Advancing collaborative efforts in cancer research: a convening of north-eastern Nigeria universities and international health systems on etiology, care, and outcomes

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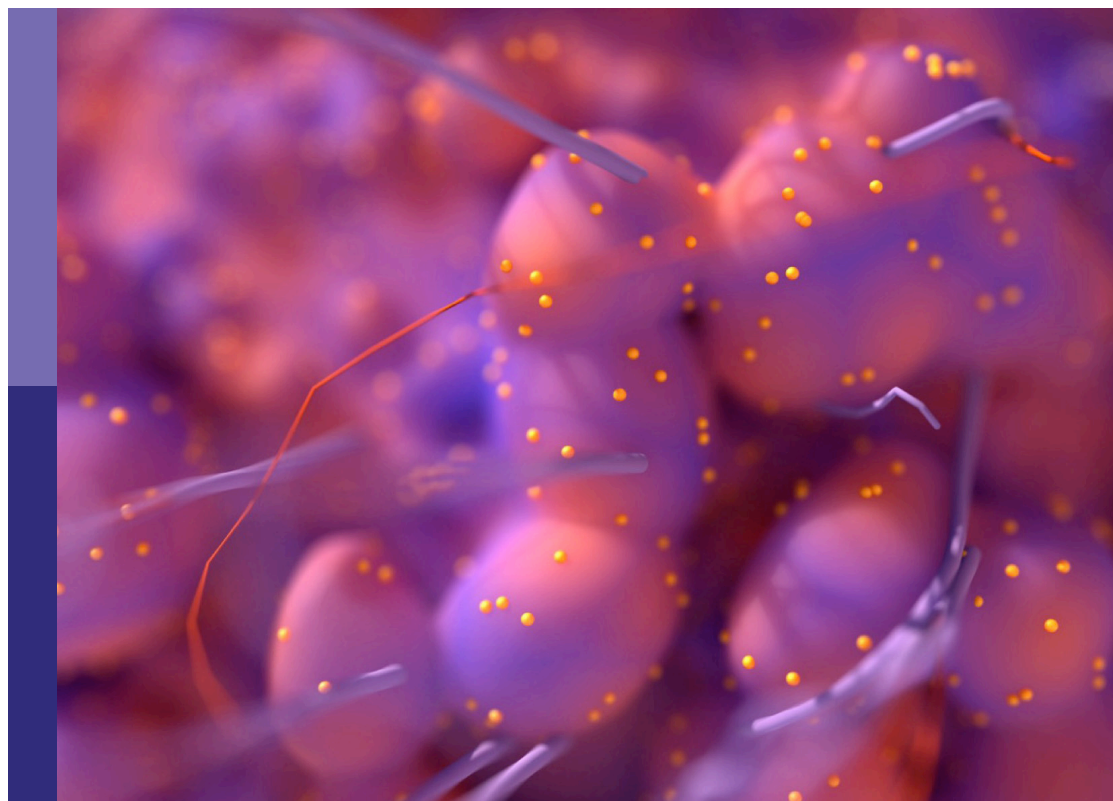Sophia George, Matthew Schlumbrecht and Bala Audu

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Table of contents

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Editorial: Advancing collaborative efforts in cancer research: a convening of north-eastern Nigeria universities and international health systems on etiology, care, and outcomes

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Editorial on the Research Topic
Advancing collaborative efforts in cancer research: a convening of north-eastern Nigeria universities and international health systems on etiology, care, and outcomes

In northeastern Nigeria, a region marked by limited healthcare resources, socioeconomic challenges, and cultural barriers, the burden of cancer is significant (1). Recent studies have highlighted the need for multidisciplinary collaboration and systemic interventions to improve cancer care outcomes (2). This editorial synthesizes the findings of six key papers that explore various aspects of cancer management in northeastern Nigeria, emphasizing the need for a holistic approach to address this growing crisis.

Mental health in oncology care

" *The Role of a Mental Health Physician in the Management of Oncology Patients: A Case Vignette and the Need for Collaboration*" underscores the critical role that mental health professionals play in supporting cancer patients (Armiya'u and Akande). The study used case vignettes to illustrate how mental health physicians can address these challenges through personalized interventions, such as psychotherapy, medication management, and coping strategies. The article emphasizes that mental health care should be integrated into standard oncology practice and that stronger partnerships between oncology and mental health teams should be developed to provide comprehensive care.

