leg pain	Yes { }	No { }	I don't know { }
Difficulty in breathing	Yes { }	No { }	I don't know { }
Nausea & vomiting	Yes { }	No { }	I don't know { }
Dizziness	Yes { }	No { }	I don't know { }
Loss of balance	Yes { }	No { }	I don't know { }
Chest discomfort	Yes { }	No { }	I don't know { }

SECTION C: PRACTICE PATTERN OF PHYSICAL EXERCISE (Please tick as appropriate)

18. Did your Doctor recommend exercise programme for you as part of the management of your Diabetes?   Yes { }   No { }

19. If yes to question 18, were you referred to the Physiotherapy department for the exercise programme?   Yes { }   No { }

20. Do you think carrying out exercise with the supervision of the Physiotherapist is necessary?   Yes { }   No { }   I don't know { }

21. Do you regularly exercise on your own with or without supervision of a Physiotherapist?   Yes { }   No { }
    If your answer to Q21 is a "NO", go to Q30

22. If yes to question 21, with or without supervision, how regularly do you carry out exercise?

Every day   { }
3-5 times per week   { }
1-2 times per week   { }
1-2 times per month   { }
Less than 1 time per month   { }
Others please specify   _____

23. For how long do you carry out exercises per time?
Less than 30 minutes   { }
30-60 minutes   { }
More than 60 minutes { }
Uncertain   { }
Others please specify _____
24. For how long have you been consistent in carrying out exercise?
Less than 3 months   { }
3 – 6 months   { }
More than 6 months – 1 year { }
More than 1 year   { }
25. What time of the day do you normally carryout exercise
Morning   { }
Late morning { }
Afternoon   { }
Evening   { }
Before bedtime   { }
Anytime   { }

26. Where do you carry out your exercise?
House   { }
Nearby the house/street   { }
Park   { }

Sport club   { }
Stadium   { }
Uncertain   { }
Others please specify _____

27. How many companions do you usually have when exercising?
None   { }
1-2   { }
3-5   { }
More than 5 { }

1. What type of exercise do you usually do?
Walking   { }
Swimming   { }
Jogging   { }
Attending aerobic exercise class   { }
Using exercise machine   { }
Others please specify   _____

2. Do you monitor your pulse rate while exercising
No {   }
Yes-sometimes   { }
Yes-every times   { }

3. If No to question 21, what is/are the reason(s) for not exercising regularly (you can tick
    more than one option)
Feel Unhealthy   { }
Lack of time   { }
No Motivation   { }
No Joy   { }
No Companions   { }
No safe place   { }
Afraid of getting injured { }
I think it is expensive { }
Not aware of the benefits   { }
Was not recommended by my Doctor{ }
My doctor did not refer me to a Physiotherapist   { }
Others please specify   _____

CROSS-CULTURAL ADAPTATION AND VALIDATION OF THE IGBO VERSION OF THE RETURN TO WORK ASSESSMENT SCALE (I-RAS) AMONG STROKE SURVIVORS IN SOUTH-EAST NIGERIA

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ABSTRACT

BACKGROUND: The Return-to-work Assessment Acale (RAS) questionnaire is an outcome instrument used to measure the physical, psychological and social behavior and response of individuals to returning to work following injury or illness. This instrument has been validated in the English language, though here in Nigeria we have three (3) major languages: Igbo, Hausa and Yoruba.

AIM: The aim of this study was to translate, culturally adapt and validate the Igbo version of RAS in order to enhance its use in Igbo speaking population.

METHOD: This study was a cross-sectional survey involving 100 post stroke survivors. The original version of Return-to-work Assessment Scale (ERAS) was translated to Igbo (IRAS) and cross-validated. This Igbo version of RAS (IRAS) was subjected to reliability, validity and internal consistency.

RESULT: the results revealed that 59 (59.0%) were males and 41 (41.0%) females. Internal consistency was high with a Cronbach's alpha coefficient of 0.86 for Domain 1, 0.86 for Domain 2 and 0.87 for Domain 3. Test-retest reliability analysis gave an ICC of 0.99(p=0.001) for Domain 1, Domain 2 an ICC of 0.99(0.001), Domain 3 an ICC of 0.99(0.001). TheKaiser-Meyer-Olkin measure of sampling adequacy(KMO) value for Domain 1 was X^2=0.69 and that of Bartlett's test of sphericity value was significant (p=0.001); Kaiser-Meyer-Olkin measure of sampling adequacy for Domain 2 was X^2=0.80 and the Bartlett's test of sphericity value was significant (P=0.001); the Kaiser-Meyer-Olkin measure of sampling adequacy for Domain 3 was X^2=0.79 while the Bartlett's test of sphericity was significant (p=0.001).

CONCLUSION: The Igbo version of the Return-to-work Assessment Scale (IRAS) is a good, reliable and internally consistent toolfor assessing readiness to return to work in Igbo stroke survivors.

Keywords: Stroke, Work, Return-to-work, Return-to-work Assessment Scale, Translation and Cross-cultural adaptation.

Introduction

The International Classification of Functioning, Disability and Health (ICF) defined work as engaging in all aspects of work, as an occupation, trade, profession or other form of employment, for payment or when payment is not provided, as an employee, full time or part-time, or self-employed[1,2]. According to Eriksson *et al.,* work includes all aspects of work and employments or being self-employed, for payment or unpaid. Work plays an essential role in peoples' lives, may be therapeutic, and has positive health effects for people with or without disabilities[3]. Asides its economic significance as an important source of income, work is associated with benefits of critical importance for an individual's health and well-being. It is necessary for active involvement in society and for satisfying essential psychosocial needs; it helps develop and maintain one's identity and social status[4, 5]. Not participating in working-life has both social and personal economic consequences, as well as a negative impact on quality of life[3]. Individuals who aren't able to work in any construct of work are said to be "work disabled" - and a class of individuals who are often work disabled are stroke patients.

Stroke which is a cardiovascular accident is a major cause of long-term disability and the second leading cause of death globally, with an associated high economic cost and detrimental impact on the physical, social and psychological functioning of the survivors[6].

According to the Global Burden of Disease Study, stroke affects 13.7million people globally per year and is the second leading cause of death, with 5.5million deaths per year[7]. An estimated 1 in 4 adults will experience a stroke in their lifetime and there are >80million survivors of stroke globally[8, 9]. Its mortality in Nigeria is high. According to Danesi *et al.,* in a study conducted in Lagos, Southwest Nigeria, the gender specific rate was 28.3/100,000 for males and 21.3/100,000 for females[10]. The age adjusted rate was 54.08% per 100,000 year; hospitalization rate was 84.6%, while the case-fatality-rate (CFR - hospitalized) was 16.2% in Surulere Sub-urban of Lagos [2, 10]. In a study conducted in Ondo, Southwest Nigeria, Okon *et al.,* placed pathologic diagnosis as confined in 75% of the cases[11]. Stroke is the leading cause of neurological admissions into tertiary health care institutions in Nigeria also accounting for a fatality rate between 1.8% and 15.6% of all deaths in these institutions and as such is an important health concern for individuals and society and a public health burden in Nigeria [2, 12].

Individuals who have suffered a stroke accident and survived are referred to as Post stroke survivors. The incidence of stroke is growing in different parts of the world and the condition most commonly affects the working-age population, say, one in four patients is less than 60 years old [13,14]. Hence the social, physical and psychological consequences of stroke affect the rate of return to work of working-age post stroke adults.

Return-to-work, often abbreviated as RTW, can mean the process of returning to work but also refers to an outcome of the process of vocational rehabilitation[3].

Return-to-work is not just astate, but a multi-phase process, encompassing both a series of events, transitions and phases as well as interaction with other individuals and the environment. The process begins at the onset of the work disability and concludes when a satisfactory long-term outcome has been achieved. This RTW-process is complex, requires constructive collaboration between stakeholder and an openness for new solutions and approximately 40% -50% of those having stroke in working ages do not return to work[3]. The RTW-process is dependent on the dynamic interaction between a person's health status and contextual factors hence, it is important to have instruments which can capture the dynamic nature of the RTW process [15,16]. Therefore the return-to-work assessment scale is used to assess their level, capability and readiness toreturn to work.

