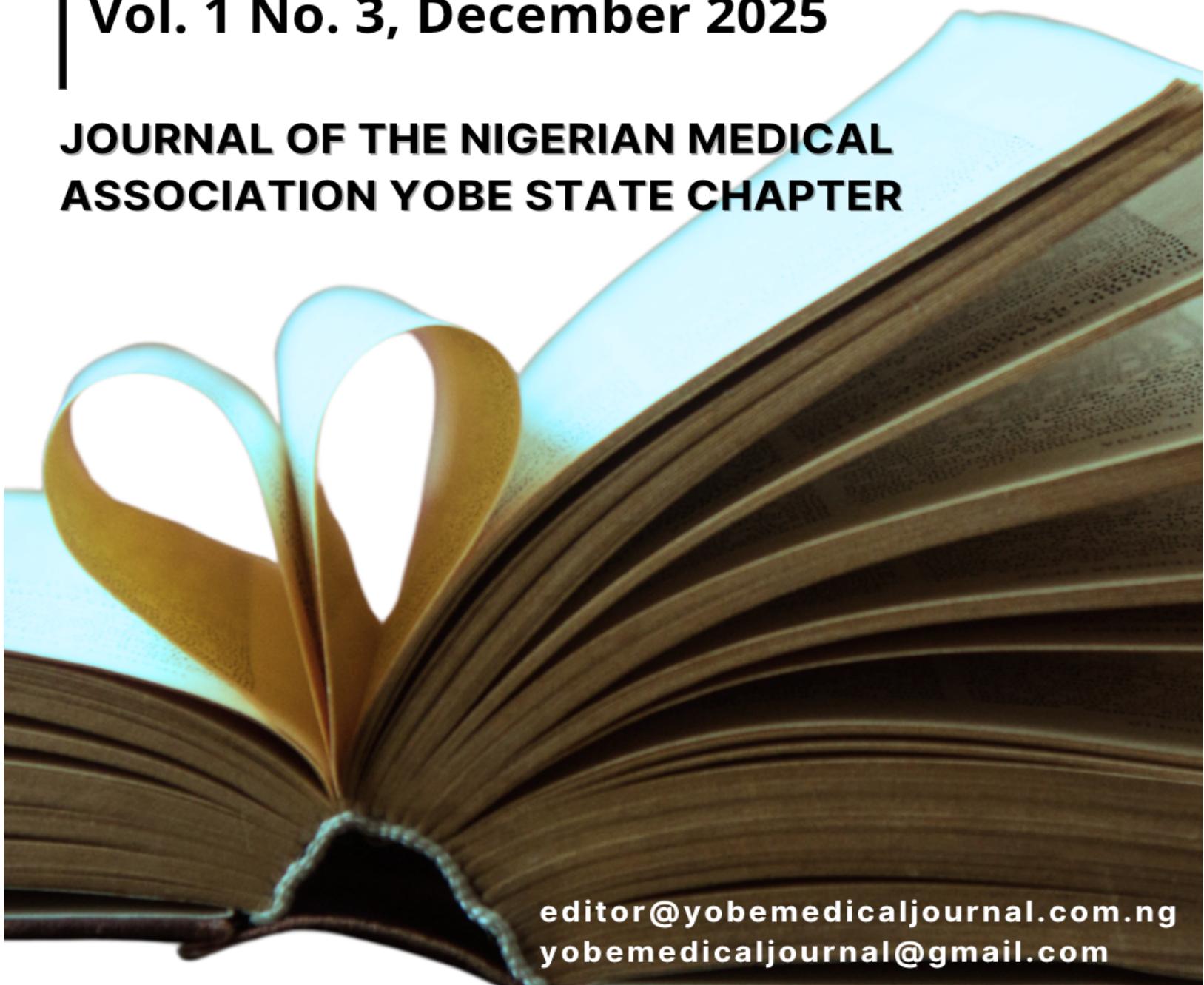




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ASSOCIATION YOBE STATE CHAPTER**



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2. Short research notes

These are single-finding articles that can be reported with not more than two illustrations/figures/tables. Posters from conferences or internal meetings may be written as short research notes. Some additional detail in the methods, description of the results, and discussion may be required to enable readers have enough information to understand the description of the work. A Short research note should follow the structure of Abstract, Introduction, Methodology, Results, Discussion, Conclusion, Acknowledgements, Authors' contributions, Competing Interests, Funding, Consent (where applicable), Ethical approval (where applicable), and References. This should not exceed 2,500 words, 3 illustrations/figures/tables, and 30 references.

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These are urgent communications of important preliminary results that are original, of high interest and likely to have a significant impact on the subject area of the Yobe Medical Journal. The original research article is expected to be sent to Yobe Medical Journal for publication following a short communication. A short communication should follow the structure of Abstract, Introduction, Methodology, Results, Discussion, Conclusion, Acknowledgements, Authors' contributions, Competing Interests, Funding,

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These will include discussion of published articles and data acquired in a specific area, and will not have to be data acquired by the authors. The name of the author(s) reviewing particular article(s) should be written as the author(s) of a review article. The source of the article(s) reviewed should be written in the abstract. Review articles should follow the structure of Abstract, Introduction, Body (may have different headings, and does not follow a particular pattern), Conclusion, Acknowledgements, Authors' contributions, Competing Interests, Funding, Consent (where applicable), Ethical approval (where applicable), and References. This should not exceed 6,000 words, 100 references and 12 illustrations/figures/tables.

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These are usually based on medical interventions or animal model studies. Authors should consult the PRISMA guidelines for reporting in systematic reviews. Systematic reviews deal with a clearly formulated question and use systematic and explicit methods to identify, select, and critically assess the relevant research. The sections on Acknowledgements, Authors' contributions, Competing Interests, Funding, Consent (where applicable), Ethical approval (where applicable), and References should be included. These articles should not exceed 6,000 words, 50 references and 12 illustrations/figures/tables.

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A TEN-YEAR REVIEW OF CANCERS OF THE OVARY AT THE UNIVERSITY OF MAIDUGURI TEACHING HOSPITAL, MAIDUGURI, NIGERIA

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Abstract

Background: Cancer of the ovary is the most common cause of death due to gynecological malignancy worldwide, although it ranks second in gynaecological cancer incidence. In Nigeria, it is also a major cause of morbidity and mortality especially in women of reproductive age. The aim of this study is to determine the frequency of ovarian cancers and analyze their clinicopathological characteristics at a tertiary health institution in Maiduguri, Northeast Nigeria

Materials and Methods: This study was a 10-year retrospective review of all cases of histologically-confirmed ovarian cancers at the Department of Histopathology and Cancer Registry, University of Maiduguri Teaching Hospital. Relevant information was extracted from the histology request forms and records of the Cancer Registry. Data were analyzed using descriptive statistics and results were presented in tables and charts.

Results: Seventy-four (74) cases of ovarian cancer were diagnosed, which constituted 14.0% of gynaecological malignancies, 4.6% of female cancers and 2.6% of total cancers. Patients were aged between 9 and 85 years. The modal age group was 41–50 years. The three most common clinical presentations were abdominal distension, abdominal pain and weight loss; while the commonest stage at presentation was stage III. Surface-epithelial tumours were the most common histological class, with high-grade serous carcinoma being the most common histological subtype.

Conclusion: This study shows a significant number of ovarian cancers afflict women of reproductive age at advanced stage. High-grade serous carcinoma was also the most common histological type.

Keyword: Ovary, Cancer, Clinical features, Histological types

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Introduction

Worldwide, ovarian cancer is the eighth most common cancer in women, but second most common gynaecological malignancy.^{1,2,3} It constitutes an estimated 3.7% of cancer cases and 4.7% of cancer mortalities in 2020.² Globally, there were 240,000 new cases of ovarian cancer and 152,000 estimated deaths in 2020.^{1,4} This gynaecological cancer is most often diagnosed in developed countries such as North America, Europe, New Zealand and Australia.¹ It is mainly seen in middle-aged and elderly women with age range of 55-70 years.¹ Ovarian cancer is the third most common malignancy in women and the second commonest gynecological malignancy in Nigeria after cervical cancer.^{5,6} In a 10-year retrospective study on ovarian cancer in Southeast Nigeria, it was found to represent 22.9% of all gynecological malignancies.⁷ In a study from Ibadan Nigeria, ovarian cancer was the third most common malignancy in women accounting for 3% of all cancers.⁸ In Kano, Northwest Nigeria, ovarian cancer constituted 30.5% of gynaecological malignancies.⁹ A study conducted in Gombe, Northeast Nigeria, it has been reported that ovarian cancer was the second most common gynaecological malignancy and accounted for 14.7% of the cases.¹⁰ An analysis of gynecological malignancies in Bauchi State has revealed that ovarian cancer accounted for 30% of all gynaecological malignancies.¹¹ In Maiduguri, Borno State Nigeria, a study carried out on cancers of female genital tract has shown that ovarian cancer was the second most common cancer and represented 21.3% of the cases.¹²

Ovarian cancer is a heterogeneous disease due to the existence of several clinically and genetically distinct histotypes.^{1,2} In a study in Bangalore, epithelial ovarian cancers accounted for 52.9% of the ovarian cancers seen; mucinous adenocarcinoma 28.2%, clear cell carcinoma 7.05%, and endometrioid cancer 11.7%.¹³ Serous

adenocarcinoma was the commonest histopathological variety constituting 42.4%.¹³ A study in Ibadan, Nigeria revealed that epithelial ovarian cancer constituted 76.2% of the cases of ovarian cancer.⁸ In another study in Gombe, Northeast Nigeria, the three major histological types of ovarian cancer namely, malignant surface epithelial, germ cell and sex cord-stromal tumours, including metastatic neoplasms were reported. Majority of the cases were surface epithelial cancers and constituted 44.9%, among which the serous carcinoma was the predominant subtype.¹⁰

The vague nature of disease manifestation makes screening and early diagnosis quite challenging for clinician, and therefore advance-staged disease and late presentation is not an uncommon finding.⁷ The patients with ovarian cancers usually present late due to the fact that it is an intra-abdominal tumour with much space to grow before presenting with clinical features, and these are often vague.¹⁴ Abdominal swelling was the most common presenting symptom in a study in Ibadan.⁸ Eighty-one per cent of the patients presented in Stages III and IV. Only 23.8% of patients had adjuvant therapy, consisting of combination chemotherapy using cisplatin-based regimes.⁸ As in developing countries, the prognosis of patients with ovarian cancer even in developed countries, is poor with a 5-year survival of about 35%.¹⁴ Ovarian cancer has the highest case fatality rate among gynaecological cancers worldwide because of lack of effective screening methods and non-specific early warning symptoms with late presentation.¹⁵

Although quite a number of characteristics of ovarian cancers remains the same across different regions of the world, there are obvious variations in some features. This study was conducted to determine the frequency and clinico-pathological features of ovarian cancers that were diagnosed at the University of Maiduguri Teaching Hospital, Maiduguri, Northeast Nigeria.

Materials and Methods

This was a retrospective, descriptive study conducted at the University of Maiduguri Teaching Hospital (UMTH), Maiduguri over a ten-year period between January 1, 2015 to December 31, 2024. The hospital is a tertiary health institution that serves as a centre of training, research and clinical services in Borno State, Northeast Nigeria.

The histologically-diagnosed ovarian cancer cases were retrieved from the records of the hospital

Cancer Registry and the archives of Histopathology Department. In addition, the records of yearly-diagnosed cases of gynaecological malignancies as well as total cancers of all histological types were collected from the hospital Cancer Registry. The clinico-pathological characteristics such as age, clinical presentation, stages, and histological types were extracted and analysed. The results were analysed using descriptive statistics and displayed in frequency tables and charts.

Results

During the 10 years' period of study, a total of 2,809 cancer cases were histologically diagnosed at the University of Maiduguri Teaching Hospital, Maiduguri. The total number of female cancers and female genital tract malignancies were 1621 and 530 respectively. There were 74 cases of ovarian cancer, which accounted for 14.0% of gynaecological malignancies and 4.6% of female cancers. Patients were aged between 9 and 85 years. The modal age group was 41–50 years and the mean age was 42 ± 12.8 years. The extreme age groups of 1–10 and 81–90 years were the least affected and represented 1.6% and 2.7% of the cases respectively, as shown in table 1.

All of the three major histological subtypes of ovarian cancer, including metastatic neoplasms were diagnosed during the period of study. As shown in table 2 and figure I, there were 48 cases of surface epithelial cancers and 9 cases of malignant germ cell

tumours which respectively, represented 64.9% and 12.2% of all ovarian cancers. Malignant sex cord-stromal tumours and metastatic carcinomas accounted for 16.2% and 6.8% of cases respectively.

Among the surface epithelial cancers, serous carcinoma was the most common representing 87.5% (42/48) of surface epithelial tumours. Mucinous carcinoma accounted for 10.4%, while malignant Brenner tumour was the least common and constituted 2.1% of the malignant surface epithelial tumours. The mean age of occurrence of surface epithelial cancers was 52.5 ± 8.5 years.

The malignant germ cell tumours included immature teratoma (4 cases; 5.4%), dysgerminoma (3 cases; 4.1%) and yolk sac tumour (2 cases; 2.7%). Their mean age was 22.5 ± 5.5 years. All of the cases of sex cord-stromal tumours were malignant granulosa cell tumour which together accounted for 16.2% (12 cases) of the ovarian cancer. Among the 5 metastatic carcinomas, 2 cases were Krukenberg tumours, while the remaining 3 were cases of unilateral adenocarcinomas.

Majority of the patients had more than one chief complaints; and therefore, the three most common clinical presentations were abdominal distension (in 59 patients), abdominal pain (in 43 patients) and weight loss (in 38 patients). Other less common presentations as indicated in table 3, included abnormal vaginal bleeding (in 11 patients), vomiting (in 7 patients) and constipation (in 5 patients). Most of patients with ovarian cancer presented at stage III, which accounted for 44.9%, while the least number of patients presented at stage I (12.1%). Stages II and IV represented 27.1% and 15.9% respectively.

Table 1: Age distribution of cancer of the ovary

Age group (years) (%)	Number of cases	Percentage
1 – 10	1	1.4
11 – 20	3	4.0
21 – 30	13	17.6
31 – 40	12	16.2
41 – 50	19	25.7
51 – 60	14	18.9
61 – 70	7	9.5
71 – 80	3	4.0
81 – 90	2	2.7
Total	74	100

Table 2: Frequency distribution of histological types of ovarian cancer

Ovarian cancer Percentage (%)	Number of cases	
Surface epithelial tumours	48	64.9
Serous carcinoma	42	56.8
Mucinous carcinoma	5	6.7
Malignant Brenner tumour	1	1.4
Germ cell tumours	9	12.2
Immature teratoma	4	5.4
Dysgerminoma	3	4.1
Yolk sac tumour	2	2.7
Sex cord-stromal tumours	12	16.2
Malignant Granulosa cell tumour	12	16.2
Metastatic carcinoma	5	6.8
Total	74	100

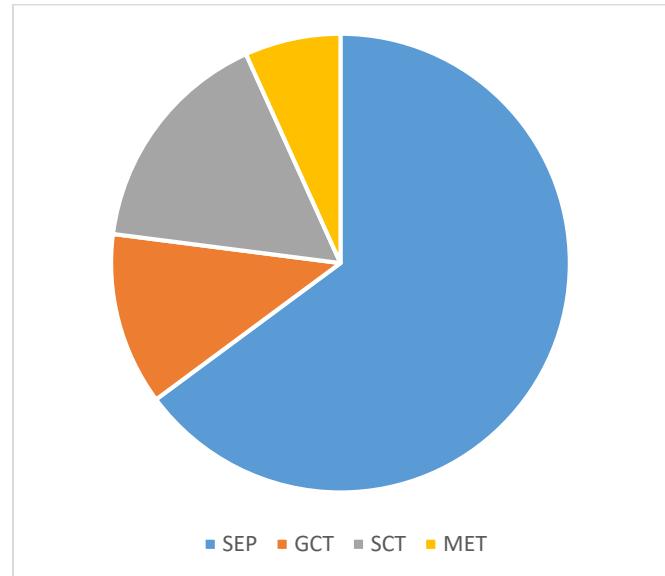


Figure I: Histological types of ovarian cancer

Legends: **SEP**= surface-epithelial tumours; **GCT**= germ cell tumours; **SCT**= sex cord-stromal tumours; **MET**= metastatic tumours

Table 3: Clinical presentation of patients diagnosed with ovarian cancer

(This table allows multiple responses)

Clinical features (%)	Number of cases	Percentage
Abdominal distension	59	79.7
Abdominal pain	43	58.1
Weight loss	38	51.3
Abnormal vaginal bleeding	11	14.9
Vomiting	7	9.5
Constipation	5	6.8

Discussion

This study reviewed ovarian cancer at the University of Maiduguri Teaching Hospital, showing the prevalence over a 10-year period, the age at presentation, the histologic subtypes and clinical features.