The burden of hematologic malignancies

"Common Hematological Malignancies in Northeastern Nigeria: A Multi-Centre Study of Their Pattern, Distribution, and Treatment Challenges" investigates the prevalence, types, and obstacles to treatment of blood cancers in northeastern Nigeria (Dachi et al.). The study, conducted across multiple healthcare centers, identifies non-Hodgkin lymphoma, leukemia, and multiple myeloma as the leading hematologic malignancies in the region. The study highlights significant challenges in the management of these malignancies, including limited diagnostic facilities, inadequate treatment options, and poor access to specialized care, which are exacerbated by financial constraints and lack of awareness. The findings underscore the need for improved healthcare infrastructure and enhanced public awareness. This contribution calls for a coordinated effort to improve early diagnosis and expand treatment options.

The burden of cancer in rural Sub-Saharan Africa

"Emerging Cancer Disease Burden in a Rural Sub-Saharan African Population: Northeast Nigeria in Focus" examines the increasing prevalence of cancer in a rural, underserved region of sub-Saharan Africa (Ezenkwa et al.). Common cancer types identified include those of the breast, cervical, spine, prostate, and liver, which are often diagnosed at advanced stages due to delays in seeking medical attention. The study emphasizes the socio-economic and cultural barriers that hinder effective cancer management, including poverty, stigma, lack of access to healthcare facilities, and reliance on traditional medicine. It also points to the region's lack of oncology specialists, diagnostic tools, and treatment facilities. The authors emphasize the need for collaboration among governments, non-governmental organizations, and international partners to reduce the cancer burden and improve outcomes for rural populations.

Gynecologic malignancies: a growing concern

"The Spectrum of Gynecologic Malignancies in Northeastern Nigeria" investigates the prevalence, types, and characteristics of gynecologic cancers in this territory (Katagum et al.). The study identifies cervical cancer as the most common gynecologic malignancy in the region, followed by ovarian and uterine cancers, while also highlighting the challenges faced in the management of gynecologic cancers in this resource-limited setting, including inadequate diagnostic facilities, a shortage of skilled healthcare professionals, a lack of formalized screening programs, and low symptom awareness. Cultural factors and stigma also contribute to delays in seeking medical care. The authors advocate for targeted interventions, such as HPV vaccination programs and capacity building for healthcare providers, to reduce incidence and improve outcomes for women with gynecologic cancers in the region.

Cervical cancer awareness

"Cervical Cancer Awareness, Perception, and Attitude Among Tertiary Health Institution Students in Northeastern Nigeria" explores the level of knowledge, along with perceptions and attitudes, toward cervical cancer among university students (Muhammad et al.). The study reveals that while a significant proportion are aware of cervical cancer, their understanding of its causes, risk factors, and prevention methods, such as HPV vaccination and regular screening, is limited. Misconceptions and knowledge gaps were particularly evident regarding the role of HPV infection and the importance of early detection. This contribution highlights cultural and educational barriers that contribute to low awareness, including stigma, lack of health education programs, and insufficient emphasis on reproductive health in the school curriculum. However, the study also found that students generally express positive attitudes toward learning more about cervical cancer and participating in prevention efforts. The article calls for comprehensive educational campaigns and the integration of cervical cancer awareness programs into university health curricula.

Pediatric cancers

"Incidence of Childhood Cancers in the North East Geopolitical Zone of Nigeria" examines the prevalence of childhood cancers in northeastern Nigeria (Suleiman et al.). The study identifies a significant burden of pediatric malignancies in the region, including lymphoma, leukemia, and retinoblastoma. These cancers predominantly affect children under the age of 10, with variations in incidence based on age, gender, and geographic location. The study highlights the challenges of diagnosing and managing childhood cancers in this resource-limited setting, including inadequate healthcare infrastructure, lack of specialized pediatric oncology services, and limited access to diagnostic tools and treatment options. The authors advocate for the establishment of specialized treatment centers, training programs for healthcare providers, and community-based awareness campaigns to promote early detection and improve survival rates for affected children.