The Return-To-Work assessment scale (RAS) is an outcome measure developed by Ibikunle *et al.,* which assesses return to work among post stroke survivors[2]. This instrument was designed to assist stroke survivors with assessing their readiness to return to work. It is a self-report questionnaire with 2 sections (A and B) and containing a sum total of 86 items in the 3 domains of the section B. Each domain of the RAS questionnaire has sub domains which answers questions addressing the personal, work and contextual factors aspect of the individual's life and well-being. The domains address separate aspects of the individual's life and contains unequal number of sub domains therefore they are scored separately. The RAS outcome measure has been shown to be reliable and valid in a patient population of various age and gender post stroke survivors[2]. Hence the RAS is an excellent, intentionally consistent and reliable tool that demonstrates good group reliability, internal consistency and structural validity and should be adapted for use in monitoring return to work in post stroke patients[2].

Cross-cultural adaptation of validated outcome instruments has been advocated to facilitate their use in international multi-center clinical trials [17, 18], which would also reduce the need for developing new instruments with the same purpose[18, 19]. To maintain the validity of the original instrument while taking into consideration important cultural differences, a specific methodology has been developed for the adaptation process [18,20,21,22]. Nigeria is a multicultural country, with the South Eastern region (Igbo speaking population and one of the main indigenous language), constituting of approximately 22million of the total 193million Nigerian population[23]. There is need for translation, cross cultural adaptation and validation of RAS as a standardized outcome measure for Igbo monolingual individuals who have survived stroke in Nigeria.

The Return-to-work assessment scale is a good, internally consistent and reliable tool that has demonstrated good group and structural validity in English language[2]. In Nigeria, the RAS hasn't been cross culturally translated or adapted to any tribe, language or geographical region. Hence, the Nigerian Native languages (Igbo, Hausa, Yoruba and other tribal languages) monolinguals in Nigeria lack a standardized uniform outcome measure for post stroke individuals seeking physiotherapy and medical evaluation and assessment to return to work.

The absence of the Igbo version of RAS (I-RAS) in the hospitals will short-change the post stroke Igbo monolinguals in Nigeria to access complete and effective medical care. Therefore, there is a need for the original English version of the RAS questionnaire to be translated, cross-culturally adapted and validated as the Igbo version of RAS (I-RAS).

The aims of this study are to:

1. Translate Original English version of RAS (E-RAS) to I-RAS.

2. Cross-culturally adapt and validate the I-RAS to the Igbo culture and environment.

The outcome of this study has established a standardized outcome measure which will be used in hospitals for Igbo monolinguals in Nigeria.It has also provided a uniform communication measure for assessing post stroke individuals who are Igbo monolinguals.

This study will promote the evaluation of medical treatment, physiotherapy interventions among Igbo monolinguals who are post stroke survivors.This study will stand as a reference and aid further research purposes.

MATERIALS AND METHOD

This research wasa cross-sectional survey.The population for this study were adult individuals aged 40 years and above who were post stroke survivors within selected locations in South East Nigeria, who met the inclusion criteria. They were recruited from the following health institutions;

1. Nnamdi Azikiwe University Teaching Hospital. Nnewi, Anambra State.

2. Federal Medical Centre Owerri, Imo state.

3. Enugu-ukwu

4. Igbo-ukwu

Inclusion Criteria

1. Participants who are post stroke survivors in the selected South-Eastern health establishments.

2. Patients who are 40 years and above.

3. Patients who are literate in both English and Igbo language.

4. Patients who are emotionally stable.

Exclusion criteria

1. Patients whose symptoms duration was less than two months.

2. Patient's inability to complete questionnaires because of cognitive impairments or language barriers.

3. Post stroke survivors who are not willing to participate

4. Patients with other comorbidities that can affect their return to work.

Sampling techniques and sample size

Purposive sampling technique was used to select post stroke survivors from the selected institutions.

One hundred (100) participants were recruited from the selected health establishments in the South-Eastern region of Nigeria

Research Instrument

The RAS Questionnaire

The return-to-work assessment scale (RAS) questionnaire according to Ibikunle*et al.,* (2021), is an instrument designed to assist stroke survivors with assessing their readiness return to work. The scale is made up of two sections, A and B.

Section A is made up of general questions about the individual completing the scale, while section B includes three parts that are important to consider in deciding the individual's ability to return to work. The three domains of return to work in section B are scored separately; each domain assesses a different concept in return to work. Domain 1 (personal), Domain 2 (work), Domain 3 (contextual factors). It is important to note that the three (3) Domains are assessed independently of the other, so their scores do not provide an overall sum.

Psychometric properties of the RAS

Internal consistency

Internal consistency was high with a Cronbach's alpha coefficient of 0.81 for Domain 1, 0.93 for Domain 2 and 0.76 for Domain 3.

Reliability

Test-retest reliability analysis gave an ICC of 0.85(p=0.001) for Domain 1, Domain 2 an ICC of 0.91 (p=0.001) and Domain3 an ICC of 0.99(p=0.001).

Validity

TheKaiser-Meyer-Olkin measure of sampling adequacy (KMO) value for Domain 1 was X2 =0.63 and that of Bartlett's test of sphericity value was significant (P=0.000), Kaiser-Meyer-Olkin measure of sampling adequacy for Domain 2 was 0.84 and the Bartlett's test of sphericity value was significant (P=0.000), the Kaiser-Meyer-Olkin measure of sampling adequacy for Domain 3 was 0.66 while the Barlett's test of sphericity was significant (p=0.001). Therefore, the factor analysis was appropriate.

Scoring of RAS

The scoring of RAS follows established methods in the RAS questionnaire developed by Ibikunle *et al.,*[2]. It consists of two sections: A and B; section A involves general questions about the individuals while the section B addresses 3 domains which is important to consider in the decision to return to work. The 3 domains of the RAS questionnaire address different constructs and are therefore scored separately. The RAS questionnaire is thus scored as:

Domain 1

0-53	Poor not ready to return
54-106	moderately ready to return
107-140	Independent and ready to return

Domain 2

0-22	Poorly able to cope
23-46	moderately able to cope
47-93	Able to cope at work place

Domain 3

0-19	Poorly supportive
20-38	mildly supportive
39-57	moderately supportive
58-95	Contextual factors supportive

Procedure for Data Collection

An ethical approval was obtained from the Ethical Review Committee of Nnamdi Azikiwe University Teaching Hospital Nnewi before the commencement of this study. A letter of introductionwas also gotten from the Department of Medical Rehabilitation Nnamdi Azikiwe introducing the researcher as one of her students thereby facilitated the permission to conduct the study in the Physiotherapy Department of the selected healthinstitutions where data was collected.

The procedure employed in this study followed the guideline for translation and cross-cultural adaptation by Beaton et al [24]. The procedure for this study was in 3 phases:
Phase 1: Translation Phase.
Phase 2: Adaptation Phase.
Phase 3: Validation Phase.

The purpose and procedure of this study was explained to the participants who met the inclusion criteria. They were made to understand that their participation in this study would be voluntary. Therefore, only post stoke survivors who gave their informed consent were allowed to partake in this study. The socio-demographic characteristics (age, sex, occupation) and information on the part(s) of the body that was affected were obtained from the participants. They responded to the questionnaire according to their abilities to do so and they answered/completed all sections.

PHASE 1: TRANSLATION PHASE

This involves the translation of the original English version of the RAS to Igbo version of RAS. The original English version of RAS was translated by two bilingual translators whose first language is Igbo, with one having a medical background and the other having no medical background (forward translation). This produced two different Igbo versions of RAS (T1 and T2). The two forward translations were reviewed and discussed by the two translators and a synthesized version was formed (T-12), differences were resolved by consensus. The synthesized version (T-12) was translated back to English language (back translation – B1 and B2) by two other bilingual translators (who speaks and understands both English and Igbo languages), who are graduates of English language and had no idea of the concepts being investigated.

PHASE 2: ADAPTATION PHASE

The translations (T1, T2, T-12, B1, and B2) were reviewed by members of an expert committee comprising of translators (forward and back translators), physiotherapist, and an outcome methodologist. Discrepancies were resolved by consensus to achieve semantic equivalence, idiomatic equivalence, experiential equivalence and conceptual equivalence of the pre-final Igbo version of RAS. The pre-final version was created and subjected to field testing on twenty (20) post stroke patients of both genders. The findings of this field testing were reviewed by this expert committee in a second meeting to produce the final Igbo version of RAS (I-RAS).