Ovarian cancers constituted 14.0% of the total gynaecological cancer, which is lower than 21.3% observed in a previous study from the same centre.¹² The low prevalence in this study may not be unrelated to availability of Histopathology laboratory in the State Government-owned hospital for the past 5 years. Our finding is similar to that of Katagum DA where ovarian cancer forms 14.8% of gynaecological cancers in their study.¹⁶ A Southern Ethiopian study found ovarian cancer to constitute about 10.5% of the total gynaecological cancers which is lower than what was obtained in our study.¹⁷ Ovarian cancer affected women across a wide range of age in our study, with the mean age of the disease at presentation being 42 ± 12.8 years. This contrasts with the documented mean age of 51.2 ± 13.3 years in Zaria, 57.6 ± 5.2 years in Nnewi, 50.2 ± 8.5 years reported in Abuja and 49 years in a study of ovarian cancer in Ghana by Akakpo.^{18,19,20,21} The lower mean age of ovarian cancer observed in our study may be due to a relatively younger age group in the population.

Globally, surface epithelial cancer is the commonest ovarian cancer with serous carcinoma being the commonest subtype.^{1,2,22} This study aligned with the global documentation of surface epithelial tumours as the commonest type of ovarian cancer with serous carcinoma being the predominant subtype. Malignant Brenner tumour, a transitional surface epithelial tumour, was the least common of the tumours observed in this study. This finding resonates with the finding of a tertiary centre in Turkey where the prevalence of malignant Brenner tumour was low.²³ In other studies, malignant Brenner tumour was not recorded.^{18,19,24} Malignant granulosa cell tumour, the second commonest cancer after serous ovarian cancer found in this study was the only sex-cord stromal cancer identified. This is in consonant with the findings by many studies.^{6,10,16,18} Immature teratoma was the most common of germ cell tumours in this study. This is similar to the finding of Iyoke

CA.²⁴ This finding contrasts that observed by Usman A in Katsina.²⁵ In their study, yolk sac tumour was the commonest germ cell tumour and it was second only to cystadenocarcinoma.²⁵ Metastatic cancers from other sites were the least malignant ovarian tumours identified during the study period.

The most featured complaints of the patients were abdominal distension, abdominal pain and weight loss in that order. These complaints were due to cancer-related metabolic changes, anorexia and ascites which are associated with advanced cases. This is not surprising as most of the patients presented at advanced stage of the disease. Similarly, the common complaints reported by Etukudo A were abdominal swelling and abdominal pain, while Muhabat Q found urinary frequency as the second most common complaint in addition to abdominal swelling in Pakistan.^{18, 26} Dilley J study in London showed the reverse; with abdominal pain/discomfort being the predominant complaint while increased in abdominal size as the second complaint.²⁷

The majority of the patients presented at an advanced stage of the disease, with stage III being the most prevalent. This is in comparison with most cases of ovarian cancer, as the disease is asymptomatic or having non-specific symptoms in the early stage.^{15, 20, 24, 26, 27}

Conclusion

A significant number of cancers of the ovary studied have affected younger women of reproductive age at advanced stage. Similarly, there was predominance of surface-epithelial tumours in form of high-grade serous carcinoma. Although there is no currently very effective screening method available, the incidence of ovarian cancer can be reduced by creating more awareness in the populace.

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Conflict of Interest

The authors declare no conflict of interest

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THE TRIPLE FEEDBACK DISRUPTION (TFD) MODEL: A PROPOSED MODEL LINKING UNILATERAL NEGLECT, APRAXIA AND LEARNED NON-USE AFFECTING MOVEMENT AFTER STROKE

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Abstract

Background: Stroke remains a leading cause of long-term disability worldwide, with upper-limb dysfunction significantly reducing independence and participation. Beyond motor weakness, complex cognitive-sensorimotor impairments such as unilateral spatial neglect, limb apraxia, and learned non-use play a substantial role in determining rehabilitation outcomes. Evidence suggests these impairments frequently coexist and interact, magnifying disability, yet their interrelationships remain poorly understood.

Objective: This review aimed to synthesize current evidence on the interaction among unilateral neglect, limb apraxia, and learned non-use following stroke, and to propose the Triple Feedback Disruption (TFD) Model, a conceptual framework explaining how disruptions in sensory feedback, motor planning, and reinforcement learning form a self-perpetuating cycle limiting functional upper-limb recovery.

Materials and Methods: A narrative review was conducted using PubMed, Google Scholar, Scopus, and Web of Science, covering studies published from 2015 to 2025. Search terms included *neglect, apraxia, learned non-use, stroke rehabilitation, and sensorimotor integration*. Eligible studies involving adults post-stroke discussing any of the three impairments or their rehabilitative implications were qualitatively synthesized.

Results: Twenty-nine studies were included. Findings indicate strong evidence of interaction among the three impairments, with neglect reducing sensory engagement, apraxia limiting motor planning, and learned non-use reinforcing behavioural disuse. Co-occurrence of these deficits predicts poorer therapy response and functional outcomes compared to isolated impairments.

Conclusion: The TFD Model provides a unified explanation for persistent upper-limb dysfunction after stroke, highlighting the need for integrated rehabilitation targeting sensory-attention, motor-planning, and behavioural reinforcement simultaneously. This framework may guide future multimodal intervention trials and personalised rehabilitation strategies.

Keywords: Stroke Rehabilitation, Unilateral Neglect, Limb Apraxia, Learned Non-Use, Sensorimotor Integration

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1.0 Introduction

Stroke is one of the primary causes of adult disability globally, with many survivors experiencing lasting upper-limb impairments that restrict independence, participation, and overall quality of life [1]. Beyond simple muscle weakness, stroke often results in complex interactions of sensorimotor and cognitive deficits, which can limit functional recovery and reduce responsiveness to standard rehabilitation approaches [2]. Gaining a deeper understanding of how these deficits interact is therefore crucial for developing targeted interventions that restore meaningful upper-limb function.

Unilateral spatial neglect, commonly referred to as “neglect,” is a multifaceted disorder affecting attention and spatial awareness, in which individuals fail to perceive, respond to, or utilize information on the side opposite their brain lesion [2]. Apraxia is a higher-order motor disorder in which patients cannot plan or execute learned, purposeful movements despite retaining sufficient strength and primary sensation [3]. Its presence predicts worse rehabilitation outcomes, independent of basic motor deficits [4,3]. Critically, apraxia impairs the translation of intention into precise, timely motor commands, leading to failed attempts, task errors, and reduced practice opportunities that would otherwise drive motor relearning [3]. Learned non-use is a behavioral and neuroplastic phenomenon in which patients gradually stop attempting to use the affected limb because initial attempts are inefficient, frustrating, or unrewarding [5]. Over time, habitual reliance on the unaffected limb develops, and neural representations of the paretic limb weaken, reducing spontaneous use even when some motor function returns [1]. Learned non-use effectively converts remaining motor capacity into functional loss and is a central target of behavioral therapies such as constraint-induced movement therapy

(CIMT) [5]. Evidence suggests that the presence of cognitive barriers, including attention and planning deficits, further increases the likelihood of arm non-use and reduces responsiveness to conventional training [6,1].

Empirical research demonstrates that neglect, apraxia, and learned non-use frequently co-occur and interact. Observational data indicate that patients with neglect are more likely to exhibit proprioceptive impairments and poor upper-limb performance, which increase the risk of developing learned non-use [7]. Disturbances in proprioception and multisensory processing associated with neglect reduce the accuracy of feedback needed for online motor control and error-based learning [8]. Prospective cohort studies and early rehabilitation investigations show that both apraxia and neglect, independently and together, predict poorer functional outcomes and limit gains during inpatient therapy, suggesting overlapping effects on recovery trajectories [1]. In a multi-centre early rehabilitation cohort, the severity of both apraxia and neglect significantly predicted discharge functional status [4]. Studies examining predictors of arm non-use highlight cognitive factors such as attention and planning, alongside higher-order motor deficits like apraxia, as key contributors to persistent non-use, indicating that behavioral avoidance of the limb is influenced not only by motor limitations but also by sensory-attentional and planning systems [1].

Taken together, this evidence suggests that deficits in sensory registration (neglect), motor planning and execution (apraxia), and behavioral reinforcement (learned non-use) may mutually reinforce one another, creating a persistent cycle of disuse and impaired motor learning. While previous work has documented pairwise relationships (e.g., neglect ↔ reduced limb use; apraxia ↔ poorer ADL performance), there is a lack of conceptual frameworks and empirical studies

that simultaneously examine all three phenomena or test their dynamic interactions during rehabilitation. Therefore, this study aims to review relevant literature to develop and evaluate the Triple Feedback Disruption (TFD) model, which based on the narrative synthesis will hypothesize that unilateral neglect, limb apraxia, and learned non-use interact in a feedback loop that sustains upper-limb dysfunction after stroke.

2.0 Methodology of the Narrative Review

This narrative review aimed to synthesize current evidence on the interplay between unilateral neglect, limb apraxia, and learned non-use following stroke, with the goal of informing the development of the proposed TFD Model. While narrative reviews do not follow the strict protocols of systematic reviews, methodological transparency was maintained to ensure rigor, reproducibility, and reliability of the findings (Figure 1).

2.1 Search Strategy

A thorough literature search was conducted using major scientific databases, including PubMed, Google Scholar, Scopus, and PEDro. The search period spanned January to February 2025 and focused on studies published between 2015 and 2025 to capture the most recent evidence. Keywords and Boolean operators were applied in multiple combinations, including: *{“unilateral spatial neglect” OR “hemispatial neglect” AND stroke AND upper limb}*, *{apraxia AND stroke AND motor planning}*, *{“learned non-use” OR “nonuse” AND stroke AND rehabilitation}*, *{interaction OR relationship OR association AND neglect AND apraxia AND learned non-use}*, and *{sensorimotor integration AND stroke AND recovery}*. Medical Subject Headings (MeSH) terms such as *Apraxias, Stroke Rehabilitation*,

Motor Cortex, Sensory Feedback, and Arm were incorporated to enhance search sensitivity. Additionally, reference lists of key studies and review articles were manually searched to identify further relevant publications.

2.2 Inclusion and Exclusion Criteria

Studies were eligible for inclusion if they examined neglect, apraxia, or learned non-use in adult stroke populations. They needed to investigate rehabilitation outcomes, recovery mechanisms, neurophysiological aspects, or the interactions among these impairments. Included study designs comprised observational, interventional, cohort, or review articles, published in English between 2017 and 2025.

Studies were excluded if they focused exclusively on children or non-stroke neurological populations, presented qualitative or anecdotal findings without clinical or quantitative evidence, or did not address upper-limb functional outcomes.

2.3 Study Screening and Selection

Titles and abstracts retrieved through the database search were first screened for relevance, followed by a full-text review of eligible articles. Studies meeting the inclusion criteria were synthesized qualitatively. Any disagreements about study selection were resolved through consensus discussions among the reviewers.

Given the heterogeneity of study designs and outcome measures, a narrative synthesis approach was adopted instead of meta-analysis. 29 articles were found to be eligible for inclusion, the findings were organized thematically, first examining individual impairments, then exploring evidence of their interactions, and finally discussing implications for rehabilitation.

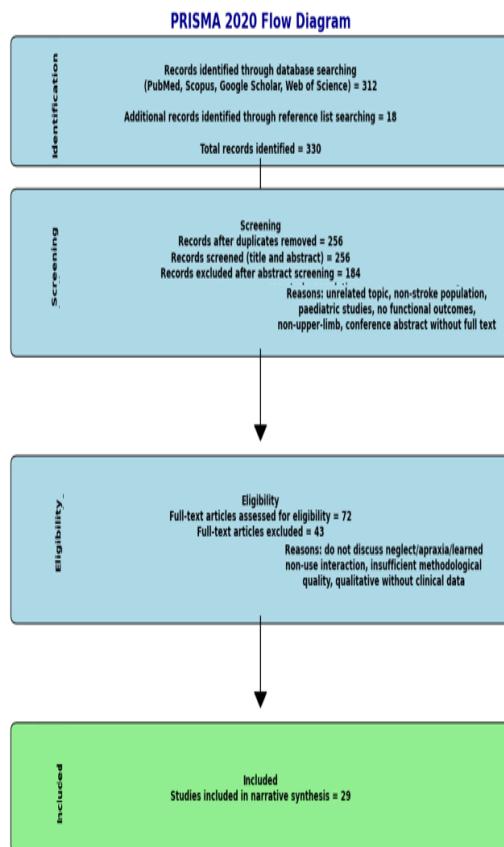


Figure 1: PRISMA flow chart

3.0 Results

3.1 Neurophysiological Basis of Upper Limb Impairment After Stroke

Upper-limb deficits after stroke result not only from muscle weakness but also from disruption of neural networks responsible for sensorimotor integration, spatial attention, movement planning, and reinforcement learning. Damage to cortical and subcortical regions, the cerebellum, and white matter tracts impairs coordinated movement. Recovery relies on intact neural feedback loops, and when these are disrupted, movements become inefficient, quality declines, and patients increasingly compensate with the unaffected limb [9]. Damage to the sensorimotor network reduces motor drive and plasticity, while injury to frontoparietal attention networks impairs spatial perception and attentional control needed for precise limb movements.

Spatial impairments, such as unilateral neglect, often result from impaired multisensory integration (visual, tactile, proprioceptive) in parietal areas, especially in the right hemisphere [10]. This impairment reduces awareness of the affected limb, degrading the sensory feedback needed for real-time error correction and motor adaptation. Imaging and connectivity studies show that neglect is linked to weakened functional connections between parietal and premotor areas, which may explain why individuals with neglect struggle to initiate or monitor movements effectively [9,10].

Similarly, limb apraxia is related to interruption in networks that support the planning, sequencing, and internal modeling of learned actions, particularly in the left inferior parietal lobule and premotor cortex [11]. When connections between intention

and execution are disrupted, patients may retain strength and sensation but lose the ability to produce well-organized, purposeful movements. Meta-analytic and lesion studies suggest that these left-hemisphere regions are critical for ideomotor and ideational apraxia [12]. Apraxia limits effective motor practice and inhibits learning, because patients cannot reliably translate their goals into appropriately timed motor commands.

Although learned non-use is primarily behavioral, it reflects underlying neurophysiological change. Repeated failures or inefficient movements with the paretic limb reduce attempts to use it, which over time weakens its cortical representation and synaptic connectivity [10,11]. This creates a maladaptive feedback loop: negative experiences depress the brain's engagement of the impaired limb, pushing behavior toward more successful compensatory patterns using the intact side. Reinforcement learning frameworks help explain this: early failure generates negative

reinforcement, biasing behavior toward the unaffected limb and suppressing motor circuits in the damaged hemisphere.

Thus, stroke disrupts the integrity of three interconnected systems:

1. Sensory-attentional processing (neglect)
2. Motor planning and execution (apraxia)
3. Reinforcement-based motor learning (learned non-use)

These systems normally interact through feedback-driven adaptation essential for motor recovery. When disrupted simultaneously, a self-sustaining cycle of impairment emerges, explaining persistent disability despite adequate motor potential. This neurophysiological framework provides the rationale for the TFD Model (Figure 2), which conceptualizes how these interconnected deficits interact to restrict functional arm use.