A way forward: recommendations for action

The findings from these studies paint a stark picture of the cancer burden in northeastern Nigeria, but they also provide a roadmap for action. Key recommendations include:

1. Strengthening Healthcare Infrastructure: Establishing specialized cancer treatment centers and improving access to diagnostic tools and therapies.
2. Enhancing Public Health Education: Launching targeted awareness campaigns to promote early detection, HPV vaccination, and regular screening.
3. Integrating Mental Health Services: Incorporating mental health care into standard oncology practice to address the psychological burden of cancer.
4. Capacity Building: Training healthcare providers in oncology and mental health care to improve service delivery.
5. Community Engagement: Empowering communities through education and outreach programs to reduce stigma and promote early medical consultation.
6. Policy and Funding Support: Increasing funding for cancer care and advocating for policies that prioritize cancer prevention and treatment in the national health agenda.

Conclusion

The findings from these studies serve as a call to action for policymakers, healthcare providers, and the global health community to prioritize cancer care in northeastern Nigeria and similar settings. Only through collective efforts can we hope to achieve equitable cancer care for all.

Author contributions

MG: Writing – original draft, Writing – review & editing. SG: Writing – original draft, Writing – review & editing. AM: Writing – original draft, Writing – review & editing. BA: Writing – original draft, Writing – review & editing. MS: Writing – original draft, Writing – review & editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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Role of a mental health physician in the management of oncology patients: a case vignette and the need for collaboration

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There is an interplay between oncology and mental health, resulting in a high prevalence of mental disorders among cancer patients. Out of the several interventions developed to target cancer specifics, collaborative care is indicated due to its efficacy. The perspective delves into the efficacy of collaborative care models, spotlighting a culturally informed strategy designed to harmonize mental and physical health interventions to bolster the overall wellbeing and resilience of individuals battling cancer. Central to our discussion is a compelling case vignette of Raliat, a patient diagnosed with ovarian cancer whose narrative exemplifies the multifaceted challenges cancer patients face, including stigma, psychological distress, and social isolation. Raliat's story illuminates the profound impact of cultural beliefs on patient experiences and the critical importance of a sensitive, holistic approach to care that respects cultural contexts. Through this lens, our analysis reveals that addressing emotional and situational stressors through collaborative care can significantly reduce oxidative stress, potentially decelerating the progression of both cancer and accompanying mental health disorders. We advocate for integrating mental health services into oncological care, drawing on the case vignette to argue for policies that facilitate such merger by employing validated collaborative care models. We conclude with a call for public education to diminish cancer stigma and improve social outcomes, emphasizing the use of a culture-informed PACER (physical, affective, cognitive, environmental, and relationship) strategy in providing comprehensive care for cancer patients and their families.

KEYWORDS

cancer, mental health, PACER, oncology, culture, collaborative care

Introduction

A complex bi-directional relationship exists between mental health conditions and cancers, where each domain significantly influences the other, creating a complex interplay of biological, psychological, and social factors. Recent advances in the neurobiology of cancer pinpoint this interconnection, with Mravec providing a comprehensive definition and historical overview, along with outlining the clinical implications of the neurobiological pathways involved in cancer progression and its impact on mental health (1). This body of work highlights the pivotal role of the nervous system in the development and spread of cancer and the modulation of the tumor microenvironment, which, in turn, influences psychological wellbeing.

On the other hand, the work of Dhabhar, "Effects of stress on immune function: the good, the bad, and the beautiful," highlights the effects of stress on immune function, illustrating how acute stress can enhance immune responses, while chronic stress can lead to immunosuppression (2). This dynamic is particularly relevant in the context of cancer, where stress-related immune modulation can affect tumor growth and metastasis and the psychological resilience of patients.

Multiple pathways have been suggested to explain this comorbidity including psychoneuroimmunology. One of which is the free radical theory. Free radicals are unstable molecules that are naturally produced in the body as byproducts of the breakdown of nutrients from bodily processes or exposure to toxic substances (residual waste). The production of free radicals at a pace that exceeds the neutralization capacity of antioxidants causes oxidative stress, which has been implicated in cancer, depression, and high anxiety levels. Free radical-induced chromosomal defects and oncogene activation are associated with the initiation and progression of cancer (3, 4). Inflammation and immunological suppression have been linked to long-term stress (physical or psychosocial) (5). In addition, stress contributes to cardiovascular and neurodegenerative illnesses, as shown by the strong correlation between cancer and traumatic life experiences (6). Workplace stress was identified as a risk factor for a number of cancers in a meta-analysis that included 281,290 individuals (7).