PHASE 3: VALIDATION PHASE

The final Igbo version of RAS and the original English version of RAS were distributed to post stroke survivors among patients attending physiotherapy sessions in selected health institutions in the South-East of Nigeria. The order of administration of the two questionnaires was based on importance; the final Igbo version of the RAS was administered first.The I-RAS questionnaire was re-administeredon the participants a week after the first administration by the researcher.

Procedure for Data Analysis

1. The data and scores on the I-RAS and E-RAS obtained from this study were summarized using frequency counts and percentages, mean and standard deviation.

2. The Spearman rank order correlation coefficient was used to analyze the correlation between participants' scores on the E-RAS and I-RAS (to determine known group validity), and was also used to analyze the correlation between the items in the E-RAS and I-RAS, (to determine construct validity).

3. The Interclass Correlation Coefficient (ICC) and Bland and Altman plotting method was used to compare the scores on the I-RAS at the two different occasions to determine the test-retest reliability of I-RAS.

4. The Cronbach's alpha was used to determine the internal consistency of the I-RAS.

5. Factor analysis was used to determine the structural validity of the I-RAS.

The level of significance was set at ≤ 0.05.

RESULTS

Phase 1: Translation process of the original version of the Return to work Assessment scale (RAS) to the Igbo version of the RAS.

The original version of the RAS was translated to Igbo version which produced two different Igbo versions of I-RAS (T1 and T2). The two forward translations (T1 and T2) were reviewed, discussed and a synthesis (T-12) was reached. The consensus version (T-12) was translated back to English Language (B1 and B2).

Phase 2: Cross-cultural Adaptation process of the RAS into Igbo culture and environment.

All the instructions, domain preambles of each section were retained. Out of the total 86 items in the section B of the ERAS questionnaire, one (1) item was removed, one (1) totally modified and terms in some items modified during the process of cultural adaptation. Table 5 summarizes the modifications. Some terms (e.g. the options *Right* and *Left* in items 4, 5 and 7 of section A) were replaced with Igbo culturally equivalent terms. Some other terms (e.g. responses *Unable to* and its likes occurring in section B) were modified to their personalized forms to match with the culturally adapted Igbo lexis and structure. Item 5 of the Personal domain and the term *Cordial* in the work domain of section B were replaced with the semantic equivalent in the culturally adapted Igbo RAS.

Phase 3: Validation of Igbo RAS

Socio-Demographic distributionof the participants

One hundred patients who are stroke survivors participated in the psychometric testing of the Igbo RAS (Table 1). They comprised of 59 (59.0%) males and 41 (41.0%) females with age groups ranging from 40 (being the minimum age in the inclusive criteria) to 80 years (the maximum age encountered during data collection). The most frequently affected age group was 51 to 60 years (Table 1). All the participants (i.e. 100%) are Africans in the option of Race.The participants were categorizedaccording to the nature of their employment frequency, in which 62 (62.0%) participants were under permanent employment (Table 3). In the aspect of employment function/position, *others;* an option referring toparticipants who carry out non-administrative and non-technical functions was ticked the most: (66.0%) (Table 3). In the clinical aspect, 47 (47.0%) participants presented with left sided paralysis (Table 2); 44 (44.0%) participants presented with Hypertension as the most frequent comorbidity (Table2).

TABLE 1: Frequency Table

Variable	Class	Frequency	Percent (%)
Sex	Male	59	59.0
	Female	41	41.0
	Total	100	100.0
Race	African	100	100.0
Age	31-40	8	8.0
	41-50	24	24.0
	51-60	38	38.0
	61-70	24	24.0
	71-80	6	6.0

Table 2: Clinical variables of participants in the validity study

Variable	Class	Frequency	Percent(%)
Side affected	Right side	46	46.0
	Left side	47	47.0
	Both sides	7	7.0
Location of brain	Right	49	49.0
	Left	46	46.0
	Both	5	5.0
Grading of stroke	Total weakness	10	10.0
	Partial weakness	90	90.0
Impairment	Right	48	48.0
	Left	49	49.0
	Both	3	3.0
Speech defect	Yes	28	28.0
	No	72	72.0
Cognitive defect	Yes	53	53.0
	No	47	47.0
Hospitalization	No	53	53.0
	Days	4	4.0
	Weeks	25	25.0
	Months	11	11.0
	Years	7	7.0
Treatment	None	23	23.0
	Hospital drugs	54	54.0
	Igbo drugs	4	4.0
	Traditional	7	7.0
	Holisticmedical care	11	11.0
	Surgery	1	1.0
Rehabilitation	Physiotherapy	44	44.0
	OT	2	2.0
	Homebased	3	3.0
	Others	31	31.0
	PT + traditional	10	10.0
	PT + homebased	5	5.0
	PT+ speech	2	2.0
	PT + psychiatric	3	3.0
Intensity of treatment	Once a week	70	70.0
	Twice a week	28	28.0
	Thrice a week	2	2.0
Recovery rate	Good	61	61.0
	Moderate	38	38.0
	Poor	1	1.0
Comorbidity	Hypertension	44	44.0
	Diabetes	14	14.0
	Others	1	1.0
	None	30	30.0
	Hypertension + diabetes	11	11.0

Table 3: Employment variables in the validity study

Variable	Class	Frequency	Percent (%)
Nature of employment	Temporary	15	15.0
	Casual	18	18.0
	Contract	5	5.0
	Permanent	62	62.0
Time off work	Weeks	21	21.0
	Months	41	41.0
	Years	38	38.0
Renumeration when off work	Yes	14	14.0
	No	86	86.0
Are you required to return to work	Yes	54	54.0
	No	46	46.0
Are you ready to return	No	100	100.0
Any policy for disability at work	Yes	5	5.0
	No	95	95.0
Type of work	Admin.	22	22.0
	Technician	12	12.0
	Other	66	66.0
Hours of work	1-3hours	4	4.0
	4-6hours	26	26.0
	7-9hours	44	44.0
	10-14hours	26	26.0
Shift duty	Yes	11	11.0
	No	89	89.0
Does your work include travelling	Yes	38	38.0
	No	62	62.0
Desk or office bound work	Desk work	15	15.0
	Office work	40	40.0
	Others	45	45.0
Communication	Speak fluently	54	54.0
	I don't have to speak fluently	46	46.0
Writing	I must write legibly	30	30.0
	I don't need to write legibly	70	70.0
Communicating with people	Daily	79	79.0
	Once a week	21	21.0

DOMAIN 1 OF IGBO VERSION OF RETURN TO WORK ASSESSMENT SCALE (IRAS)

PRINCIPAL COMPONENT ANALYSIS (PCA)

This domain 1 of the IRAS is made up of Forty-three items and were subjected to principal component analysis (PCA) using the SPSS version 23. Prior to performing PCA, the suitability of the data for Factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser Meyer-Olkin value was 0.69, slightly exceeding the recommended value of .6 and Bartlett's Test of Sphericity reached statistical significance, (p=0.001) supporting the factorability of the correlation matrix[25,26,27].