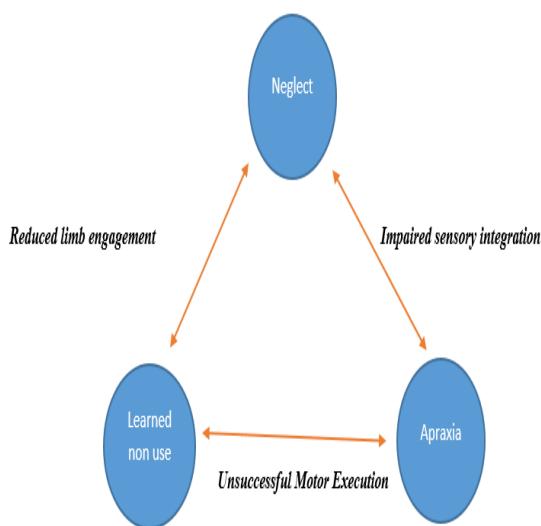


Figure 2: Vicious cycle of TFD Model

3.2 Unilateral Spatial Neglect in Post-Stroke Patients

Unilateral spatial neglect is one of the most disabling cognitive-perceptual disorders following stroke. It is characterized by an impaired ability to detect, orient to, or respond to stimuli on the side of space opposite the cerebral lesion, despite intact primary visual and sensory pathways [2]. The condition occurs most frequently after right-hemisphere stroke, resulting in left-sided neglect, although it can also arise following damage to the left hemisphere. Neglect reflects disturbances in multi-modal spatial representation rather than loss of sensory reception, affecting visual, tactile, proprioceptive, and auditory awareness [1]. As a result, individuals with neglect may behave as if the affected side of their body or environment does not exist, significantly compromising independence and participation in daily life. Prevalence estimates vary widely due to differences in assessment tools and timing of evaluation. A systematic review found the overall prevalence of spatial neglect after unilateral stroke to be about 29%, with higher rates following right-brain damage (38%) versus left-brain damage (18%) [13]. Other studies report early-stage prevalence up to ~43% after right-hemisphere injury and about 20% after left-hemisphere lesion [2]. USN is strongly linked with longer hospital stays, reduced gains from rehabilitation, slower and less complete motor recovery even when muscle weakness is equivalent and greater caregiver burden [14].

From a neurophysiological perspective, neglect arises from dysfunction across widespread attention networks, particularly the right-hemisphere dorsal and ventral attention systems and parietal cortex, resulting in deficits in vision, proprioception, and multimodal spatial representation. By downplaying sensory input from the affected

side, neglect reduces spontaneous use of the contralesional limb and limits the sensorimotor experiences necessary for recovery [15].

3.3 Limb Apraxia After Stroke

Limb apraxia is a higher-order motor cognitive disorder resulting from brain injury, most commonly stroke, and is characterised by a failure to perform learned, purposeful movements despite preserved basic motor, sensory, and comprehension abilities. This impairment goes beyond weakness or paralysis and reflects disruption in the planning, sequencing, and execution of skilled actions [16]. Limb apraxia is classically divided into ideomotor and ideational (or conceptual) subtypes. Ideomotor apraxia involves impaired translation of an intended movement into the correct motor programme (e.g., inability to pantomime tool use), whereas ideational apraxia refers to breakdown of the conceptual knowledge required to carry out a multi-step action sequence (e.g., making coffee) [16]. Prevalence estimates in stroke populations vary, with earlier studies reporting up to 30–50% of survivors affected; more recent reviews suggest a substantial number of patients demonstrate clinically meaningful praxis deficits in the upper limb, yet many go undetected in standard rehabilitation settings [16].

The neural substrates of apraxia span a wide network, including the left inferior parietal lobule, premotor cortex, supplementary motor area, and their interconnections with sensory and motor output regions. Damage to these networks interrupts the translation of intention into movement, disrupts the representation of tool use actions, and interferes with spatial-temporal sequencing of action units [3]. This results in misgrasping, improper tool use, inefficient movement trajectories, and increased error

rates during task execution. The functional consequences are profound: patients with apraxia frequently struggle with activities of daily living (ADLs), such as grooming, dressing, and utensil use, independently of primary motor paresis.

3.4 Learned Non-Use Phenomenon After Stroke

Learned non-use is a behavioural and neuroplastic phenomenon following neurological injury in which a stroke survivor gradually abandons use of the affected upper limb despite retaining some motor capability. Originally described by Edward Taub in primate de-afferentation experiments, the concept has been extended to human stroke rehabilitation. When early attempts to move the limb repeatedly fail (frustration, inefficiency, discomfort), negative reinforcement leads the individual to increasingly rely on the unaffected limb. Over time, this compensation becomes habitual, suppressing attempts to use the affected limb even when neurological recovery might permit functional movement [17]. Learned non-use involves maladaptive re-organisation within motor networks. Reduced attempts to use the paretic limb lead to diminished corticospinal excitability, weakened synaptic pathways, and contraction of the cortical representation of that limb. For example, studies show reduced motor cortical maps and altered interhemispheric connectivity in individuals exhibiting arm non-use [1].

Learned non-use is distinguished from pure biomechanical inability: patients may demonstrate adequate capacity in structured assessments but fail to use the affected arm spontaneously in real-life settings. This capacity–performance gap is now recognized as a key behavioural marker in motor recovery research [17]. Clinically, learned non-use contributes to persistent deficits in

independence, limits participation, increases caregiver burden, and reduces engagement in rehabilitation. Importantly, it often predicts long-term functional outcomes more strongly than initial paresis severity [1].

4.0 Unique Features of the TFD Model

To the best of our knowledge this is the first model to explicitly connect these three conditions as a single interdependent system. Prior models typically treat them as isolated phenomena. It also emphasizes the role of disrupted feedback systems in maintaining and exacerbating the triad. It also integrates behavioral, neuroanatomical, and physiological evidence into a cohesive mechanism.

4.1 Clinical Implications

The TFD Model suggests that treating one condition can disrupt the vicious cycle and improve the others:

- **For Neglect:** Using sensory reactivation therapies (such as prism adaptation, visual scanning) to re-establish feedback loops. Techniques to improve attention and awareness of the neglected side, can reduce the impact of neglect [18].
- **For Learned Non-Use:** introducing Constraint-Induced Movement Therapy (CIMT) can enforce use and enhance cortical representation. CIMT addresses learned non-use by constraining the unaffected limb and encouraging use of the affected limb, thereby strengthening neural connections [6].
- **For Apraxia:** by implementing errorless motor learning and guided practice to improve motor planning. Motor imagery exercises and repetitive task-specific training can help patients with apraxia relearn motor planning and execution [19].

Within the TFD Model, limb apraxia occupies the motor-planning disruption node. Specifically, when praxis systems fail, attempted movements become inefficient or

erroneous, leading to frustration or reduced success, which in turn reduces reinforcement and practice opportunities. In other words: poor motor planning → increased movement errors → decreased movement attempts → increased learned non-use. Moreover, apraxia may also amplify sensory-attentional deficits by making movement monitoring more difficult and increasing reliance on external cues. Therefore, incorporating apraxia assessment and targeted intervention is critical for breaking the cycle envisioned in the TFD Model.

5.0 Discussion

The present narrative review has synthesized evidence that three critical post-stroke impairments, unilateral spatial neglect, limb apraxia, and learned non-use do not simply co-exist by coincidence but rather form an interacting network of deficits that undermines functional upper-limb recovery. This has important theoretical, clinical and translational implications.

First, the evidence affirms that each of the three impairments independently predicts worse outcomes. For instance, severity of visuospatial neglect has been shown to significantly predict poorer functional recovery and prolonged rehabilitation stays [1]. Similarly, apraxia severity predicts cognitive and functional outcomes beyond motor impairment [4]. Learned non-use, in turn, is increasingly identified as a behavioural mediator linking motor capacity to actual arm use: patients may retain physical ability yet fail to use the limb, because of behavioural suppression of movement attempts [17].

Second, and more importantly, the literature increasingly supports interaction among these impairments. Studies show that patients presenting with neglect are more likely to have apraxia and that both deficits contribute

to non-use of the affected limb. For example, the study by Latarnik et al. [4] found that apraxia and neglect severity were significant predictors of early rehabilitation outcome. The fact that neglect and apraxia share attention- and action-based neural networks fosters a mechanistic bridge between perceptual-attentional disruption and motor-planning failure.

Third, the behavioural consequence, learned non-use can itself be seen as the outcome of a disrupted feedback loop: when attentional registration (neglect) is poor, movement attempts are less frequent and less successful; when motor planning (apraxia) is poor, the attempted movements are inefficient or fail; together these reduce successful movement practice and reinforcement, leading to habitual disuse of the limb (learned non-use). This chain of events supports the TFD model's central proposal that sensory-feedback disruption, motor-planning disruption and reinforcement disruption are linked in a self-sustaining cycle.

The TFD Model offers a conceptual framework that integrates these three domains in a single cycle. By doing so, it helps explain why some stroke survivors fail to recover meaningful upper-limb function despite ostensibly adequate motor capacity and conventional therapy. Specifically, it predicts that unless all three nodes of the cycle are addressed, attentional/sensory registration, motor planning, and reinforcement of use rehabilitation gains may be limited and transient.

The model also anticipates that the severity or presence of one node may amplify the impact of the others: for example, severe neglect may mitigate the benefits of motor-planning interventions, and pronounced apraxia may blunt the effect of behavioural reinforcement strategies. This is consistent

with clinical observations: patients with neglect and apraxia often respond poorly to pure motor therapies or standard constraint-induced training.

Clinically, the findings and model collectively suggest that assessment of post-stroke patients should routinely include screening for neglect, apraxia and arm-use behaviour (i.e., non-use) rather than focusing on motor strength/impairment alone. Rehabilitation programmes may need to be redesigned to incorporate multimodal interventions targeting:

- Enhancement of sensory-attentional awareness (e.g., visual scanning, prism adaptation, multimodal stimulation)
- Motor-planning training (e.g., tool use training, gesture imitation, strategy coaching)
- Behavioural reinforcement of affected-limb use (e.g., shaping, forced use, feedback systems, real-world integration)

By combining these components, therapy may break the vicious cycle: improved attention allows more meaningful movement practice; improved planning makes practice more effective; increased successful practice reinforces use and further consolidates neural reorganisation.

Several limitations must be noted. The empirical literature is still somewhat limited in terms of large-scale, longitudinal or interventional studies that explicitly address all three domains simultaneously. Many studies focus on single impairments (neglect or apraxia or non-use) and rarely track their dynamic interaction over time [3].

6.0 Conclusion

By synthesising the literature on neglect, apraxia and learned non-use, and by embedding it in the integrated framework of the TFD Model, this discussion highlights that persistent upper-limb dysfunction after

stroke is rarely attributable to a single impairment. Rather, a network of disruption in sensory-attentional registration, motor planning, and behavioural reinforcement collaborates to maintain functional loss. Recognising and addressing this complex interplay offers new avenues to optimise rehabilitation and improve meaningful recovery of limb use.

7.0 Recommendation

1. Future studies should empirically evaluate integrated rehabilitation protocols that concurrently address neglect, apraxia, and learned non-use. Comparative trials against single-domain interventions would provide evidence on potential synergistic benefits and optimal therapy dosage.
2. Interventional studies are required to validate the effectiveness of the proposed clinical implications and therapies showing how improvement in one domain will improve others.
3. There will be need to use imaging method (such as fMRI) to identify overlapping and distinct neural pathways linking the three conditions so as to validate the model.
4. To properly predict the model, there will be need to develop computational models to simulate how disruptions in one domain affect the others.

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Authors' contributions

IAA draft the methodology and designed the manuscript, proposes and develop the model. **AA** conceived the idea and supervised the review, **HYA** and **MAB** draft the assisted in screening the relevant articles and proof read the entire manuscript. **AHG** and **ZA** draft the

conclusion and discussion section of the manuscript. All authors approve the final version of the study.

Competing Interests

All authors declare no conflict of interest

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PREVALANCE AND PATTERN OF SUBSTANCE USE AMONG YOUTH IN BAUCHI NORTHEAST, NIGERIA: A COMMUNITY-BASED CROSS-SECTIONAL STUDY

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Abstract

Background: Substance use remains a significant public health concern with widespread social, psychological, and economic consequences.

Aim and objectives: This study aimed to assess the prevalence and pattern of substance use among residents of Dan Amar B community in Bauchi Local Government Area, Bauchi State.

Methods: A community-based descriptive cross-sectional study design was used. The study population comprised 384 youths, systematic sampling was employed and data were collected using pre- tested semi-structured questionnaire and SPSS version 21.0 was used for data analysis.

Results: The aged range of the respondents is 15-34 years; the prevalence of substance abuse was 75% among the surveyed youths. Cannabis 28%, tobacco 47%, solvents 11%, sedatives 10% and alcohol 4% were using substances by single users and multiple users. Peer group influence, improved work performance, sex enhancement and attempts to deal with stress were the factors that contributed to substance abuse.

Conclusion: There is a need to create and sustain awareness on substance use among youth and its consequences in the community.

Keywords: Prevalence, pattern, substance use, youth, Bauchi.

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Introduction

Background

Drug and/or substance use has become a global issue, affecting almost every country, town and community. Though the extend and characteristics vary depending on the country or area. It has been estimated that more than 200 million people in all segments of the societies use substance all over the world.¹ This figure is growing by every day due to modern methods of transport and communications that has facilitate the dissemination of substance use. The increase in number of people travelling as compared to the past is also a contributing factor to the increase incidence of substance use globally. A study estimated that the number of substance users among youths in Africa is between 22 and 72 million people with a prevalence rate of 3.8 percent and 12.5 percent while youths in West Africa age 15 and above years is 12.4 percent who had used cannabis. Compared with 4.2 percent and 5.4 percent in East and South Africa respectively.²

A study reported that the prevalence of Nigerian youths who engaged in substance use is about 40% with the South East and some parts of the South West having significant prevalence of substance or drug trafficking as a result of lack of awareness of the general population, especially on the inherent dangers of substance/drug use.³ Previous study in Bauchi town, revealed that substance use among youth 21-25 years was up to 40% many have in one way or the other been on psychoactive substances like marijuana and narcotics which has negative effect following repeated use, and weighing much on individual user, the family, friends and the society at large.⁴ The most commonly used and used substances are alcohol, cannabis and solvents. Drug or substance use and other related problems are becoming more and more a public health concern. In the Nigerian content cannabis is known by various names, including "pot," "igbo," "wee-wee," "marijuana," "Ganja," and "Morocco." The active ingredient in all these is tetrahydrocannabinol (THC).⁵ It is therefore necessary that the right steps should be taken to stop the prevalence and root causes of substance abuse in Bauchi in particular, and in the Nigerian society at large.

Drug/substance abuse is the use of any substance to alter the state of the body or mind for purposes

other than medically warranted. Drug use usually stems from the aspiration to enhance mental, physical, or social performance, often driven by the inordinate desire to excel and to get self-satisfaction.⁶ A study Posits drug abuse as any substance other than a good which alters the body's function.⁷ On the other hand, drugs are chemical substances which interacts with our body system to modify the physiological and biological processes of the body.⁸

Moreover, groups study on drug use. It is reported that people are most likely to begin using drugs when they reach young adulthood. Almost 70% of the students of higher learning have taken alcohol, half of them have taken illegal drugs, about 40% have smoked cigarettes and more than 20% use a prescription drug for non-medical purposes.⁹ Some of the reasons youths abuse these substances includes the desire for new experiences, to perform better in school, attempting to deal with problems and simple peer group influence. Other factors includes; the availability of drugs within neighbourhood community, school and family environment which in turn increases the likelihood for adolescent youths to become addicted.¹⁰

Youths are "biologically" wired to seek new experiences and take risks, as well as to carve out their-own identity. Trying drugs may fulfil all normal developmental derives but in an unhealthy way that may have-a serious long-term consequences.¹¹

Youths sometimes inherit genetic vulnerability and personality traits like poor impulse control or a high need for excitement to predispose mental health conditions such as depression, anxiety and beliefs that such drugs are "cool" or harmless, which makes it more likely for them to become drug abusers.¹²

Drug use, therefore, can develop into addiction (drug addict) and other substance use behaviour like unsafe sex, and reckless driving in the individual and community leading to intoxicated and violence. It can also cause serious social and health risks like school failure, loss of interest in other healthy activities, impaired memory, increased risk of infectious diseases like HIV/AIDS, hepatitis, via risky sexual behaviour or sharing of contaminated instruments and injection equipment. Others include problems with family and other relations, psychological disorders and may result in high morbidity and mortality rates among youths.¹³

Substance use/misuse are the major serious issues of public health important that contributed to significant medical, psychological and legal consequences later in life. Though it can be challenging to prevent and treat substance misuse among youths, scientists have discovered some strategies that are effective among the high-risk population.¹⁴

Substance use as it includes helpful medicine elements which bring cure to illness, but today not all youths in the communities adhered or restricted to what the drug is made for. Substance use among our youths has reached an alarming dimension, it has continued to cause serious problem to the youths and the society at large. If care is not taken about them other disastrous complications may arise from the widespread practice of self-medication and reckless misuse of substances which may lead to an alarming deterioration of virtually all human diseases including psychological syndrome which need expert treatment and long-term rehabilitative management.