Principal component analysis revealed the presence of eleven components with Eigen factor exceeding 1, explaining 22.13%, 10.74%,7,86%,7.12%,5.17%,4.25%,4.08%,3.68%,3.41%,2.79%,2.40% of the variance respectively (see fig 1). An inspection of the scree plot revealed a clear break after the fifth component. Using the Cartel's scree test[28], it was decided to retain five components for further investigations (see fig 2) This was further supported by t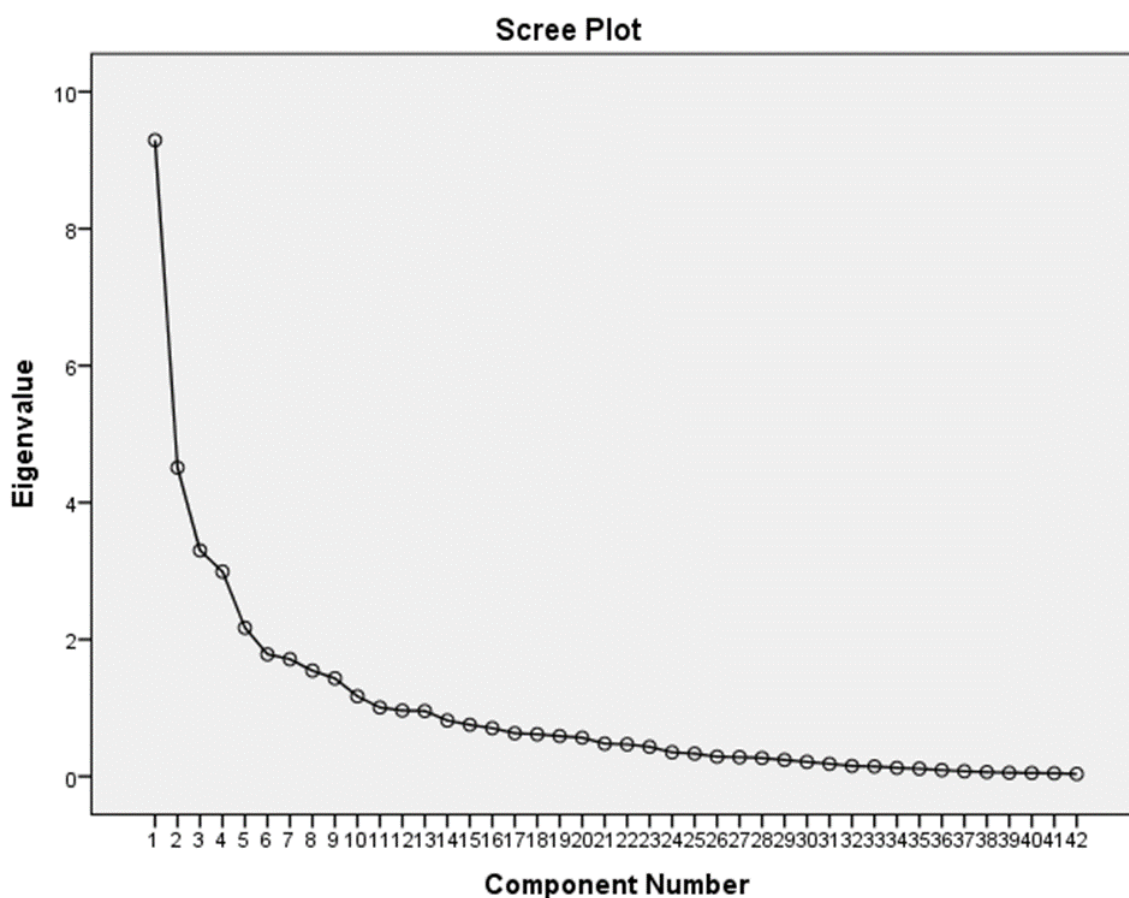he result of the Monte Carlos PCA for parallel analysis (see table 4), which showed only five components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the sample size (42 variables ×100 respondent)

The five components solution explained a total of 53.01% of the variance, with Component 1 contributing 22.13%, Component 2 contributing 10.74%, Component 3 contributing 7.86%, Component 4 contributing 7.12%, and Component 5 contributing 5.17%. To aid in the interpretation of these five components, oblimin rotation was performed. The rotated solution revealed the presence of simple structure[29], with five components showing a number of strong loadings and all variables loading substantially on only three component and negative affect items loading strongly on components 4 and 5.The interpretation of the five components was consistent with previous researches on the RAS Scale, with positive affect items loading strongly on Component 1 and 2 and negative affects items loading strongly on Components 3, 4 and 5.

DOMAIN 2 OF IGBO VERSION OF RETURN TO WORK ASSESSMENT SCALE (IRAS)

PRINCIPAL COMPONENT ANALYSIS (PCA)

This domain 2 of the IRAS is made up of Twenty-two items and were subjected to principal component analysis (PCA) using the SPSS version 23. Prior to performing PCA, the suitability of the data for Factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above.

The Kaiser Meyer-Olkin value was 0.80, slightly exceeding the recommended value of .6 and Bartlett's Test of Sphericity reached statistical significance, (p=0.001) supporting the factorability of the correlation matrix[25,26].

Principal component analysis revealed the presence of six components with Eigen factor exceeding 1, explaining 31.96%, 11.3%, 7.74%, 7.12%, 6.3% 5.08% of the variance respectively (see fig 3). An inspection of the scree plot revealed a clear break after the fourth component. Using the Cartel's scree test[28], it was decided to retain five components for further investigations (see fig 4). This was further supported by the result of the Monte Carlos PCA for parallel analysis (see

Fig 1: Scree plot of Domain 1 before direct oblimin rotation.
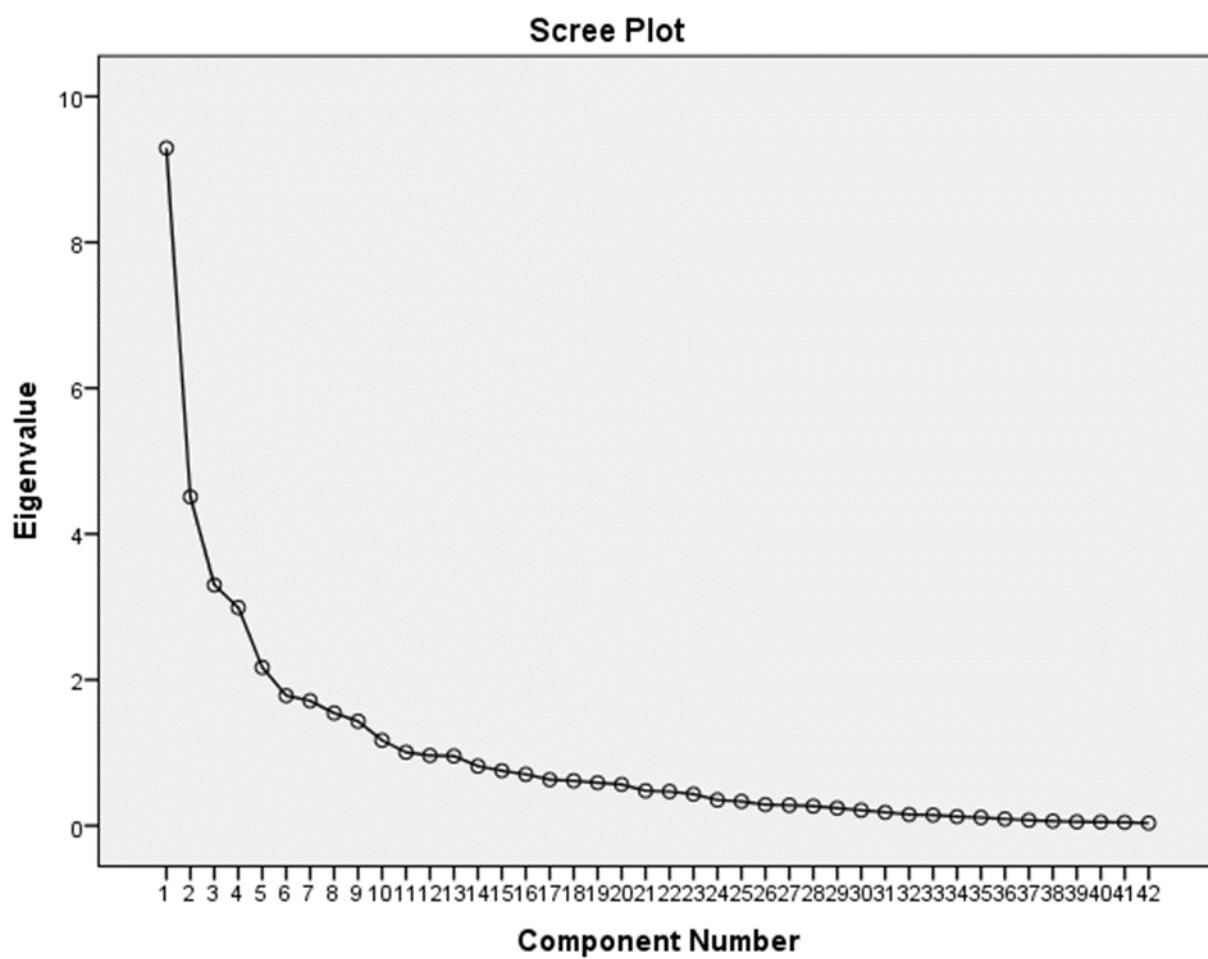
Figure 2: Scree plot of Domain 1 after direct oblimin rotation.
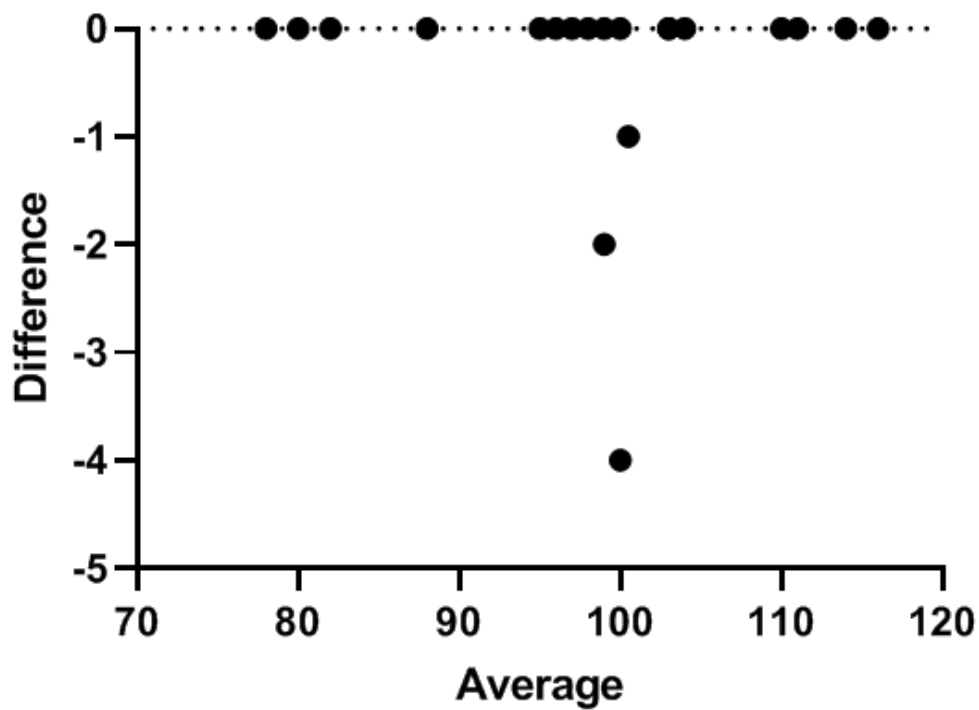
Fig 3: Bland-Altman plot of test-retest scores of Domain1 of IRAS.