Substance use by youths in Dan Amar B community is not different from other countries /societies, but it varies according to proximity, accessibility, availability and affordability of the substances used. As a result, many of the youths have become HIV positive, developed liver diseases, drop out of school and have found themselves in activities like stealing, raping of girls and women, fighting with dangerous weapons and even committing suicide. It has reached a point where they neither fear nor have respected for parents and elders in the communities. One can see them grouping themselves in broad day-light (In the cause of the act of terrorism), and after they become intoxicated, they walk around angrily" like a hungry lion looking for souls to devour".

This study aims to investigate the prevalence and pattern of substance or drugs use and its implications to the youths (users), family and the society at large so as to bridge the existing gap of knowledge about the menace of substance use in Dan Amar B ward in Bauchi LGA, Bauchi State.

Methodology

Study area

The area of study is Dan Amar B community, which has a total population of 100594 with 22131 (22%) of the youth (15-35) years and is

located in the southern part of Bauchi Metropolis in Bauchi Local Government Area of Bauchi State, it shared boundaries with Dan Amar A, Dan'iya, Tirwun and Makama B in the north, south, east and west respectively. The popular settlements that form the Dan Amar B communities includes: Bakaro, Kandahar, Karofin Madaki, Unguwar Bauchi, Unguwar Shagari and Unguwar Mahaukata among few others.

The major tribes in the area are Hausa and Fulani, and practice Islam as their major religion and observe festivities like Sallah and hawan dubar, which promote unity and social interactions, especially among the youth. The majority of people in the area are self-reliant as they mainly depend on business and farming to earn a living.

Study design

A community-based descriptive cross-sectional study was employed.

Study Population

The target population were youths 15-35 years who were residing in the study area for at least six months and used one form of drug or the other, were included, and those who were too sick or mentally incapacitated were excluded.

Sample size determination

The sample size of this study was determined using Leslie Fischer's formula:

$$n = \frac{z^2 pq}{d^2}$$

Where n = minimum sample size, z = percentage point of the standard normal distribution curve, which defines a 95% confidence interval, p = prevalence of substance use from the previous study was 52%, q = complimentary probability = $(1-p) = 1-0.52=0.48$ and d = degree of precision = 0.05. Therefore, the minimum sample size was = 384

Sampling technique

A systematic random sampling technique was employed. The list of eligible youths in Dan Amar B obtained, the sampling interval was $2763/384 = 7$, the first respondent was selected randomly using simple random sampling by balloting and every kth person on the list was selected until the desired sample size was exhausted.

Data collection method

A pre-tested semi-structured, interviewer-administered adapted questionnaire was used. Trained research assistants collected the data over

two weeks. Respondents were interviewed in a private area to ensure confidentiality.

Data Analysis

Data were entered into an Excel spread sheet, checked for errors and analysed using SPSS version 21.0, frequencies, percentages, and charts were used for descriptive statistics.

Results

Table 1: Demographic information of the respondents

Variables	Frequency (n=384)	Percentage (%)
Age		
15-19	85	22.5
20-24	123	32
25-29	105	27.5
30-34	71	18
Sex		
Male	290	75.5
Female	94	24.5
Educational Level		
Primary	96	25.0
Secondary	98	25.5
Tertiary	19	5.0
Illiterates	171	44.5
Marital status		
Single	106	27.6
Married	138	35.9
Divorce	115	30.0
Widow	25	6.5

The table above shows that the majority of the respondents, both single and multiple substance users, were between the ages of 20-24 years, 123 (32%) and 25-29 years, 105 (27%), respectively. Respondents between the ages of 15-19 years form 85 (22%) of the total respondents, while those between the ages of 30-34 years were the minority, comprising 71 (19%) of the respondents. The table also shows that 290 (75.5%) of the respondents were males, while 94 (24.5%) were females. And in respect of the educational level 96 (25.0%) of the respondents attended primary school, 98 (25.5%) attended secondary, 19 (5%) attended tertiary institutions, while 171 (44.5%) of the respondents were illiterate.

The data also indicate that youths in Dan Amar B communities abuse both single substances irrespective of age, gender or educational level.

Ethical consideration

Ethical approval was obtained from the Bauchi State Ministry of Health Research Ethics Committee, and permission was secured from the village head of Dan Amar B, Bauchi and all principles governing the research and Helsinki declaration were observed.

Prevalence of substance use among youth

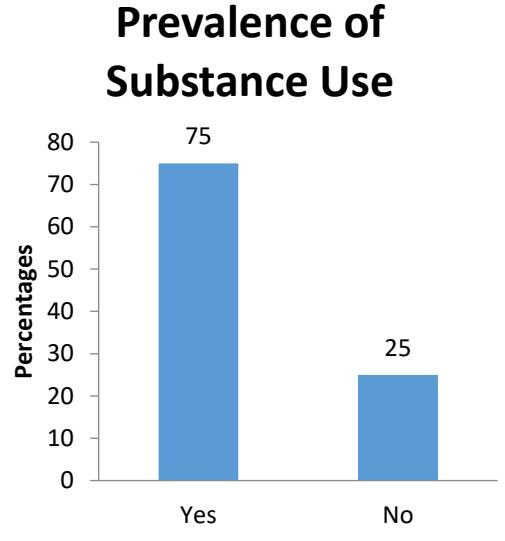


Figure 1: Prevalence of substance use among youth

The figure above shows the prevalence of substance use among youth was 75%.

Table 2: Substance use among youth

Variables	Frequency (n=384)	Percentage (%)
Ever used a substance for a non-medical reason		
Yes	288	75
No	96	25
Use more than one substance at a time		
Yes	284	74
No	100	26
Frequency of substance use		
Daily	184	65
Weekly	70	25
monthly	20	7
occasionally	10	4

At what age do you first start using substances	70	25
Less than 15years	75	26
15-19	75	26
20-24	64	23
25years and above		

Table 2, above, shows that majority of the respondents 288 (75%) have used substances at one time or another, with a still higher number, 284 (24%), still currently on the act. An equal number of the respondents 75 (52%) of the ages 15-19 and 20-24, started using substances for the time respectively. Some started before the age of 15years while others were 25 years and above. The data also reveals that some of the youth use these substances weekly, monthly and occasionally, while significant numbers, 284 (64%), were reported to use the substance regularly which pointed that substance abuse is a

regular habit among youth in Dan Amar B communities.

Table 3: Types of substance commonly used by youth

Variables	Frequency (n = 384)	Percentage (%)
Cannabis(marijuana, wee-wee)	106	28
Alcohol	15	4
Tobacco (cigarette)	182	47
Solvent	43	11
Sedatives	38	10

The table above shows that the majority of the respondents, 182(47%) agreed that tobacco is the most common substance used by the youth in Dan Amar B community followed by Cannabis with 106 (28%), Solvents 43(11%), Sedatives 38 (10%) while Alcohol has the least percentage of 15 (4%)

Table 4: Reasons for youth involvement in substance use

Variables	Frequency (n=384)	Percentage (%)
Curiosity about the substance	60	16
Peer group influence	108	28
To deal with stress	39	10
To improve work performance	48	13
Self-medication	39	10
Sexual enhancement	30	8
Family background	25	7
Social media influence	20	5
Others (specify)	15	4
Risk factors for substance use		
Genetic factor	74	19
Mental illness	45	12
Trauma	55	14
Environmental factor	85	22
Peer pressure	105	27
Others;(e.g divorce, frequent argument at home)	20	5
Effects of substance use on the individual family and society		
Neglect family	65	17
Turn to theft	80	21
Violent behaviour	84	22
Prostitution	45	12
Contact diseases like HIV/AIDS, Tuberculosis, etc	50	13
Others (e.g school withdrawal, feeling guilty)	40	10
	20	5
Awareness about the dangers associated with substance use		
Yes	180	47
No	204	53
Willingness to quit use of substance		
Yes	166	43
No	218	57
Able to quit abuse of substance		
Yes	109	28
No	275	72

Table 4 above shows that peer group influence, curiosity about the substance, and improved work performance were the major reasons for substance use among youth in Dan Amar B Communities, with a responses of 108(28%), 60 (16%) and 48 (13%), respectively. Other reasons include stress and self-medication 39 (10% each). Sex enhancement 30 (8%), while a few respondents agreed that family history of substance use, social media are reasons for substance use and high-risk groups include: peer pressure, which still recorded the highest 105 (27%), followed by environment 85 (22%) and genetic 85 (12%). Other factors include mental illness, trauma, divorce, frequent family arguments, etc.

In the area of issues experienced by individuals, families and or society in relation to substance use, violent behaviour forms the highest percentage of 84 (22%) followed by turning to theft 80 (21%), neglect of family 65(17%). Acquisition of disease (like HIV/AIDS) has 50 (13%), prostitution 45 (12%), while others, like school withdrawal, have the least percentage.

The data further revealed that more than half of the respondents, 288 (75%), are unwilling to stop the use of substance. Also, a significant number, 204 (53%) reported lacking knowledge on dangers (complications) of substance use, which calls for a more intensive educational campaign.

Discussion

The study was aimed at finding the prevalence and pattern of substance use among youths in Dan Amar B communities in Bauchi Local Government Area, Bauchi State. The respondents were youth between the ages of 15-34 years who are more likely to be involved in risky behaviours like use of substances and other forms of negative behaviours. This is consistent with similar studies conducted in urban and semi-urban areas in Nigeria. For instance, Sambo reported a prevalence of 41.2% among urban school adolescents in Lagos¹ while Muhammad found a 37% prevalence among youth in Sokoto metropolis.² Based on gender classification, the majority of the respondents, 290 (76%), were male, while 94 (24%) were female, and the male gender were found to use substances almost thrice the female opponent which the finding support earlier research. For example, Atoyebi and Atoyebi reported males were more likely to

engage in substance use due to societal expectations and risk-taking behaviour. Similarly, Lawal reported that unemployment and peer pressure were strong predictors of drug use among students in Kano.⁶ In education aspect the data reveals that majority of the respondents 171 (46%) were illiterate, followed by secondary with 98 (26%), primary 96 (25%) and only 19 (5%) attended tertiary education which shows that the high level of illiteracy/low level of education of the youth is a contributory factor for use of substance this finding seem to clear the misconception by National Traditional institute on substance use that once reported that majority of youth between the ages of 15-34 years in higher institute of learning use substances such as alcohol (70%) and cigarette (40%).

The prevalence of substance use in Dan Amar B communities is not different from other societies or communities. However, the degree may vary depending on several factors. The analysed data reveals that the prevalence rate of substance use among youths in Dan Amar B communities in Bauchi Local Government Area, Bauchi State, is 75% which is a bit higher compared to other communities. However, this is not a surprise due to a high level of illiteracy accompanied by peer pressure, unemployment, and the desire to improve work performance, For example, in their farms or businesses, which is in line with other researchers worldwide as reasons of varying degrees of prevalence of substance use. The data also reveals that Tobacco is the most commonly use substance with a prevalence rate of 47% followed by Cannabis 23% solvent/syrup 11% sedatives 10%, and alcohol 4% among others. And the majority of the youth regularly use two or more (multiple) types of substances irrespective of age, gender or educational level. This supports the report conducted in Northern Nigeria, e.g Sokoto, which indicated that 37% of out -of -school children abuse substances like cannabis, cigarettes, and solvents.

The major determinant of substance use identified in this study area (Dan Amar B communities) was peer group influence, which formed 108 (28%) of the total respondents supporting the social learning theory, which posits that youth are likely to model behaviour observed within their social network.⁵ Other reasons identified includes curiosity about the substance 60 (16%) to improve work

performance 48 (13%), to deal with stress and self-medication has equal respondents of 39 (10% each) sexual enhancement 30 (7%) and family history of substance use has 25 (6%).

Additionally, lack of sound education seem to be a contributory factor of the youth's involvement in substance abuse as the higher prevalence was recorded among the illiterate and less educated ones which was contrary to the view by traditional institute on substance use who reported that majority of student in higher leaning are involved in use of substance like alcohol 70%, 40% smoke cigarette and 20% use prescription drug for non-medical reason. So this research viewed that report to be a misconception, which proved that the more educated a youth is, the more capable he is to resist, e.g peer group pressure to take part in substance use and the less involvement in the act, which is similar to findings from previous research in sub-Saharan Africa^{6,7}. The study also identifies the risk factors like genetic, environment, trauma, frequent family conflict and divorce to prone youth to use. The analysed data further shows that as a result of the youth overindulging in act of substance use, both the individual, family and even the society are feeling the negative impacts of substance abuse as 84 (22%) cases violent behaviour was recorded, 80 (21%) reported. turning to theft and 65 (17%) neglect their family. Other reported issues include prostitution, contacting diseases like HIV/AIDS etc. This is in line with a researcher that opined that when an individual drug user cannot do without the substance he/she can takes every risk like begging, stealing, prostitution, fraud or cheating to obtain drug.²⁴. And one boring issue is that despite all these challenges, majority of the youth are not willing to stop the act of use of substances which could be because of addiction as stated by a writer that when a person became addicted to substance the desire for impulsiveness make it difficult to stop the use of substance.

Another reason could be the reported existing gap of knowledge on negative health effects of substance use this is in line with a report by a researcher that lack of awareness on inherent dangers associated with substance use by youth contributed to their involvement in the use of substance.³⁰ This call for urgent intervention through more intensive education campaign to create awareness on the issue to help save the life

of our future generation leader from the dangers associated with substance use.

A research conducted in Bauchi town shows the prevalence of substance use among youth within group of 15-35 years was also 40%. Based on 2018 National Drug Use Survey (UBS/UNODC) an estimated 16% prevalence of substance use was reported in the wider Bauchi State among individuals aged 15-64 respectively. A study was conducted among secondary school in Bauchi State which reveals that 34.2% were actively engaging in substance use versus 65.8% who claimed to have stopped.

Similarly, within the Nigerian context the prevalence rate of youth involved in substance use was reported to be 40% with South-East and some parts of the South West having a significant prevalence of substance trafficking as a result of lack of awareness of the general public especially on the inherent dangers associated with substance use. The 2018 National Drug use Survey reported that 14.4% of the population age 15-64 years are psychoactive substance with the highest use among young adult. In Lagos 41% of adolescents reported using at least one psychoactive substance in Sokoto 37% of out of school youth admitted using cannabis and codeine syrup. And in Northern Nigeria cannabis and tramadol remain the most widely used substance among males.

In Africa the prevalence rate was found to be between 3.8 to 13%, while youth in West Africa age 15-64 years is 12% compared with 4 and 5% in East and South Africa respectively

Globally, over 276 million people use drug in 2022 with youth accounting for significant proportion. (5.6%) reported using at least one illicit drug indicating an increase of 64 million (3%) since 2018.

Limitations

This study is subject to social desirability bias and cross-sectional design cannot establish causality.

Conclusion

This study showed a high prevalence of substance use among youths. Cannabis, tobacco, solvents, sedatives and others were used substances as single users and multiple users. Peer group influence, improved work performance, sex enhancement, and attempts to deal with stress were the contributory factors to substance use. There is a need to create and sustained an

awareness of substance use and its consequences in the community.

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CLINICAL AND ECHOCARDIOGRAPHIC FEATURES OF HEART FAILURE IN NORTH-EASTERN NIGERIA: A SINGLE-CENTER STUDY

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Abstract

Background: Heart failure (HF) is a major cardiovascular disorder with a growing burden in sub-Saharan Africa. Epidemiological data shows regional variations in aetiology and patient characteristics across Nigeria. There is a paucity of contemporary data from North-Eastern Nigeria, a region with unique socio-economic and health challenges.

Objective: To describe the clinical presentation, aetiology, and echocardiographic characteristics of heart failure patients at a tertiary hospital in Gombe, North-Eastern Nigeria.

Methods: This was a hospital-based, cross-sectional study conducted at the Federal Teaching Hospital, Gombe, from January to December 2022. Ninety consecutively recruited, newly diagnosed HF patients (using the Framingham criteria) underwent clinical evaluation and transthoracic echocardiography. Data on socio-demographics, clinical features, and echocardiographic parameters were collected and analysed using SPSS version 20.