Table 5), which showed only five components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the sample size (22 variables ×100 respondent)

The four components solution explained a total of 53.12% of the variance, with Component 1 contributing 31.96%, Component 2 contributing 11.30%, Component 3 contributing 7.74%, Component 4 contributing 7.12%. To aid in the interpretation of these five components, oblimin rotation was performed. The rotated solution revealed the presence of simple structure[29], with four components showing a number of strong loadings and all variables loading substantially on only one component and negative affect items loading weakly on components 2 and 4 .The interpretation of the four components was consistent with previous researches on the RAS Scale, with positive affect items loading strongly on all the Component and negative affects items loading weakly on Components 2 and 4. The bland-AltmanThe interpretation of the four components was consistent with previous researches on the RAS Scale, with positive affect items loading strongly on all the Component and negative affects items

loading weakly on Components 2and 4 (see table 5), which showed only five components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the sample size (42 variables ×100 respondent)

The three components solution explained a total of 61.59% of the variance, with Component 1 contributing 32.41%, Component 2 contributing 15.15%, Component 3 contributing 10.04%. To aid in the interpretation of these five components, oblimin rotation was performed. The rotated solution revealed the presence of simple structure[28], with three components showing a number of strong loadings and all variables loading substantially on only one component and negative affect items loading moderately on components 2 and 3 .The interpretation of the five components was consistent with previous researches on the RAS Scale, with positive affect items loading strongly on all three Component 1 and 2 and negative affects items loading moderately on Components 2 and 3
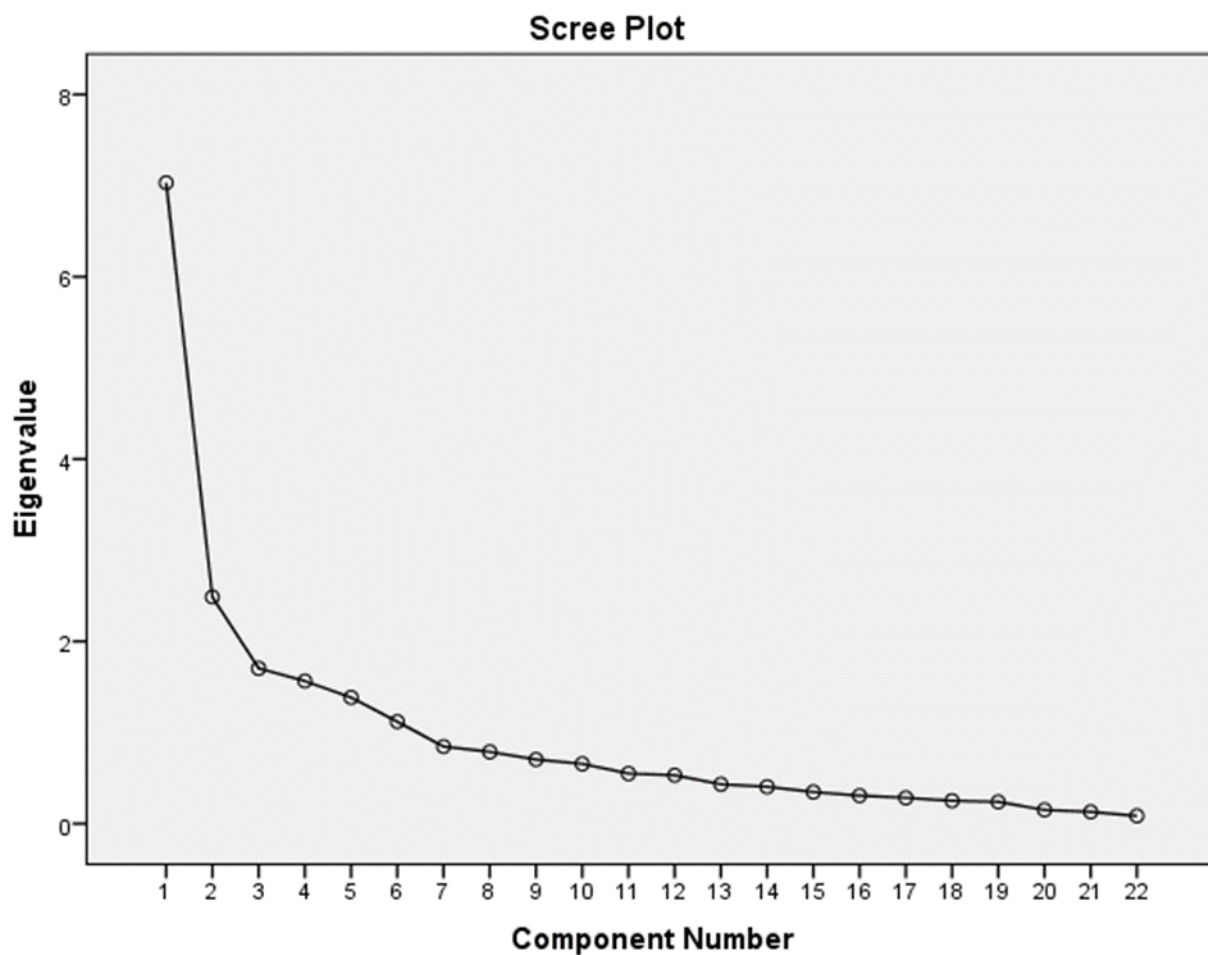
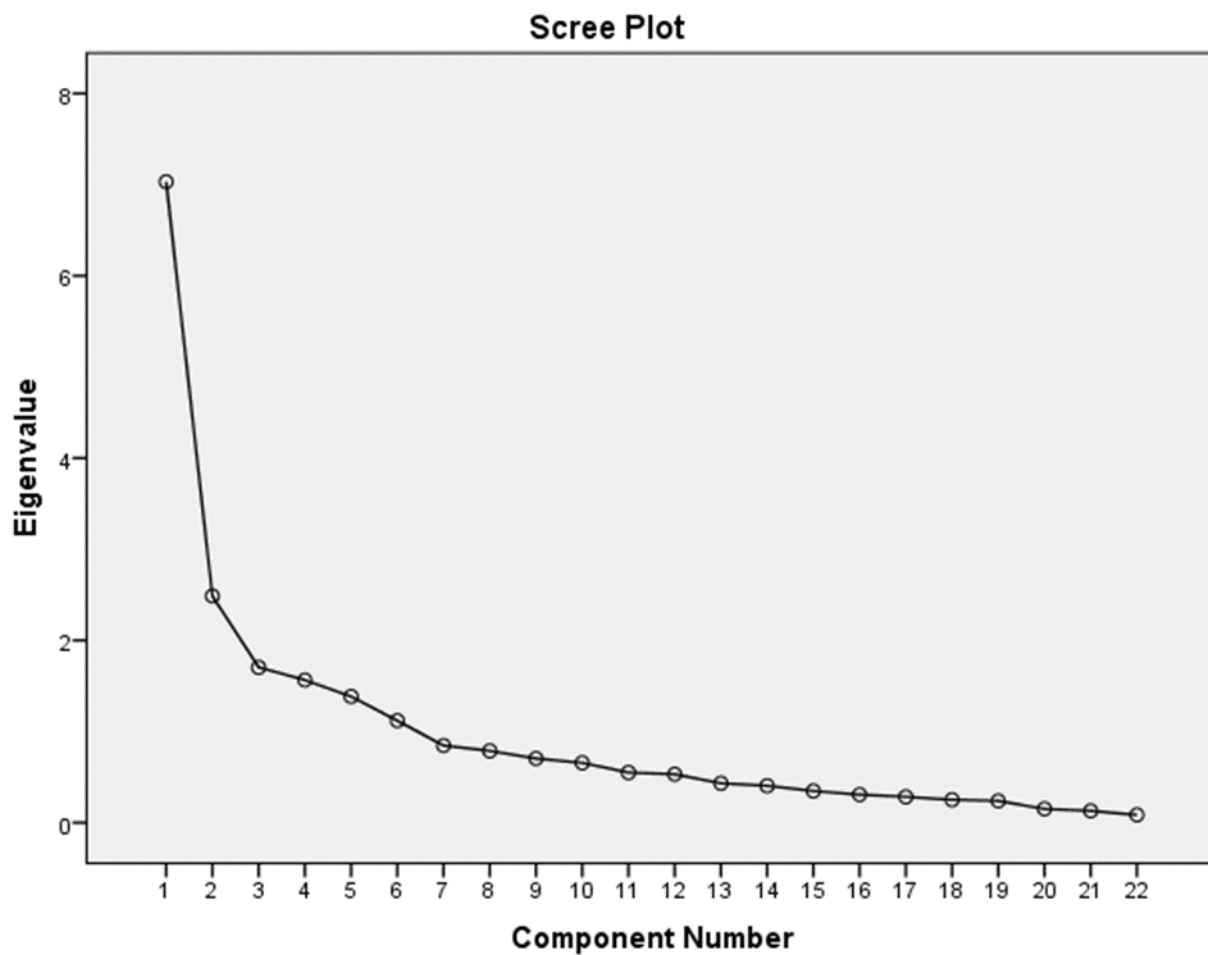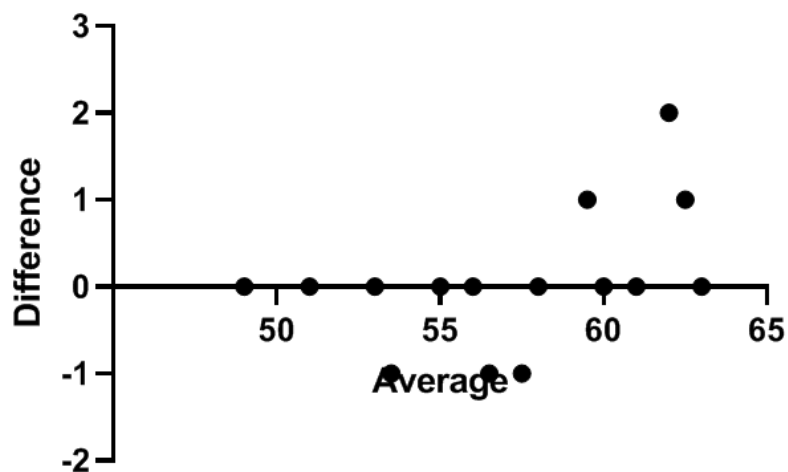Fig 4: Scree plot of Domain 2 before the direct oblimin rotation

Fig 5: Scree plot of Domain 2 after Direct Oblimin rotation.