Results: The mean age of the patients was 44.4 ± 18.6 years, with a female preponderance (65.6%, n=59/90). The majority of patients (85.6%) presented in New York Heart Association (NYHA) functional class III or IV, with a median symptom duration before presentation of 4 weeks. Hypertensive heart disease (HHD) was the leading cause of HF (47.8%, n=43), followed by peripartum cardiomyopathy (PPCM) (26.7%, n=24). Echocardiography revealed severe systolic dysfunction with a mean left ventricular ejection fraction (LVEF) of $35.4\% \pm 9.8\%$. Most patients (70%) had an LVEF below 40%. The mean left ventricular mass index (LVMI) was significantly elevated at 184.8 ± 74.5 g/m².

Conclusion: Heart failure patients in North-Eastern Nigeria are remarkably young and predominantly female, presenting with advanced symptomatic disease and severe systolic dysfunction. HHD and PPCM are the predominant aetiologies. These findings underscore the critical need for aggressive public health measures targeting hypertension control, improved maternal health services, and early diagnosis to mitigate the severe burden of HF in this region.

Keywords: Heart Failure, Echocardiography, Hypertension, Peripartum Cardiomyopathy, Nigeria, North-East.

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Introduction

Heart failure (HF) is a global pandemic, a complex clinical syndrome that represents the common end-stage pathway for a multitude of cardiac diseases.[1] It is associated with significant morbidity, mortality, and immense economic burden on healthcare systems worldwide.[2] In the United States and Europe, HF predominantly affects the elderly, with coronary artery disease (CAD) being the leading underlying cause.[1, 3] However, the epidemiological and aetiological profile of HF in sub-Saharan Africa (SSA) presents a strikingly different picture, often characterized by a younger age of onset and a predominance of non-ischaemic causes.[4, 5]

The pattern of heart failure in SSA is largely attributable to mechanical dysfunction arising from hypertension, rheumatic heart disease (RHD), and various forms of cardiomyopathy.[6] Hypertension, in particular, has been identified as a central driver of the HF epidemic on the continent, often earning the grim moniker of being the greatest cardiovascular health challenge after HIV/AIDS.[7] Hospital-based studies from various parts of Africa consistently report hypertensive heart disease (HHD) as the leading cause of HF admissions.[8, 9] Other significant contributors include idiopathic dilated cardiomyopathy (DCM), peripartum cardiomyopathy (PPCM), and RHD, with ischaemic heart disease playing a comparatively minor, though increasing, role.[10, 11]

Nigeria, as the most populous nation in Africa, bears a significant portion of this burden. Several studies from different geopolitical zones of the country have provided valuable insights into the national profile of HF. Studies from Abuja,[12] Port Harcourt,[13] and Abeokuta[14] have highlighted HHD, DCM, and RHD as the predominant aetiologies. A consistent finding across these studies is the relatively young age of affected patients, typically presenting

in their fifth and sixth decades, which is decades younger than their counterparts in high-income countries.[12, 14]

However, Nigeria is a nation of vast diversity, and significant regional disparities in healthcare access, socioeconomic status, and disease patterns exist. North-Eastern Nigeria, in particular, faces unique challenges, including higher poverty indices, lower literacy rates, and profound insecurity, which have collectively strained an already fragile healthcare system.[15] These factors can profoundly influence health-seeking behaviour, disease presentation, and ultimately, the clinical profile of conditions like HF.

While the Sub-Saharan Africa Survey of Heart Failure (THESUS-HF) provided a multi-country perspective,[5] and studies from North-Western Nigeria (e.g., Kano[16] and Zaria[17]) have contributed to the understanding of HF in the northern region, there is a distinct scarcity of recent, detailed data from North-Eastern Nigeria. An earlier study from the region by Antony in 1980 reported idiopathic DCM as the commonest cause of HF,[18] but the epidemiological transition over the past four decades likely places hypertension at the forefront today.

This study, therefore, aims to fill this critical knowledge gap by providing a detailed contemporary description of the clinical and echocardiographic profile of heart failure patients presenting to a major tertiary referral center in Gombe, North-Eastern Nigeria. The findings will be crucial for informing local public health interventions, guiding clinical practice, and planning resource allocation to address the specific challenges of HF management in this underserved region.

Methods

Study Design and Setting

This was a hospital-based, cross-sectional analytical study conducted at the Cardiology Unit of the Department of Internal Medicine, Federal Teaching Hospital (FTH), Gombe,

between January and December 2022. FTH Gombe is a 400-bed tertiary health institution serving as a referral center for Gombe State and neighbouring states including Bauchi, Yobe, Borno, Adamawa, and Taraba. The cardiology unit manages an average of 20-25 newly diagnosed HF patients monthly.

Study Population and Sampling

The study participants consisted of ninety (90) consecutively recruited, newly diagnosed heart failure patients. Heart failure was diagnosed using the validated Framingham Criteria,[19] which requires the concurrent presence of two major or one major and two minor criteria. Patients aged 18 years and above who provided informed consent were included.

Ethical Consideration

Ethical approval for the study was obtained from the Research and Ethics Committee of the Federal Teaching Hospital, Gombe (Ref: NHREC/25/10/2013). Written informed consent was obtained from every participant before enrolment into the study.

Data Collection

Data collection was performed using a structured study questionnaire and involved three main protocols:

1. **Clinical Evaluation:** The principal investigator obtained detailed demographic data (age, sex, marital status, occupation) and clinical history, including symptoms attributable to HF and their duration. A thorough physical examination with emphasis on the cardiovascular system was performed. Functional status was classified according to the New York Heart Association (NYHA) criteria.[20] Anthropometric measurements (weight and height) were taken, and Body Surface Area (BSA) was calculated using the Mosteller formula.[21]

2. **Echocardiography:** Conventional transthoracic echocardiography was performed on all subjects using an I-VIS60 Digital Color Doppler Ultrasound system

(Chison medical imaging Co Ltd. China) equipped with a 3.5-MHz transducer. Examinations were conducted following the recommendations of the American Society of Echocardiography (ASE).[22, 23] Parameters measured or calculated included:

- Left ventricular internal dimension in diastole and systole (LVIDd, LVIDs).
- Posterior wall thickness and interventricular septal thickness in diastole (PWTd, IVSTd).
- Left ventricular ejection fraction (LVEF) was calculated using the Teichholz formula.[24]
- Left ventricular mass (LVM) was calculated using the formula of Devereux and Reichek[25] and indexed to BSA to obtain the Left Ventricular Mass Index (LVMI).
- Left atrial diameter (LAD) and aortic root diameter (ARD).
- Diastolic function was assessed via mitral inflow Doppler (E and A waves, E/A ratio). Left ventricular systolic dysfunction (LVSD) was categorized as: normal (LVEF $\geq 50\%$), mild (LVEF 40-49%), moderate (LVEF 30-39%), and severe (LVEF $< 30\%$).

3. **Aetiological Classification:** The aetiology of HF was determined based on clinical history, physical examination, and echocardiographic findings, following standard clinical definitions.

Data Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) for Windows, Version 20 (IBM Corp., Armonk, NY). Continuous variables were presented as mean \pm standard deviation (SD) for normally distributed data, and median with interquartile range (IQR) for skewed data. Categorical variables were expressed as frequencies and

percentages (n, %). Descriptive statistics were used to summarize the socio-demographic, clinical, and echocardiographic characteristics of the patient population.

Results

Socio-Demographic and Clinical Characteristics

A total of 90 heart failure patients were recruited and analysed. The socio-demographic and clinical characteristics are summarized in Table 1.

The mean age of the patients was 44.4 ± 18.6 years, with a range from 18 to 85 years. There was a distinct female preponderance, with 59 females (65.6%) and 31 males (34.4%). The majority of the patients were married (75.6%, n=68), and 17.8% (n=16) were widowed.

The clinical presentation was notably severe. Half of the patients (50.0%, n=45) presented in NYHA functional class IV, while 35.6% (n=32) were in class III. Only 11.1% (n=10) and 3.3% (n=3) presented in class II and I, respectively. This indicates that 85.6% of the patients had advanced, symptomatic HF at presentation.

The median duration of HF symptoms before presentation was 4 weeks (IQR: 6 weeks). A third of the patients (33.3%, n=30) presented within two weeks of symptom onset, while 23.3% (n=21) had symptoms for over 8 weeks before seeking tertiary care.

The anthropometric measures showed a mean weight of 62.3 ± 10.8 kg and a mean Body Mass Index (BMI) of 22.8 ± 3.8 kg/m².

Table 1: Socio-demographic and Clinical Characteristics of Heart Failure Patients (N=90)

Characteristic	Value
Age (years), Mean \pm SD	44.4 \pm 18.6
Sex, n (%)	
Male	31 (34.4)

Characteristic	Value
Female	59 (65.6)
Marital Status, n (%)	
Single	1 (1.1)
Married	68 (75.6)
Divorced	5 (5.6)
Widowed	16 (17.8)
NYHA Class at Presentation, n (%)	
Class I	3 (3.3)
Class II	10 (11.1)
Class III	32 (35.6)
Class IV	45 (50.0)
Duration of Symptoms (weeks), Median (IQR)	
Weight (kg), Mean \pm SD	62.3 \pm 10.8
Body Mass Index (kg/m ²), Mean \pm SD	22.8 \pm 3.8

Aetiology of Heart Failure

The aetiological distribution of heart failure in the study population is detailed in Table 2. Hypertensive heart disease (HHD) was the predominant cause, accounting for 47.8% (n=43) of all cases. Peripartum cardiomyopathy (PPCM) was the second most common aetiology, responsible for 26.7% (n=24) of cases. Dilated cardiomyopathy (DCM) was found in 12.2% (n=11) of patients, while rheumatic heart disease (RHD), specifically rheumatic mitral valve disease, accounted for 11.1% (n=10). Rare causes included ventricular septal defect (VSD) and cor pulmonale, each constituting 1.1% (n=1) of the cohort. Ischaemic heart disease was not identified as a primary aetiology in any patient.

Table 2: Aetiology of Heart Failure in the Study Population (N=90)

Aetiology	Frequency, n	Percentage, %
Hypertensive Heart Disease (HHD)	43	47.8
Peripartum Cardiomyopathy (PPCM)	24	26.7
Dilated Cardiomyopathy (DCM)	11	12.2
Rheumatic Heart Disease (RHD)	10	11.1
Ventricular Septal Defect (VSD)	1	1.1
Cor Pulmonale	1	1.1
Total	90	100.0

Echocardiographic Characteristics

The echocardiographic parameters revealed significant structural and functional abnormalities, as shown in Table 3. The patients exhibited marked left ventricular dilation, with a mean LVIDd of 5.99 ± 0.99 cm and a mean LVIDs of 4.90 ± 1.00 cm. The mean left ventricular ejection fraction (LVEF) was severely reduced at $35.4\% \pm 9.8\%$.

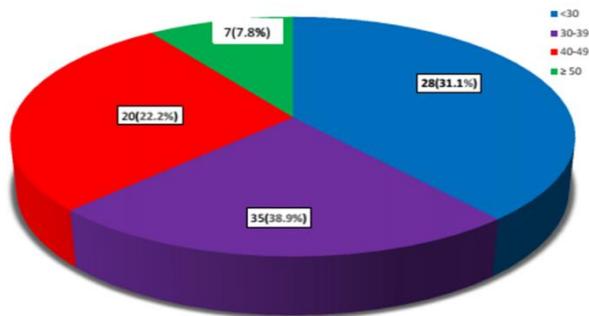
The distribution of patients based on LVEF categories is presented in Figure 1. The majority of patients (70%, n=63) had severe or moderate systolic dysfunction, with 38.9% (n=35) in the 30-39% EF range and 31.1% (n=28) with an EF less than 30%. Only 7.8% (n=7) of patients had a preserved EF ($\geq 50\%$).

Evidence of significant left ventricular hypertrophy was present, with a mean LVMI of 184.8 ± 74.5 g/m 2 . The mean left atrial diameter was enlarged at 34.3 ± 17.7 cm. Diastolic function assessment showed a mean E/A ratio of 1.69 ± 0.79 .

Table 3: Echocardiographic Characteristics of Heart Failure Patients (N=90)

Echocardiographic Parameter	Value (Mean \pm SD)
LVIDd (cm)	5.99 ± 0.99
LVIDs (cm)	4.90 ± 1.00
IVSTd (cm)	1.05 ± 0.29
PWTd (cm)	0.99 ± 0.30
Left Ventricular Ejection Fraction (%)	35.4 ± 9.8
Left Ventricular Mass (g)	257.3 ± 95.1
Left Ventricular Mass Index (g/m 2)	184.8 ± 74.5
Left Atrial Diameter (cm)	34.3 ± 17.7
Aortic Root Diameter (cm)	22.8 ± 11.1
E/A Ratio	1.69 ± 0.79

Figure 1: Pie Chart Showing Classification of Patients Based on Ejection Fraction



Discussion

This study provides a detailed contemporary profile of heart failure patients in North-Eastern Nigeria. The key characteristics of this cohort are the young age of onset, the striking female preponderance, the late and severe stage of presentation, and the dominance of hypertensive heart disease and peripartum cardiomyopathy as underlying causes, accompanied by severe echocardiographic derangements.

The mean age of 44.4 years in our study is consistent with the well-documented trend of HF affecting a younger demographic in SSA compared to high-income countries.[5, 12] This finding aligns with reports from Kano (46.9 years)[16] and is slightly lower than the mean age of 52.3 years in the multi-country THESUS-HF study.[5] This younger age profile can be attributed to the high prevalence of aetiologies like RHD, PPCM, and DCM, which manifest in early to middle adulthood. Furthermore, hypertension and its complications present at a younger age in Africans,[26] and as the primary aetiology here, it drives the early onset of HF. This contrasts sharply with Western populations, where HF is predominantly a disease of the elderly, with a mean age of 76 years, largely due to the high burden of ischaemic heart disease.[3] The economic impact of HF in this young, productive population is

devastating, leading to significant loss of productive years and increased dependency.

A remarkable finding of our study is the female preponderance (65.6%), which differs from several other Nigerian studies where males were either predominant or equally affected. [12, 13, 27] This disparity is largely explained by the very high prevalence of peripartum cardiomyopathy (PPCM), which accounted for over a quarter of all HF cases and exclusively affects women. The 26.7% prevalence of PPCM in our cohort is one of the highest reported in hospital-based studies in Nigeria and highlights PPCM as a major women's health issue in this region. This could be linked to regional factors such as poor antenatal care attendance, traditional birthing practices, and specific nutritional deficiencies.[28] Furthermore, gender differences in health-seeking behaviour, where women in this socio-cultural context might be more likely to seek hospital care when critically ill, may also contribute to this observed preponderance.[29]

The severity of presentation is a major concern. The fact that 85.6% of our patients presented in NYHA class III or IV, with half being in class IV, indicates a critical failure in the early diagnosis and management of cardiac diseases in the community. This finding is more severe than reports from the THESUS-HF registry, where 51% presented in class III/IV,[5] and studies from Cameroon[8] and Ghana,[9] which reported more patients in class II. This late presentation can be attributed to a confluence of factors prevalent in North-Eastern Nigeria, including poor health literacy, reliance on patent medicine vendors and unorthodox care as first-line treatment, poverty, and the significant barriers to accessing specialist care posed by distance and insecurity.[15] The median symptom duration of 4 weeks before presentation supports this pattern of delayed care-seeking. The low mean BMI (22.8 kg/m²) further suggests the presence of cardiac cachexia, a complication of advanced

and chronic HF,[30] reinforcing the finding of late-stage disease. Malnutrition could also have played a role.