Difference vs. average: Bland-Altman of IRAS Domain 2

Fig 6: Bland-Altman plot of test-retest scores of Domain 2 of IRAS.

DOMAIN 3 OF IGBO VERSION OF RETURN TO WORK ASSESSMENT SCALE (IRAS)

PRINCIPAL COMPONENT ANALYSIS (PCA)

This domain 3 of the IRAS is made up of Nineteen items and were subjected to principal component analysis (PCA) using the SPSS version 23. Prior to performing PCA, the suitability of the data for Factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of 0.3 and above. The Kaiser Meyer-Olkin value was 0.79, slightly exceeding the recommended value of .6 and Bartlett's Test of Sphericity reached statistical significance, (p=0.001) supporting the factorability of the correlation matrix[25,26,27].

Principal component analysis revealed the presence of eleven components with Eigen factor exceeding 1, explaining 36.41%, 15.15%, 10.04%, 6.01%, and 5.41% of the variance respectively (see fig 5). An inspection of the scree plot revealed a clear break after the fifth component. Using the Cartel's scree test[28], it was decided to retain five components for further investigations (see fig 6) This was further supported by the result of the Monte Carlos PCA for parallel analysis (see table 6), which showed only five components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the sample size (42 variables ×100 respondent)

The three components solution explained a total of 61.59% of the variance, with Component 1 contributing 32.41%, Component 2 contributing 15.15%, Component 3 contributing 10.04%. To aid in the interpretation of these five components, oblimin rotation was performed. The rotated solution revealed the presence of simple structure[29], with three components showing a number of strong loadings and all variables loading substantially on only one component and negative affect items loading moderately on components 2 and 3 .The interpretation of the five components was consistent with previous researches on the RAS Scale, with positive affect items loading strongly on all three Component 1 and 2 and negative affects items loading moderately on Components 2 and 3

Cronbach Alpha and Test-retest reliability of the Igbo version of Return to work assessment scale (IRAS)

The IRAS has good internal consistency, with a Cronbach Alpha coefficient reported for Domain 1 as 0.856, Domain 2 as 0.86 and Domain 3 as 0.87.