Regarding aetiology, our study confirms the central role of hypertension in driving the HF epidemic in Nigeria, with HHD accounting for 47.8% of cases. This is consistent with findings from Abuja (62.6%),[12] Zaria,[17] and other parts of SSA. [5, 8] This underscores the urgent need for effective, population-wide hypertension control programs. The significant burden of RHD (11.1%) reflects the persistent failure of primary and secondary prevention of streptococcal infections in the region. The 12.2% prevalence of DCM is similar to reports from other parts of Nigeria[12, 13] and indicates a substantial burden of undiagnosed inflammatory disease and idiopathic myocardial disease. The complete absence of ischaemic heart disease as a primary aetiology, while surprising, aligns with its historically low prevalence in SSA, though recent data suggests it is on the rise.[11]

The echocardiographic data objectively confirms the clinical severity. The mean LVEF of 35.4% indicates severe systolic dysfunction on a population level, which is comparable to findings from Ilorin (32.9%)[31] and Abuja (42.9%),[12] and worse than reports from European registries.[32] The high mean LVMI of 184.8 g/m² signifies pronounced left ventricular hypertrophy, a hallmark of HHD and a key factor in the pathogenesis of HF in this population. This finding is similar to a report from Ilorin (196.9 g/m²)[31] and reflects the long-standing, uncontrolled pressure overload on the left ventricle. The enlarged left atrial diameter is a marker of chronically elevated left ventricular filling pressures, commonly seen in both systolic and diastolic HF.

Study Limitations

This study has some limitations. As a single-center study, the findings may not be fully

generalizable to the entire North-Eastern population or to patients in primary and secondary health facilities. The cross-sectional design provides a snapshot in time and cannot establish causal relationships or track outcomes. The aetiological classification was based on clinical and echocardiographic findings without coronary angiography, which could have led to an under-diagnosis of ischaemic heart disease. Despite these limitations, the study provides invaluable contemporary data from an under-represented region.

Conclusion and Recommendations

This study highlights the profile of heart failure in North-Eastern Nigeria that is characterized by young age, female preponderance, late and severe clinical presentation, and a preponderance of HHD and PPCM, with severe systolic dysfunction and left ventricular hypertrophy on echocardiography.

Based on these findings, we recommend the following:

- 1. Public Health Interventions:** There should be aggressive, community-based hypertension screening and control programs tailored to the region. Early detection and sustained treatment of hypertension are paramount to reducing the incidence of HHD.
- 2. Maternal Health Strengthening:** The high burden of PPCM calls for improved access to quality antenatal and postnatal care, including echocardiographic screening for at-risk women and education on seeking care for peripartum cardiac symptoms.
- 3. Health System Strengthening:** Efforts to improve early diagnosis and referral are critical. This includes training primary healthcare workers to recognize HF symptoms, establishing referral pathways, and public health education to discourage delays in seeking appropriate care.

4. **Further Research:** Large, prospective, multi-center studies incorporating follow-up data are needed to determine the mortality rates, prognostic factors, and long-term outcomes of HF patients in this region to guide management strategies effectively.

Addressing the burden of heart failure in North-Eastern Nigeria requires a concerted effort that targets its root causes and the systemic barriers to early and effective care.

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HEAD COMPUTED TOMOGRAPHY SCAN FOR NONTRAUMATIC NEUROLOGICAL EMERGENCIES: PATTERN OF FINDINGS IN A NIGERIAN TERTIARY HOSPITAL

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Abstract

Background: Neurologic emergencies are commonly associated with high rates of disability and mortality in developing nations like Nigeria, requiring rapid and accurate diagnosis and management. Computed tomography (CT) scan is an important imaging modality which is readily available in emergency settings, it can be applied rapidly to provide accurate diagnosis.

Objectives: To assess the pattern of findings on the head CT scan of adult patients presenting with non-traumatic neurological emergencies in Damaturu, north-eastern Nigeria.

Methodology: A retrospective study conducted at the Department of Radiology, Yobe State University Teaching Hospital (YSUTH), Damaturu, over five-year period from January 2019 to January 2023. The study involved adult patients evaluated for non-traumatic neurological emergencies and examined with a 160-slice Toshiba Aquilion prime CT scanner. Clinical details and CT reports were retrieved and Data were analysed using SPSS statistical software version 23.

Results: There were 358 patients, 202 (56.4%) males and 156 (43.6%) females. The mean age was 51 ± 19 years and the majority were in 41-60 years aged group. The top three indications for head CT exam was stroke (58.0%), seizure disorder (8.1%) and persistent headache (7.5%). CT scan findings were positive in 268 (75.1%) and the remaining 90 (24.9%) were negative. One hundred and seventy-five (65.3%) of those with positive CT were confirmed stroke cases. This was followed by cerebral atrophy in 31 (11.6%) and brain tumours in 17 (6.3%), being the two most common CT findings after stroke in this study.

Conclusion: The study show positive CT findings among the majority of patient studied with stroke being the most common finding. Therefore stroke is the most prevalent non-traumatic neurological emergency in this study.

Keywords: non-traumatic, neurologic emergencies, computed tomography

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Introduction

Neurologic emergencies such as acute stroke, status epilepticus, subarachnoid hemorrhage, neuromuscular weakness, and spinal cord injury arise frequently and, if not diagnosed and treated quickly, can have devastating results, with high rates of long-term disability and death.¹ The majority of neurological emergencies are life-threatening conditions that necessitate immediate diagnosis and treatment. If not recognized and treated early, they can have catastrophic effects, resulting in long-term impairment or death. Patients presenting to emergency departments (EDs) with neurological diseases should be examined as soon as possible and managed in a multidisciplinary manner, as some of these disorders are associated with other medical and non-medical conditions.² Neurological disorders comprise 9% of total emergency department (ED) admissions⁽¹⁾ Study shows about 60% of non-contrast head computerized tomography (CT) are performed in non-trauma patients presenting in ED. These patients present with several clinical conditions, including acute neurological deficit (both transient and persistent), headache, seizures, altered state of consciousness, confusion, dizziness, vertigo, and syncope.³ Neurological emergencies are among the most common reasons for seeking care in EDs. In these cases, brain CT scans are useful for evaluating acute intracranial disease and determining its severity, with the aim of screening patients who require immediate surgical treatment and distinguishing them from those for whom medical management and observation are sufficient.⁴ CT is an important modality in the ED.⁵ Head CT is a diagnostic tool frequently used in the ED setting, to evaluate patients with a wide range of suspected central nervous system disorders.³ Since the development of CT in the 1970s, the use of CT studies has been

increasing exponentially. CT study use during a decade revealed that the proportion of CTs ordered in the ED increased by 81%.⁶ The most common CT scan done in an emergency department is CT head, which falls under two categories i.e. post traumatic and non-traumatic CT head.⁷ Multiple reasons could lead to warrant head CT scan (HCT) such as onset of a new focal neurology, failure to wake up after sedation, or probably most common an altered mental state (AMS).⁸ A study conducted in Ethiopia revealed neurological emergencies accounted for 5.27% of the total medical emergencies. Hemiparesis, altered mental status, and seizures were the most common neurological presentations, accounting for 44%, 19.3%, and 13.1% of all cases, respectively. Cerebrovascular disorders (54%), HIV/AIDS related neurologic sequels (9%), meningitis (8.7%), and seizures (7%) were the most common neurologic disorders diagnosed.⁹ Another study from southern Nigeria found that neurological emergencies accounted for 25.7% of the total medical emergencies. The most common diagnoses were stroke (52.5%), Meningitis (11.3%) and hypertensive encephalopathy (7.0%).⁽¹⁰⁾ CT findings among patients with clinical diagnosis of stroke in Maiduguri, northeast Nigeria showed 64% were confirmed stroke cases and the remaining 36% were misdiagnoses of stroke, with normal finding in 23% and stroke mimics in the remaining 13%. At Yobe state University Teaching Hospital, a tertiary health institution, the profile of patients presenting with neurologic emergencies and their imaging pattern has not been studied prior to this time. This study is therefore aimed to assess the pattern of findings of neurologic emergencies among patients undergoing cranial CT exams in the emergency setting of our hospital for non-traumatic indications. It will also determine the prevalence of acute non-traumatic neurologic disease in cranial CT scans

requested from the emergency department as well as the most common reasons why brain imaging scans were requested. This will help to identify priorities among neurological patients and prepare the hospital to better management of such cases in an appropriate

Methodology

The study was carried out among adult patients, 18-80years of age who underwent Head CT Scan for non-traumatic neurologic emergency indications. This was a retrospective study conducted from January 2019–January 2023 at Radiology Department of Yobe State University Teaching Hospital (YSUTH) Damaturu-Nigeria and involved adult patients 18-80years. Their request cards and case notes were assessed to obtain information on clinical indication for the exam, detailed demographics, additional clinical information and relevant results of investigations. We have excluded patients with incomplete records and those with images of poor diagnostic quality. In addition, all patients who had head CT examination other than for emergency non-traumatic indications, patients below 18years and above 80years of age were also excluded.

Ethical clearance was obtained from the Research Ethics committee of Yobe State University Teaching Hospital (YSUTH) Damaturu-Nigeria (reference number: YSUTH/MAC/EC/050; Approval date: 17th August, 2023).

All patients were scanned from the skull base to the vertex in supine position using Helical Multi-detector Computed Tomography machine – 160 slice CT scanner (Aquilion prime Model TSX-303A, Toshiba Medical Systems Corporation, 1385, Shimoshigami, Otawara-Shi, Japan, 2014). The justification for the examination confirmed and Patient placed in supine position on the CT table with the head supported on the head rest using immobilization pads with straps, to ensure

and cost-effective manner. The findings in this study will serve as a baseline for further researches and in planning health care policies and distribution of the available resources in our immediate environment.

correct head position. The laser beam used for indicating the starting and end point of the scan. Unnecessary irradiation of the lens avoided by examining at an angle parallel to the infra-orbitomeatal line. The couch with the patient introduced into the gantry where the tube rotates around the patient's head in the gantry. The examination done and images acquired using the appropriate exposure factors (70kv-100kv and 25mA-300mA). These images included the scanogram and axial slices with thickness of 5mm, followed by multiplanar reconstructed sagittal and coronal sections in bone window as well as 3D volume rendered images. Intravenous contrast medium administered where indicated. CT scan images retrieved and analyzed on the Radiologists diagnostic console Vitrea-vital imaging software, version 6.6.3. Copyright 2013. All native and reconstructed Images were saved on the departmental server for archiving. Images carefully studied, reports written immediately and forwarded on the Picture Archiving and Communication System (PACS). The expected CT findings included intracerebral hematoma (ICH), epidural hematoma (EDH), subdural hematoma (SDH), subarachnoid haemorrhage (SAH), cerebral oedema, cerebral contusion, mid line shift, The confidentiality of subjects was preserved by assigning numbers to each eligible subject in place of real names or hospital numbers, and the data was kept strictly confidential and safe.

Data collection and sorting was done manually and entered into an excel spread

sheet, sorted and clean. Exported into Statistical Package for Social Sciences (SPSS) version 22.0 software for analysis. Microsoft word was used for tables and excel for charts. Qualitative data was expressed in frequencies and percentages while quantitative data was described using the

measures of central tendency; (mean, median) and measures of variability; (range, standard deviation). Chi-square test or Fisher's exact test was used to determine significant association between qualitative variables. A P-value of 0.05 was considered significant.

Results

Table 1: shows distribution of Clinical indications by sex

Clinical Indications	Sex		Total
	Male	Female	
Stroke	113	95	208
	31.6%	26.5%	58.1%
Seizure Disorder	22	7	29
	6.1%	2.0%	8.1%
Hypertensive Encephalopathy	3	2	5
	.8%	.6%	1.4%
Visual Disturbance	3	2	5
	.8%	.6%	1.4%
TIA	1	2	3
	.3%	.6%	.8%
Headache	16	11	27
	4.5%	3.1%	7.5%
Altered Mental State	3	3	6
	.8%	.8%	1.7%
Visual Disturbances	4	1	5
	1.1%	.3%	1.4%
Cranial Nerve Palsy	2	1	3
	.6%	.3%	.8%
Loss Of Consciousness	7	9	16
	2.0%	2.5%	4.5%
ICSO	6	1	7
	1.7%	.3%	2.0%
Others lesions	13	15	28
	3.6%	4.2%	7.8%
Multiple symptoms	9	7	16
	2.5%	2.0%	4.5%
Total	202	156	358
	56.4%	43.6%	100.0%

There were 358 patients, 202 (56.4%) males and 156 (43.6%) females studied. Their mean age was 51 ± 19 years and the majority were in 41-60 years aged group.

The top three clinical indications for head CT exam was stroke (58.0%), seizure disorder (8.1%) and persistent headache (7.5%).

CT scan findings were positive in 268 (75.1%) and the remaining 90 (24.9%) were negative. Significant number of these patients (48.0%) were hypertensive. One hundred and three (28.8%) do not have any form of comorbidity, while the remaining patients presented with various forms of comorbidities such as DM, malignancy and other chronic diseases. One hundred and seventy-five (65.3%) of those with positive CT were confirmed stroke cases. This is followed by cerebral atrophy in 31 (11.6%) and brain tumours in 17 (6.3%), being the two most common CT findings after stroke in this study.

The most frequent form of stroke recorded in this study was cerebral infarct in 141 (39.4%). Majority of these patients, 62 (17.3%) with this finding are seen among 61-100 years age group.

Table 2: shows distribution of Clinical indications distribution by CT findings

Clinical Indications	Brain Lesions		Total
	Negative CT	Positive CT	
Stroke	14	194	208
	3.9%	54.2%	58.1%
Seizure Disorder	19	10	29
	5.3%	2.8%	8.1%
Hypertensive Encephalopathy	3	2	5
	.8%	.6%	1.4%
Visual Disturbance	3	2	5
	.8%	.6%	1.4%
TIA	1	2	3
	.3%	.6%	.8%
Headache	22	5	27
	6.1%	1.4%	7.5%
Altered Mental State	2	4	6
	.6%	1.1%	1.7%
VDS	3	2	5
	.8%	.6%	1.4%
Cranial Nerve Palsy	1	2	3
	.3%	.6%	.8%
Loss Of Consciousness	3	13	16
	.8%	3.6%	4.5%
ICSOL	0	7	7
	0.0%	2.0%	2.0%
Others	13	15	28
	3.6%	4.2%	7.8%
Compound abnormalities	6	10	16
	1.7%	2.8%	4.5%
Total	90	268	358
	25.1%	74.9%	100.0%

Table 3: shows distribution of CT findings by patients Age group

Comorbidity	Brain Lesions		Total
	Negative CT	Positive CT	
None	54	49	103
	15.1%	13.7%	28.8%
Hypertension	10	162	172
	2.8%	45.3%	48.0%
DM	1	14	15
	.3%	3.9%	4.2%
Hypertension/DM	0	9	9
	0.0%	2.5%	2.5%
Epilepsy	10	00	14
	2.8%	1.1%	3.9%
Malignancy	2	5	7
	.6%	1.4%	2.0%
CKD	0	6	6
	0.0%	1.7%	1.7%
Heart Failure	1	3	4
	.3%	.8%	1.1%
Others	12	16	28
	3.4%	4.5%	7.8%
Total	90	268	358
	25.1%	74.9%	100.0%

Table 4: shows distribution of CT findings by patients Age group

CT FINDINGS	Age Group			Total
	15-40	41-60	61-100	
Normal CT Findings	57	25	8	90
	15.9%	7.0%	2.2%	25.1%
Cerebral Infarct	25	54	62	141
	7.0%	15.1%	17.3%	39.4%
Parenchymal Haemorrhage	7	14	12	33
	2.0%	3.9%	3.4%	9.2%
IVH	0	3	0	3
	0.0%	.8%	0.0%	.8%
SAH	0	1	0	1
	0.0%	.3%	0.0%	.3%
SDH	1	3	4	8
	.3%	.8%	1.1%	2.2%
Combined Haemorrhages	1	2	2	5
	.3%	.6%	.6%	1.4%
Haem. And Infarct	0	1	4	5
	0.0%	.3%	1.1%	1.4%
Brain Abscess	2	2	0	4
	.6%	.6%	0.0%	1.1%
Meningitis	2	0	0	2
	.6%	0.0%	0.0%	.6%
Encephalitis	0	1	1	2
	0.0%	.3%	.3%	.6%
SOL	6	7	4	17
	1.7%	2.0%	1.1%	4.7%
Atrophy	3	17	11	31
	.8%	4.7%	3.1%	8.7%
no significant abnormality	8	3	5	16
	2.2%	.8%	1.4%	4.5%
Total	112	133	113	358
	31.3%	37.2%	31.6%	100.0%

Discussion

Our study shows that 56.4% patients for emergent CT are males while female subjects comprised 43.6%. This corresponds to the group with higher prevalence of stroke. Number of males is more than females for most clinical indications of emergent CT. This may be due to relative predominance of male population in our country or attributable to higher comorbidity among male patients. This is similar to what was found by Alpaslan that 52% percent of the patients in there study

were male.¹¹ The patients' mean age of was 51 ± 19 , with the most of the patients among 41-60 years of age group. The mean patients' age and gender distribution of the study population is consistent with previous studies.²

CT scan is a readily available, easily accessible, cost effective and non-invasive modality of choice. These features made it suitable for evaluation of neurological emergencies in our setting. The aim of emergency imaging is diagnosing the cause of the symptoms of the patient for urgent management which can be medical or surgical as the case may be. The commonest head CT findings done for non-traumatic indications in our hospital was ischemic infarct, age-related cerebral atrophy and brain tumours. Some cases of acute ischemic infarct were associated with haemorrhage, though less common. For the purposes of our study, other findings—such as nonspecific white matter hypodensities seen on emergent head CT—have been classified as non-significant abnormalities because they may not affect treatment.

Most studies of head CT in emergency setting focus on trauma patients, comparatively fewer studies examined nontrauma patients. These studies are demonstrate that head CT examinations are of high diagnostic yield, nearly all patients with abnormal CT findings also had abnormal neurologic examination findings.¹² This is found to be true in our study which demonstrated high positive CT findings in about 75% of patient, and nearly all patients presented with abnormal neurologic examination findings.

The higher proportion of hypertension (48.0%) as comorbidity in this study may be due to high prevalence of primary hypertension among Africans. In another study(13), 66.3% of the hypertensive patients presented with ischemic stroke which is

similarly an important comorbidity as in our study.

Table 1 shows that stroke (58.0%), seizure disorder (8.1%) and persistent headache (7.5%) are major clinical indications for emergent CT. Hypertensive encephalopathy, LOC, and visual disturbance also forms major indication for emergent CT. **Table 2** shows that 48.0% of total head CT shows presence of hypertension as a comorbidity out of which only 2.8% shows no significant abnormality on CT scan. This is possible because of the increasing frequency of uncontrolled hypertension, as well as other risk factors.¹⁴ The most common abnormality is stroke in 175 which constitutes 65.3% of those with positive CT. cerebral atrophy in 31 (11.6%) and brain tumours in 17 (6.3%), being the two most common CT findings after stroke in this study. Cerebral infarct which is 39.4% followed by Parenchymal Haemorrhage which is 9.2%. Haemorrhage and Infarct form only 1.4% each of total head CT findings. This finding is in agreement with previous studies that reported a higher prevalence of ischemic than hemorrhagic stroke in southwestern Nigeria.¹⁴

Our study shows that 17.3% of total cerebral infarct occurs among patient age group above 60 years of age. A study by Adamu et al shows relatively lower age range of 50–79 years having the highest frequency of ischaemic infarct with few cases under the age of 40 years.¹³

Our study shows negative CT findings among patients with seizure indication. This is against findings in a study where CT findings show encephalomalatic/gliotic changes, and ICH.¹⁵

The use of brain CT to investigate recurrent headaches is supported by our findings. CT scans had a very low diagnostic yield when there was no comorbidity.

Conclusion

The study shows positive CT findings among the majority of patient studied with stroke being the most common finding. Therefore stroke is the most prevalent non-traumatic neurological emergency in this study.

Conflict of Interest

The authors declare no conflict of interest.

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SERUM ELECTROLYTES PROFILE OF PAEDIATRIC SURGICAL PATIENTS WITH TYPHOID INTESTINAL PERFORATION IN AMINU KANO TEACHING HOSPITAL, KANO - A 5-YEAR REVIEW.

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Abstract

Introduction: It is estimated that there are about 17 million cases of typhoid fever worldwide every year. Intestinal perforation is a serious and common complication in these patients with fluid and electrolyte disturbances being common. These abnormalities may remain unrecognized and result in morbidity and mortality. Active surveillance and prompt correction is important to forestall adverse outcomes.

Aim: To assess the serum electrolyte profile of children with typhoid intestinal perforation in our center over a 5-year period.

Methodology: It was a retrospective study in which data was extracted from the records of consecutive patients managed for typhoid intestinal perforation between 2009 and 2013. This was achieved using a proforma designed for the study. Ethical approval was obtained from the Hospital's Research Ethics committee. Data was analysed using IBM SPSS version 21.0; statistical significance was set at p-Value < 0.05.

Results: A total of 129 patients were studied, 78 were males and 51 were females (M: F = 1.5:1). The mean age of the patients was 8.18 ± 2.63 years, and the mean duration of admission was 18 ± 15 days. Mean serum electrolyte values were Na^+ : $136.34 \pm 15.21\text{mmol/L}$, K^+ : $3.51 \pm 1.20\text{mmol/L}$, HCO_3^- : 26.62 ± 1.52 and Cl^- : 89.33 ± 21.26 . We found statistically significant association between serum K^+ and volume of peritoneal aspirate as well as number of intestinal perforations (p-Value < 0.05).

Conclusion: This study has demonstrated that serum electrolyte abnormalities are common among children with typhoid intestinal perforation and the commonest are Hypokalaemia and Hyponatraemia. In these patients hypokalaemia is associated with presence of higher volume of peritoneal fluid collection as well as presence of higher number of intestinal perforations. However, pre-and post-resuscitation electrolyte profiles did not show effects on outcome of treatment in our patients.

Key Words: *Serum Electrolytes, Typhoid intestinal perforation, Children*

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Introduction

Typhoid fever, also called enteric fever, is caused predominantly by the bacterium *Salmonella typhi*, which is a gram-negative facultative anaerobe. The common mode of infection is by the feco-oral route. It is estimated that there are about 17 million cases of typhoid fever worldwide every year. Intestinal perforation is a serious and common complication in these patients¹. Electrolytes are substances that ionize when dissolved in suitable ionizing solvents such as water, occur in variety of conditions and may remain unrecognized and result in morbidity and mortality irrespective of primary pathology². Electrolyte imbalance is a common problem in children of all age groups, and this is more so in the tropical countries where most patients are usually victims of fluid losses from various etiologies³. An optimal balance of body fluid and electrolytes is critical to overall health as well as maintaining homeostasis. Electrolytes aid in enhancing muscle functions and in maintaining acid-base balance and body fluid levels⁴. The purpose of this study is to assess the serum electrolyte profile of children with typhoid intestinal perforation in Aminu Kano Teaching Hospital over a 5-year period.

Methods

Study Design/Study site

This was a retrospective study conducted at Aminu Kano Teaching Hospital, Kano, which is a tertiary health institution of Bayero University Kano (BUK), both situated in the ancient city of Kano.

Sample size

The records of 129 patients managed for typhoid intestinal perforation from 2009 and 2013 were retrieved, and the required information was extracted.

Study population

The study population was constituted by consecutive patients who were treated for typhoid intestinal perforation over the period of 5 years in Aminu Kano Teaching Hospital.

Ethical approval

Ethical approval was obtained from Aminu Kano Teaching Hospital Health Research Ethics Committee, before carrying out the research. All information gathered from the records was kept confidential.

Data analysis

Data collection was done using a proforma prepared for the study. Data analysis was done using compatible SPSS statistics for Windows, Version 21.0, IBM Corp. Armonk, New York. Quantitative variables were summarized using means, SD, while qualitative variables were summarized as frequencies, proportions, tables and charts. The serum electrolytes were categorized as follows: Serum sodium Levels as Normal (130 mmol/L – 145 mmol/L), Hyponatraemia (<130 mmol/L), and Hypernatraemia (>145 mmol/L). Serum Potassium levels as Normal (3.5 mmol/L - 5.4mmol/L), Mild Hypokalaemia (3.0 mmol/L - 3.4 mmol/L), Moderate Hypokalaemia (2.5 mmol/L - 2.9 mmol/L), and severe Hypokalaemia (< 2.5 mmol/L). The serum Bicarbonate levels were categorized as Normal (20 mmol/L – 27 mmol/L), Alkalosis (> 27 mmol/L) and Acidosis (< 20 mmol/L). Volume of peritoneal aspirate was also categorized into Mild (< 500 mls), Moderate (500 mls – 1000 mls) and Severe (> 1000 mls). χ^2 -test (Fishers' exact) test was used to test associations between categorical variables. In all tests, statistical significance was set at $p < 0.05$ for statistical analysis.

Results: A total of 129 patients were studied, out of which 78 (60.50%) were males and 51(39.50%) were females; male: female ratio was 1.5:1 (Fig. 1). The mean age of the patients was 8.18 years ($SD \pm 2.63$ years) while the mean duration of admission was 18 days ($SD \pm 15$ days).

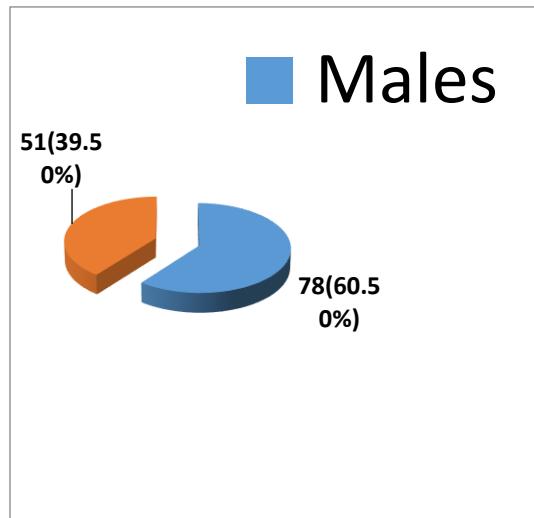


Figure 3: Pie chart showing distribution of patients by gender

Vol. of Aspirate	<500 ml	500 mls -1000 mls	>1000 mls	Total mls
Serum K⁺ level				
Normal	33	22	11	66
Mild Hypokalaemia	19	4	7	30
Moderate Hypokalaemia	5	6	4	15
Severe Hypokalaemia	10	4	4	18
Total	67	36	26	129

Table 2: Association between Volume of Peritoneal Aspirate and Level of Serum Potassium

$$\chi^2 = 96.4 \text{ p-value} < 0.05$$

Table 1: Summary of the mean values of Serum Electrolytes Pre and Post Resuscitation

Serum electrolytes	Mean (mmol/L)	SD _{pre}	SD _{post}
		Pre-Resuscitation	Post-Resuscitation
Na ⁺	130.41	6.41	15.21
K ⁺	3.37	0.64	1.20
HCO ₃ ⁻	20.13	1.12	1.52
CL ⁻	84.31	11.62	21.26
Urea	6.90	5.26	3.11
			1.78

Table 3: Association between Volume of Peritoneal aspirate and number of perforations

Vol. of Aspirate	<500 ml	500 mls - 1000 mls	>1000 mls	Total
$\chi^2 = 10.4$ p-value < 0.05				
No. of Perforations	55	22	17	94
Single Perforation				
2-3 Perforations	11	9	7	27
≥ 4 Perforations	2	4	2	8
Total	68	35	26	129

Table 4: Association between Serum Potassium Level and Outcome of Patients

Serum K ⁺ Level	Outcome		
	Alive	Died	Total
Normal	60	6	66
Mild Hypokalaemia	28	2	30
Moderate Hypokalaemia	12	2	12
Severe Hypokalaemia	17	4	21
Total	115	14	129

$\chi^2 = 3.4$ p-value > 0.05

Table 5: Association between Serum Sodium Level and Patient's Outcome

Serum Na ⁺ Level	Outcome		
	Alive	Died	Total
Normal	30	6	36
Hyponatraemia	78	7	85
Hypernatraemia	7	1	8
Total	115	14	129

$\chi^2 = 2.7$ p-value > 0.05

Table 6: Association between Serum Bicarbonate Level and Patient's Outcome

Serum HCO ₃ ⁻ Level	Outcome		
	Alive	Died	Total
Normal	99	5	104
Alkalosis	12	6	18
Acidosis	4	3	7
Total	115	14	129

 $\chi^2 = 3.3$

p-value > 0.05

Table 7: Association Between Number of Perforations and Serum Potassium Level

No. of Perforations	Serum K ⁺ Level				
	Normal	Mild Hypokalaemia	Moderate Hypokalaemia	Severe Hypokalaemia	Total
Single Perforation	48	23	8	4	83
2-3 Perforations	17	4	2	6	29
≥ 4 Perforations	1	3	2	11	17
Total	66	30	12	21	129

 $\chi^2 = 111.2$

p-value < 0.05

The mean pre-operative serum concentrations of the electrolytes both pre- and post-resuscitation were summarized in **Table 1**. Mean serum levels of potassium were compared to the volumes of peritoneal aspirate collected which showed statistically significant association ($\chi^2 = 96.4$, p-Value <0.05) as depicted in **Table 2**. Volume of aspirated peritoneal collection was also compared to the number of intestinal perforations found at surgery which also showed statistically significant association ($\chi^2 = 10.4$, p-Value <0.05), **Table 3**. The individual serum levels of potassium, sodium and bicarbonate were all compared to the final outcomes of the patients (alive or mortality) and this showed no statistically significant association. (**Tables 4,5,6**). Serum potassium levels, however, when compared to the number of intestinal perforations showed statistically significant association ($\chi^2 = 111.2$, p-Value <0.05) as summarized in **Table 7**.

Discussion

Electrolyte abnormalities are common in patients with typhoid fever due gastrointestinal losses through vomiting, diarrhea and third space loss. These patients commonly present in critical condition. In this our study, we have shown that serum electrolytes abnormalities are very common in patients with typhoid intestinal perforation commonly resulting from the mechanisms in addition to inability to take orally. This finding was corroborated by Ekpe *et al*⁴ as well as Balaji *et al*². The study showed that at presentation, the mean serum potassium level before resuscitation was 3.37 ± 0.64 mmol/L which was below the AKTH's reference range (3.5 - 5.4 mmol/L), and this persist of after initial resuscitation (mean post-resuscitation serum potassium 3.51 ± 1.20 mmol/L). This is also like that of serum sodium with pre- and post-resuscitation values. Same observation was made for serum levels of chloride and bicarbonate.

These abnormalities of hypokalaemia, hyponatraemia and acid-base imbalances were also demonstrated by Konukseveret *et al*⁵ in their study that assessed sodium and potassium imbalances in Paediatric Emergency department, with gastrointestinal disorders being the commonest causes of electrolyte abnormalities, mainly hyponatraemia and hypokalaemia. This was also shown by Yen *et al*⁶ and Panda *et al*⁷ in their studies.

Naseem *et al*⁸ reported electrolyte imbalance in critically ill paediatric patients including children with typhoid intestinal perforation, noting hypokalaemia as the commonest electrolyte abnormality. Similar finding was demonstrated by Ali *et al*⁹ and Ebrahim *et al*¹⁰.

The hypokalaemia noted in this study, which is significantly associated with the volume of peritoneal aspirate collected at surgery ($p < 0.05$) as well as with number of intestinal perforations ($p < 0.05$) further affirms the significance of loss of potassium in the third space fluid in patients with peritonitis from typhoid intestinal perforation.

Lack of significant association between individual serum levels of the electrolytes in our patients with typhoid peritonitis when compared to the outcome of treatment (ie mortality) ($p > 0.05$) did not correlate with the findings of other studies. Elala *et al*¹¹ demonstrated statistically significant association between outcome of patients with serum potassium levels in critically ill children especially when compared with those who presented without electrolyte derangements. Hypokalaemia and hyponatraemia were also shown by Paidy *et al*¹² to affect the final outcome of critically ill children in an emergency when compared to children with normal values. Haidar *et al*¹³ also noted that mortality is higher in children presenting with electrolyte derangement when compared to those without. Similarly, Lin *et al*¹⁴ reported that

variability of serum levels of sodium, potassium, and chloride are strongly associated with mortality of paediatric patients with critical illnesses. The difference of association of outcome with serum electrolytes values observed in our study may be explained by the difference in the patients being compared. Whereas in this study the serum values were of monotonous group of patients with typhoid intestinal perforation, the above quoted literature compared the serum electrolytes values of heterogeneous group of patients with critical illnesses presenting with or without electrolyte abnormalities.

Conclusion

This study demonstrated that serum electrolyte abnormalities are common among children with typhoid intestinal perforation and the commonest electrolyte derangements were hypokalaemia and hyponatraemia. The study was also showed that the levels of serum potassium is directly related to the volume of peritoneal fluid collection and number of intestinal perforations with statistically significant association. Also, electrolyte abnormalities, despite adequate correction, may not directly affect mortality, possibly, other non-electrolyte factors contribute to mortality in our patients.