Test-retest reliability analysis gave an ICC of 0.99(p=0.001) for Domain 1, Domain 2 an ICC of 0.99(0.001), Domain 3 an ICC of 0.99(0.001).The graphic representation of the test retest scores by the Bland-Altman method revealed the limit of agreement for the two scoresin Domain 1 were from-2.29 to 1.58, Domain 2 to be -1.30 to 1.40 and Domain 3 to be -0.8 to 0.72(Fig 3, 6, 9)
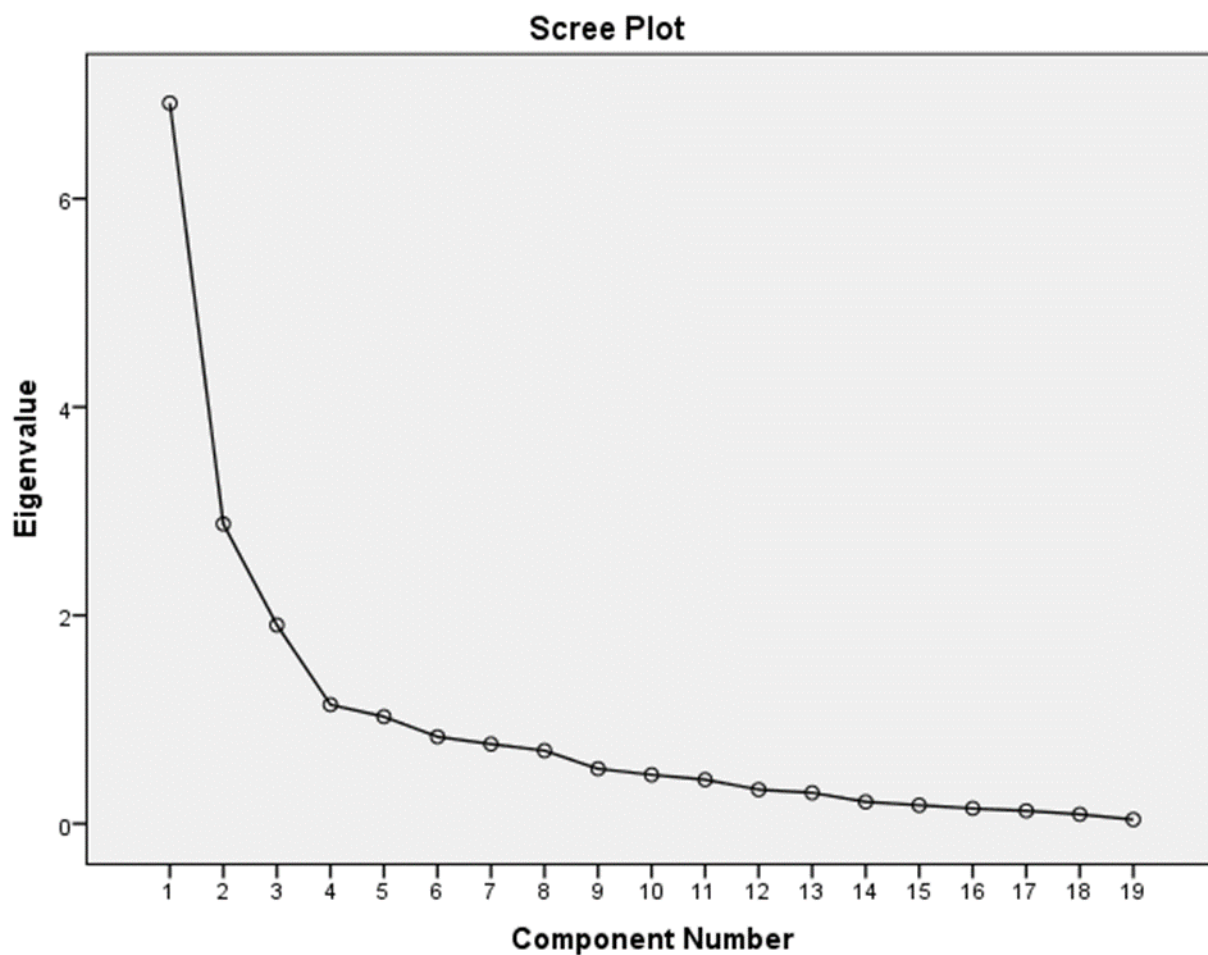
Figure 7: Scree plot of Domain 3 of RAS before Oblimin rotation.
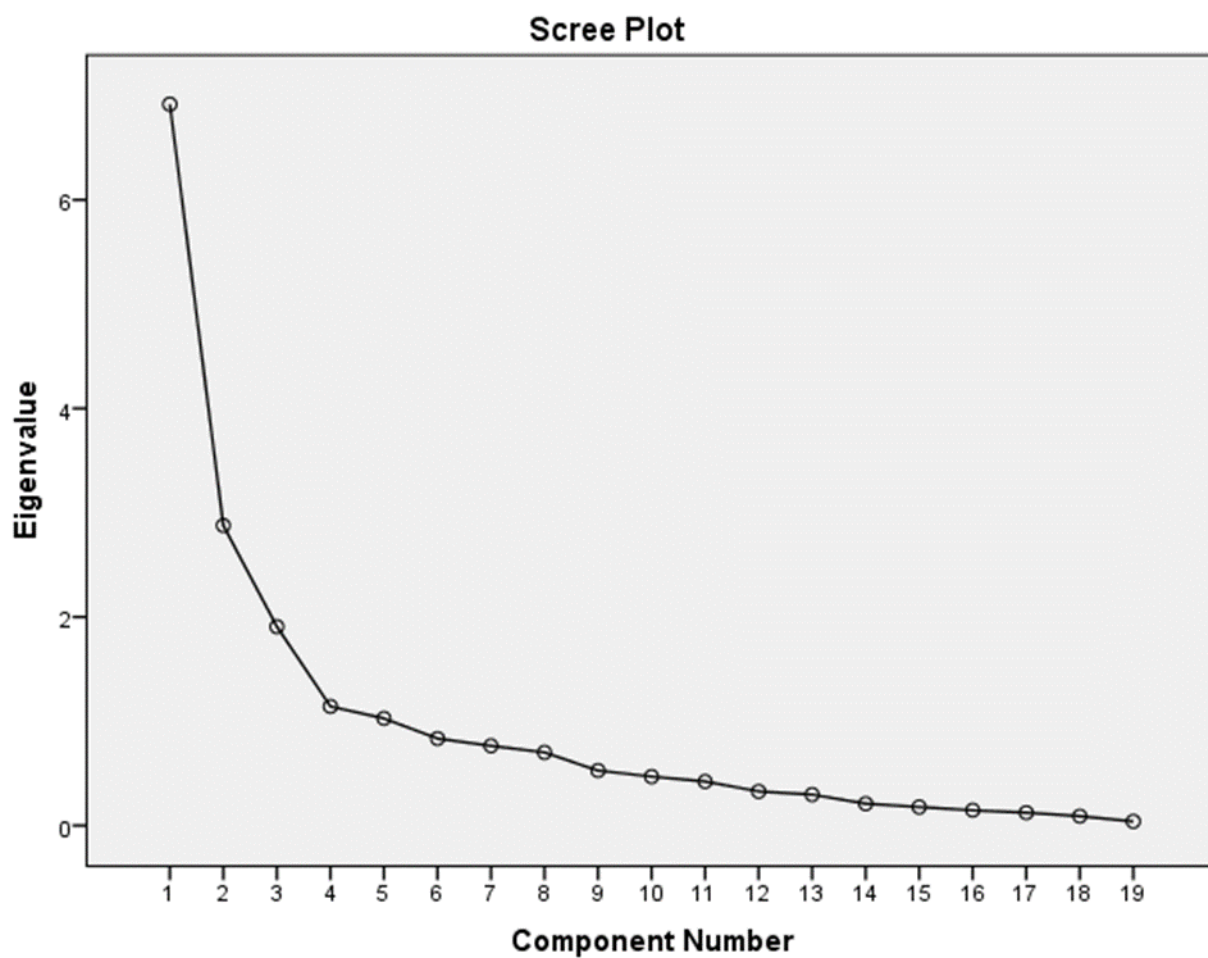
Figure 8: Scree plot of Domain 3 of RAS after Oblimin rotation

Table 4: Comparison of Eigen values from PCA and criterion values from parallel analysis (Domain 1 of IRAS).

Component number	Actual eigen value from PCA	Criterion value from parallel analysis	Decision
1	9.293	2.5353	Accept
2	4.510	2.3199	Accept
3	3.301	2.1832	Accept
4	2.991	2.0608	Accept
5	2.171	1.9497	Accept
6	1.784	1.8492	Reject
7	1.712	1.7630	Reject
8	1.545	1.6765	Reject
9	1.432	1.6002	Reject
10	1.171	1.5274	Reject
11	1.007	1.4544	Reject

Table 5: Comparison of eigen values from PCA and criterion values from parallel analysis

(Domain 2 of IRAS)

Component number	Actual eigen value from PCA	Criterion value from parallel analysis	Decision
1	7.031	1.9659	Accept
2	2.487	1.7694	Accept
3	1.703	1.6501	Accept
4	1.565	1.5343	Accept
5	1.385	1.4278	Reject
6	1.119	1.3401	Reject

Table 6: Comparison of Eigen values from PCA and criterion values from parallel analysis

(Domain 3 of IRAS)

Component number	Actual eigen value from PCA	Criterion value from parallel analysis	Decision
1	6.917	1.8803	Accept
2	2.878	1.6964	Accept
3	1.907	1.5549	Accept
4	1.142	1.4427	Reject
5	1.028	1.3429	Reject

DISCUSSION

Cross-cultural Adaptation of the English version of RAS into Igbo culture and environment.