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ASSESSMENT OF PERCEPTION AND AWARENESS OF TELEREHABILITATION AMONG MEDICAL AND PHYSIOTHERAPY STUDENTS IN SELECTED UNIVERSITIES OF NORTH-EASTERN NIGERIA

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Abstract

Introduction: Telerehabilitation refers to the use of telecommunication technologies to deliver rehabilitation services remotely, offering a solution to limited access to healthcare in underserved regions.

Objectives: This study aimed to assess and compare the levels of awareness and perception of telerehabilitation among medical and physiotherapy students in selected universities in North-Eastern Nigeria.

Materials and Methods: A cross-sectional design was employed, involving 274 students in 400-600 academic levels from three universities. Participants were selected using purposive sampling. Data were collected using the Telerehabilitation Adoption in Medical Education Questionnaire, a validated self-administered instrument. One-way ANOVA was used to assess differences in telerehabilitation awareness across the three academic levels (400, 500, and 600), with post-hoc Tukey's HSD tests to identify specific group differences. These comparisons helped determine whether significant differences existed in awareness and perception based on programme, gender, and academic progression.

Results: The students of physiotherapy demonstrated significantly higher awareness of telerehabilitation compared to medical students, with a t-value of -4.12 and a p-value less than 0.001, indicating strong statistical significance. Additionally, physiotherapy students reported more favorable perceptions across all measured domains, including knowledge, readiness, and clinical applicability, with p-values less than 0.05 for each comparison. Students at the 600 level showed significantly greater awareness than those in the 400 and 500 levels, as indicated by a one-way ANOVA result ($F = 9.24$, $p < 0.001$), suggesting that awareness increases with academic progression. However, there was no significant difference in perception scores by gender ($p = 0.471$), indicating that both male and female students held similar views regarding telerehabilitation.

Conclusion: There is a notable disparity between medical and physiotherapy students regarding awareness, perception, and readiness for telerehabilitation. The study emphasizes the need to incorporate interdisciplinary telerehabilitation training within health professional curricula to better prepare students for future digital healthcare practice in Nigeria.

Keywords: Telerehabilitation, Awareness, Perception, Medical Students, Physiotherapy Students, North-Eastern Nigeria.

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Introduction

Telerehabilitation is an emerging model of healthcare delivery that employs telecommunication technologies to remotely provide rehabilitation services, reducing the necessity for face-to-face consultations.^(1,2) It has gained international attention for improving access to therapy, particularly in rural and underserved regions where conventional rehabilitation services are limited.^(3,4) Research indicates that telerehabilitation enhances adherence to therapeutic programmes and improves health outcomes among individuals with chronic conditions.^(5, 6)

Globally, telerehabilitation has increasingly become integrated into healthcare systems, particularly in high-income countries with well-developed digital infrastructures.^(7,8) The COVID-19 pandemic further accelerated its adoption as clinicians sought safe alternatives to continue care despite restrictions imposed by social distancing.^(3,5) Additionally, telerehabilitation has been shown to reduce healthcare costs by decreasing hospital visits and removing transportation-related barriers.^(2,8)

In Nigeria, although physiotherapy services continue to evolve, the adoption of telerehabilitation remains low despite moderate awareness among health professionals.⁽⁹⁾ Major barriers include limited technological infrastructure, absence of standardised guidelines, and insufficient digital literacy.⁽¹⁰⁾ Studies report that only 43% of healthcare practitioners in the country exhibit moderate awareness of telerehabilitation, and even fewer apply it in clinical contexts.⁽⁹⁾

In Northern Nigeria, challenges such as weak internet connectivity, insecurity, and widespread poverty further impede digital health initiatives, including telerehabilitation.⁽¹⁰⁾ Among emerging healthcare providers, disparities exist in preparedness for telerehabilitation between medical and physiotherapy students. Physiotherapy students often show higher awareness yet lack hands-on application, whereas medical students, key stakeholders in referral decision-making, frequently have limited

exposure to telerehabilitation concepts.⁽¹¹⁾ These gaps may impede coordinated patient care, particularly within North-Eastern Nigeria where resource constraints are most severe.

The study specifically aims to compare the levels of awareness and perceptions of telerehabilitation among medical and physiotherapy students in selected universities in North-Eastern Nigeria. By assessing these variables, the research provides empirical evidence on the current state of knowledge and attitudes toward telerehabilitation within these student groups. The findings directly inform curriculum development by highlighting the need for improved education and training in telerehabilitation for both disciplines, thereby supporting more effective integration of digital healthcare practices in future professional training.

Materials and Method

A descriptive cross-sectional survey design was used to evaluate students' awareness and perceptions of telerehabilitation. Convenience sampling was applied to recruit participants who were readily accessible and willing to participate. The total eligible student population comprised 866 individuals (Medical students: University of Maiduguri = 434, Yobe State University = 87, Federal University of Health Sciences Azare = 176; Physiotherapy students: University of Maiduguri = 130, Yobe State University = 39). The minimum sample size of 274 was calculated using Yamane's formula ($n = N/1 + Ne^2$), where N represents the population size and e the margin of error (0.05).⁽¹²⁾

Ethical clearance for this study was obtained from the Yobe State University Teaching Hospital Health Research Ethics Committee. Permission was also sought from the relevant authorities at each participating university. All participants provided written informed consent prior to their inclusion in the study, ensuring their voluntary participation and the confidentiality of their responses.

Data were collected using the Telerehabilitation Adoption in Medical Education Questionnaire (TAME-Q), a structured self-administered tool developed by modifying previously validated

questionnaires in telehealth-related research.^(13,14,15) The instrument comprises three sections: Section A covers socio-demographic characteristics; Section B assesses knowledge of telerehabilitation using multiple-choice and ranking items; and Section C evaluates perception and readiness using a five-point Likert scale (Strongly Disagree to Strongly Agree). Scoring involves assigning points to each Likert-scale response (Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5). The total score for each section is calculated by summing the responses, enabling quantitative analysis of knowledge, perception, and readiness levels.

Regarding clinical applicability, the questionnaire's design allows for the assessment of knowledge and readiness for telerehabilitation among medical students, which can inform curriculum development and guide interventions aimed at improving clinical preparedness for telehealth practices. Face and content validation were conducted by subject experts. An initial pilot test with 20 students yielded a Cronbach's alpha of 0.59; after revision for clarity, a second pilot with another 20 students demonstrated excellent internal consistency ($\alpha = 0.89$).

Data collection occurred over one week. The researcher distributed questionnaires directly at Yobe State University, while trained assistants managed distribution through class representatives at the University of Maiduguri and the Federal University of Health Sciences, Azare. Completion time per questionnaire averaged 15–20 minutes.

Data analysis was conducted using SPSS version 26. Descriptive statistics were used to summarize demographic characteristics and measures of awareness. Independent t-tests were employed to compare mean scores between medical and physiotherapy students, as well as between genders. One-way ANOVA was used to evaluate differences across academic levels, with Tukey's HSD post-hoc test applied for pairwise comparisons. The level of statistical significance was set at $p < 0.05$.

The choice to analyze differences by academic level, gender, and professional group (medical vs. physiotherapy) was guided by the primary research objectives, which focused on assessing variations in telerehabilitation awareness and readiness among these specific categories. While factors such as institution, location, and age could influence outcomes, they were not prioritized due to the sample's relative homogeneity (students from the same region and institution) and the study's emphasis on professional and academic variables. If these factors had been more diverse or central to the research question, they would have been included in the analysis.

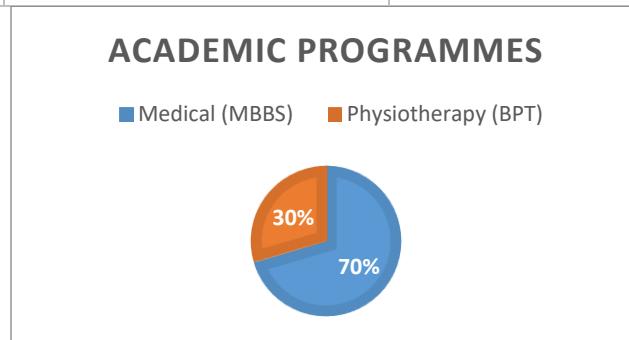
Parametric tests (t-tests, ANOVA) were selected because the main outcome variables—knowledge and readiness scores—were measured on interval or ratio scales, derived from Likert-type items and summed to create total scores. These data types are generally appropriate for parametric analysis when the sample size is adequate and the distribution is approximately normal, as confirmed by pilot testing and inspection of histograms and skewness/kurtosis values. The Cronbach's alpha values from pilot studies indicated good internal consistency, further supporting the reliability of the scales for parametric analysis.

Results

A total of 274 students participated in the study. As shown in Table 1, the majority were aged 22–25 years (57.7%), and male respondents constituted 56.9% of the sample. More than half of the participants were in the 400 level of study (54.7%), followed by the 500 level (34.7%) and 600 level (10.6%). Nearly half of the participants were from the University of Maiduguri (48.2%), with 31.0% from Yobe State University and 20.8% from the Federal University of Health Sciences, Azare. In terms of geographic background, 43.4% were from urban settings, 34.7% from semi-urban, and 21.9% from rural areas. Most participants were enrolled in the Medical (MBBS) programme (70.4%), while 29.6% were Physiotherapy (BPT) students (Figure 1).

Table 1: Socio-Demographic Characteristics of Participants

Variable	Category	Frequency (n)	Percentage (%)
Age Group	18–21 years	73	26.6
	22–25 years	158	57.7
	26–30 years	37	13.5
	>30 years	6	2.2
Gender	Male	156	56.9
	Female	116	42.3
	Prefer not to say	2	0.7
Academic Level	400 Level	150	54.7
	500 Level	95	34.7
	600 Level	29	10.6
Institution	University of Maiduguri	132	48.2
	Yobe State University	85	31.0
	Federal University of Health Sciences, Azare	57	20.8
Geographic Background	Urban	119	43.4
	Semi-Urban	95	34.7
	Rural	60	21.9

*Figure 4: Academic programmes enrolled*

Independent Samples t-Test Comparing Telerehabilitation Perceptions by Programme

An independent samples t-test was conducted to compare telerehabilitation perceptions between medical (MBBS) and physiotherapy (BPT) students across three domains (Table 2): Awareness and Knowledge, Readiness and Intent, and Clinical Applicability.

Medical students recorded significantly lower scores than physiotherapy students across all three scales. For Awareness and Knowledge,

medical students ($M = 12.15$, $SD = 3.45$) scored significantly lower than physiotherapy students ($M = 13.91$, $SD = 3.12$), $t(272) = -5.01$, $p < .001$. For Readiness and Intent, medical students ($M = 16.72$, $SD = 3.89$) again scored lower compared to physiotherapy students ($M = 17.86$, $SD = 3.52$), $t(272) = -2.56$, $p = .011$. Similarly, for Clinical Applicability, medical students ($M = 17.16$, $SD = 4.21$) scored significantly lower than physiotherapy students ($M = 19.00$, $SD = 3.79$), $t(272) = -3.87$, $p < .001$.

Table 2: Independent Samples t-Test Comparing TR Perceptions by Programme

Scale	Programme	Mean (M)	SD	t-value	p-value
Scale 1: Awareness & Knowledge	Medical (n=193)	12.15	3.45	-5.01	< .001*
	Physiotherapy (n=81)	13.91	3.12		
Scale 2: Readiness & Intent	Medical (n=193)	16.72	3.89	-2.56	.011*
	Physiotherapy (n=81)	17.86	3.52		
Scale 3: Clinical Applicability	Medical (n=193)	17.16	4.21	-3.87	< .001*
	Physiotherapy (n=81)	19.00	3.79		

Key:

SD = Standard Deviation

n = Sample size

*Significant at $p < 0.05$.**One-Way ANOVA for Telerehabilitation Awareness by Academic Level**

A one-way ANOVA was conducted to compare telerehabilitation awareness across three academic levels (400L, 500L, and 600L) (Table 3a and Table 3b). The analysis revealed a statistically significant difference in awareness scores among the groups, $F(2, 271) = 9.24$, $p < .001$, indicating that awareness varies by academic level.

Table 3a: Between-Groups ANOVA for Telerehabilitation Awareness

Source	Sum of Square	df	Mean Square	F	p-Value
Between Groups	23.27	2	11.63	9.24	< .001*

Table 3b: Within-Groups ANOVA for Telerehabilitation Awareness

Source	Sum of Square	df	Mean Square
Within Groups	341.41	271	1.26

Key:

df = degrees of freedom

F = F-statistic (ratio of between-group variance to within-group variance)

*Significant at $p < 0.05$

Post-hoc Tukey HSD analysis revealed that 600L students ($M = 2.86$, $SD = 1.20$) had significantly higher awareness scores than both 400L students ($M = 2.11$, $SD = 1.09$, $p < .001$) and 500L students ($M = 2.26$, $SD = 1.12$, $p = .014$).

To enhance clarity in statistical reporting, the one-way ANOVA results are presented in two distinct tables. Table 3a details the between-groups ANOVA, which captures the variability in awareness scores across the three academic levels. Table 3b presents the within-groups ANOVA, reflecting the variability in awareness scores within each academic level.

However, there was no significant difference between 400L and 500L students ($p = .587$). These findings suggest that telerehabilitation awareness improves with academic progression, with the highest awareness observed among final-

year students. Therefore, the null hypothesis was rejected, confirming a significant difference in awareness across academic levels.

Discussion

The present study revealed a notable disparity in telerehabilitation awareness and perceptions between medical and physiotherapy students. Physiotherapy students exhibited higher levels of core awareness and more positive perceptions across knowledge, readiness, and clinical applicability domains. This finding aligns with both international and Nigerian studies, which report that physiotherapy education integrates rehabilitation-specific technologies more extensively than medical curricula.^(13,16) The practical, intervention-oriented nature of physiotherapy training likely facilitates greater familiarity with remote healthcare delivery systems, whereas medical education, with its broader diagnostic and pharmacological focus, may place less emphasis on telerehabilitation.⁽¹⁷⁾ This knowledge gap could hinder effective interdisciplinary collaboration, particularly since medical graduates often serve as primary referral sources but may lack the awareness required to direct patients appropriately to telerehabilitation services provided by physiotherapists.⁽¹⁸⁾

Additionally, a significant positive association was observed between academic level and telerehabilitation awareness. Final-year students (600L) demonstrated higher awareness compared to junior students (400L and 500L), likely reflecting increased engagement in clinical training where telehealth solutions become more relevant.⁽¹⁹⁾ This emphasizes clinical education as a critical period for embedding digital health literacy to prepare future healthcare professionals for evolving healthcare delivery models.

The study also found no significant gender differences in telerehabilitation perceptions. This contrasts with some prior reports suggesting gender-based differences in digital health attitudes.⁽²⁰⁾ but may indicate a growing parity in technology acceptance among emerging Nigerian healthcare professionals. Such trends could reflect broader access to digital tools and shared

educational experiences that reduce traditional gender-related barriers.⁽²¹⁾

Overall, these findings highlight the need to integrate telerehabilitation education early in both medical and physiotherapy curricula. Doing so would enhance interdisciplinary understanding, improve readiness for telehealth delivery, and help bridge the current knowledge gap between healthcare professions.

Conclusion

Physiotherapy students' demonstrated significantly higher awareness and more positive perceptions of telerehabilitation compared to medical students, highlighting a gap in digital health preparedness between the two programmes. Awareness of telerehabilitation increased with academic progression, with final-year students showing the highest levels of knowledge and readiness. These findings underscore the need to integrate telerehabilitation education across all levels of medical and physiotherapy curricula to promote interdisciplinary collaboration and optimize future digital healthcare delivery.

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Authors' Contributions

AS and **UL** conceive the idea and supervise the whole study, **SMB** draft the introductory part of the study, collect data and present the result. **NHM** and **IAA** draft methodology and pre proof the study, **MAD** and **HA** draft the discussion and conclusion part of the study. **STM** draft the abstract part of the study. All authors approved the final version of the manuscript

Conflict of Interest

The authors declare that they have no conflicts of interest concerning the publication of this study.

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Consent

All participants provided written informed consent prior to their inclusion in this study.

Ethical Approval

Ethical approval for this study was obtained from the Yobe State University Teaching Hospital Health Research Ethics Committee.

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