Adaptation of the RAS into the Igbo culture and environment was performed following a systematic standardized approach. All items but one (1) on the original version of RAS was judged by the expert panel to be relevant in clinical research post stroke survivors willing to go back to work and for clinicians managing such patients, living in the South- Eastern Nigeria or Igbo land). Modifications were also made in order to ensure semantic, experiential and conceptual equivalence of the terms and examples in Igbo environment [18,30].

The terms {"Right", "Left"} in the original RAS were replaced with Igbo culture conceptually equivalent terms. This is in line with recommendations by Beaton *et al*.,[31] that a newly adapted scale should contain terms that are conceptually equivalent in the new culture as the original version is the culture for which it was developed. In the English language, the term "Right" refers to being morally good, acceptable, restore to upright position. In Igbo language, the term "Right hand" can replace "Right" in this context because Right in Igbo means -it is good, it is morally acceptable, it is of good moral standard- the same with some English language meaning of Right. use being their semantic equivalent.

While Right hand is the term used in Igbo language to refer to anything that is the opposite of the left hand/side. Since "right hand side" is more specific to the item in the question and eliminates any error of broad/general outcomes possible, it was used to replace "Right" in items 4 and 5 of section A. The above explanation goes for the replacement of "Left" with "Left hand", where in English language, left means – anything remaining, and a position towards the west. Left in Igbo language means anything remaining, hence, the culturally equivalent term of "left hand" was adapted. Good/moderate/poor options for item 14 of section A refers to/explains levels of a condition or situation, but in Igbo language, these gradings don't appear alone. They have "it is" attached to it- addressing the condition specifically. Hence, "it is good", "it is moderate", and "it is poor"were adapted forThe terms ''Temporary'', ''Casual'', ''Contract'', and "Permanent" which are options to item 16 of section Arefers to all their individual meanings but with no reference to "work" which is the subject in question and Igbo language has proven to be a language with lots of specificity than generalization.

Hence, ''Temporary Work'', ''Casual Work'', "Contract Work", and ''Permanent Work" were adapted for use in the IRAS being the options' experiential equivalent. The terms in items 17, 18, 24, 25 of section A;

RAS Domain 1 response options; RAS Domain 2 response options and RAS Domain 3 response options {"Period off from work", "Renumeration during time off", "Does work include shifts", "Does work include travel", "Unable to", "With assistance", "Independently", "Sure", Unsure", "Never thought about it", "Definitely disagree", "Mostly disagree", "Neither agree nor disagree", "Mostly agree", "Definitely agree"} were adapted to their personalized form {"Period you were off from work", "Renumeration during time you were off", "Does your work include shifts", "Does your work include travel", "I am unable to", "I will need assistance", "I am independent", "I am sure", I am unsure", "I've never thought about it", "I definitely disagree", "I mostly disagree", "I neither agree nor disagree", "I mostly agree", "I definitely agree"} to fit the Igbo language lexis and structure.

The term "general" in "general work hours" of item 23 was replaced with "Daily work hours", because general does not give a specific yardstick/guideline to which the work hours can be calculated and evaluated in the construct of study. The sentence "I can use the bathroom" in item no: 5 in Domain 1 was replaced with "I can take care of my personal grooming and appearance when outside". In Igbo language, "I can use the bathroom"simply means "to bath (and possibly toileting)", whereas in the context, it refers to personal grooming (especially in a social gathering). Hence, its replacement with an understanding that reflects its conceptual meaning and cultural adaptation equivalent.

The term "I don't need an elevator to ascend my office" was removed by the expert panel committee because it doesn't reflect the structures often found in the South -Eastern region of Nigeria. In item 19, the word "Cordial" in "my employer takes the cordial relationship of colleagues seriously" was replaced with "Sibling" because the word sibling is more appropriate and brings out the concept of the item.

The culturally adapted Igbo version of RAS (IRAS) was then pretested on twenty (20) post stroke survivors. All the participants indicated clarity of language and ease of understanding of all the items. The participants also reported that the culturally adapted IRAS was relevant since the questions asked are specific to their condition. Hence no further adjustment was made by the expert panel on any of the items on the IRAS.

Participants took a similar length of time (10 minutes) to complete the IRAS when compared with the original English version of ERAS[2].

Psychometric properties of the cross-culturally adapted Igbo version of the Return-to-work Assessment Scale

The results obtained from this study showed that there was significantly high internal consistency reliability with ICC of 0.99(p=0.001) for domain 1, 0.99 (p=0.001) for domain 2, and 0.99 (p=0.001) for domain 3 between the scores obtained on the first and second administration of the Igbo RAS using the Intra-Class Correlation (ICC).

As expected, this high internal consistency reliability score is similar to that reported by Igwesi-Chidobe *et al.,*[31]. In their study on cross-cultural adaptation of the WHODAS 2.0 and validation in rural and urban Nigerian populations with Chronic Low Back Pain (CLBP), a correlation of 0.81-0.93 was obtained. Ibikunle *et al.,* also reported a high ICC of 0.99 in their study on translation, cultural adaptation and validation of the Igbo version of DASH[18]. The results obtained from this study showed excellent reliability with Test retest reliability analysis for domain 1, 2, and 3 between the scores obtained on the first and second administration of the Igbo RAS using the Intra-Class Correlation (ICC).The graphic analysis by the Bland-Altman plotting method revealed that the test retest result are strictly centred in Domain 1,but not totally in Domain 2 and 3.This is similar to the works of Stevenlink *et al.,*[32] in Nepal in the testing the psychometrics of the P scale and Ibikunle et al.,[33,34] in their study in while testing the psychometrics of the IP scale(igbo version of the Participation scale) and while testing the psychometrics of I-SALSA(Igbo version of the screening of activity limitation and safety awareness scale) in Nigeria.The result of this study was also similar to the work of Fèdou *et al.,* [35],in their translation and cross cultural adaptation of the Readiness for Return-to-work scale (RRTWs) into French (RRTWs-F) for patients who have not yet returned to work. Cronbach's alphas were satisfactory in four dimensions and reliability was quite good.

The reliability and internal consistency of the three(3) Domains of the IRAS were similar to those of the original English version {Cronbach's alpha coefficient of 0.81 for Domain 1, 0.93 for Domain 2 and 0.76 for Domain 3; an ICC of 0.85(p=0.001) for Domain 1, Domain 2 an ICC of 0.91 (p=0.001) and Domain3 an ICC of 0.99 (p=0.001)} Ibikunle *et al.,*[3], to that of Fèdou *et al.,*[3]

[6] translation and cross cultural adaptation of the Readiness for Return-to-work scale (RRTWs) into French (RRTWs-F) for patients who have not yet returned to work. Cronbach's alphas were satisfactory (0.62-0.88) in four dimensions and reliability was quite good (0.71-0.85).

The results from this study showed that there was a significant correlation (p<0.001) between the scores obtained on the English and Igbo versions of RAS. This correlation is similar to the report by Ibikunle et al., on the translation, adaptation and validation of the Igbo version and the English version of DASH[18]. Excellent correlation coefficient was observed between the items in the English and Igbo version of RAS which suggests that IRAS was excellently translated and culturally adapted to the Igbo culture and environment.

This suggests that IRAS is a valid instrument for assessing return to work in post stroke survivors in the South-Eastern region (Igbo speaking) of Nigeria.

CONCLUSION

The Igbo version of Return-to-work Assessment Scale (IRAS) is a valid, reliable and internally consistent tool for assessing readiness to return to work in Igbo stroke survivors.

RECOMMENDATION

Based on the findings of this study, the following recommendations are made

1 The Igbo version of RAS (IRAS) should be used by clinicians and researchers to assess and evaluate post stroke survivors progress, ability and readiness to return to work in Igbo communities in Nigeria and the world at large.

1. Translation of the English version of RAS (ERAS) questionnaire into the other major and indigenous Nigerian languages should be done to enhance its use across the various cultures in Nigeria and beyond wherever those language monolinguals are found.

234

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