Within a socio-ecological framework, the bi-directional relationship between mental health conditions and cancers is further complicated by individual, community, and systemic interactions. At the individual level, genetic predispositions, lifestyle factors, and psychological resilience play critical roles. Community factors, including social support networks and cultural attitudes toward cancer and mental health, significantly influence patient outcomes. Systemically, healthcare access, policy frameworks, and the integration of mental healthcare in oncology settings are crucial for addressing the complex needs of cancer patients.

By situating the discussion within this framework, we can better understand the multifaceted interactions at play, emphasizing the need for a holistic approach to oncology care. This approach acknowledges the convergence of neurobiological insights with psychosocial and environmental factors, advocating for integrated care strategies that address the full spectrum of patient needs. In doing so, it becomes imperative to leverage recent scientific insights and adopt a comprehensive perspective that spans from molecular mechanisms to societal influences, thereby ensuring that cancer patients receive care that is not only medically effective but also psychosocially supportive.

Cancer impact on mental health

Cancer is known to impact mental health and wellbeing. Moderate to high anxiety scores were reported by approximately 40% of cancer survivors, while moderate to high depression scores were reported by approximately 20%, with non-grief-related depression possibly related to inflammation or the effects of treatment and grief related to functional losses (8). Cancer-related cognitive impairment (CRCI) is known to include changes in memory, executive function, attention, and processing speed. CRCI occurs in about 30% of patients prior to treatment and up to 75% during treatment (9).

The neurotoxicity of chronic stress from cancer and cancer treatment has been reported (10). Also, chemotherapy or radiation can result in loss of hearing and tinnitus (11). A correlation between hearing loss, depression, and cognitive decline has been reported (12), with lower cognitive performance among cancer survivors occurring up to 20 years post-treatment (13).

Psychosocial morbidity in cancer

A recent review of psychiatric disorders among cancer patients in sub-Saharan Africa reported a high incidence (14), with 66.9% presenting with a Diagnostic Statistical Manual-IV disorder (15). Major depression and anxiety were most prevalent, with diagnostic surveys revealing 16.4%–40.3% of patients were experiencing depression and 8.8%–19.0% experiencing anxiety (16–19). Screening tools indicated even higher rates (20–23). In addition, opioid use, dysthymia, post-traumatic stress disorder (PTSD), and other psychiatric conditions were noted (15, 24). Contributing factors included being single, lack of social support, and advanced cancer (19, 25), which also increased the risk of suicidality and poorer psychosocial outcomes (26). In a study in the United States, authors emphasized the need for the establishment of culturally appropriate tools and programs aimed at lessening the mental health burden among cancer patients (27). Furthermore, they suggested formulating policies that would facilitate the merging of mental healthcare into standard cancer treatment by utilizing validated models like the collaborative care approach (27).

In Nigeria, the psychological toll of cancer is substantial, with 75% of patients experiencing psychological distress (28). Studies reveal a 27.5% prevalence of major depressive disorder among cancer patients, much higher than the 9.5% in the general population (19). Patients often turn to spirituality and structured problem-solving strategies to cope with the challenges posed by their diagnosis, highlighting the critical need for integrated mental health services in oncological care (29, 30).

Need for collaborative care

Various forms of cancer-specific interventions have been developed to target the conditions resulting from the emergence of psychological disorders and maladjustment to cancer. This includes different formats of psychotherapy (individual, group, and family therapy) and orientations (psychodynamic, supportive-expressive, cognitive-behavioral, existential, and meaning-centered). However, the choice of intervention is informed by the clinical and psychological condition, type and phase of illness, context, and availability of psycho-oncology services (multidisciplinary teams) (31). Collaboration was given priority in the research on the effectiveness of targeted interventions since it has been shown to improve quality of life and overall wellbeing by lessening the severity of physical and mental symptoms (32). However, an urgent need for a systematic approach was pinpointed (31).

FIGURE 1
PACER strategy.
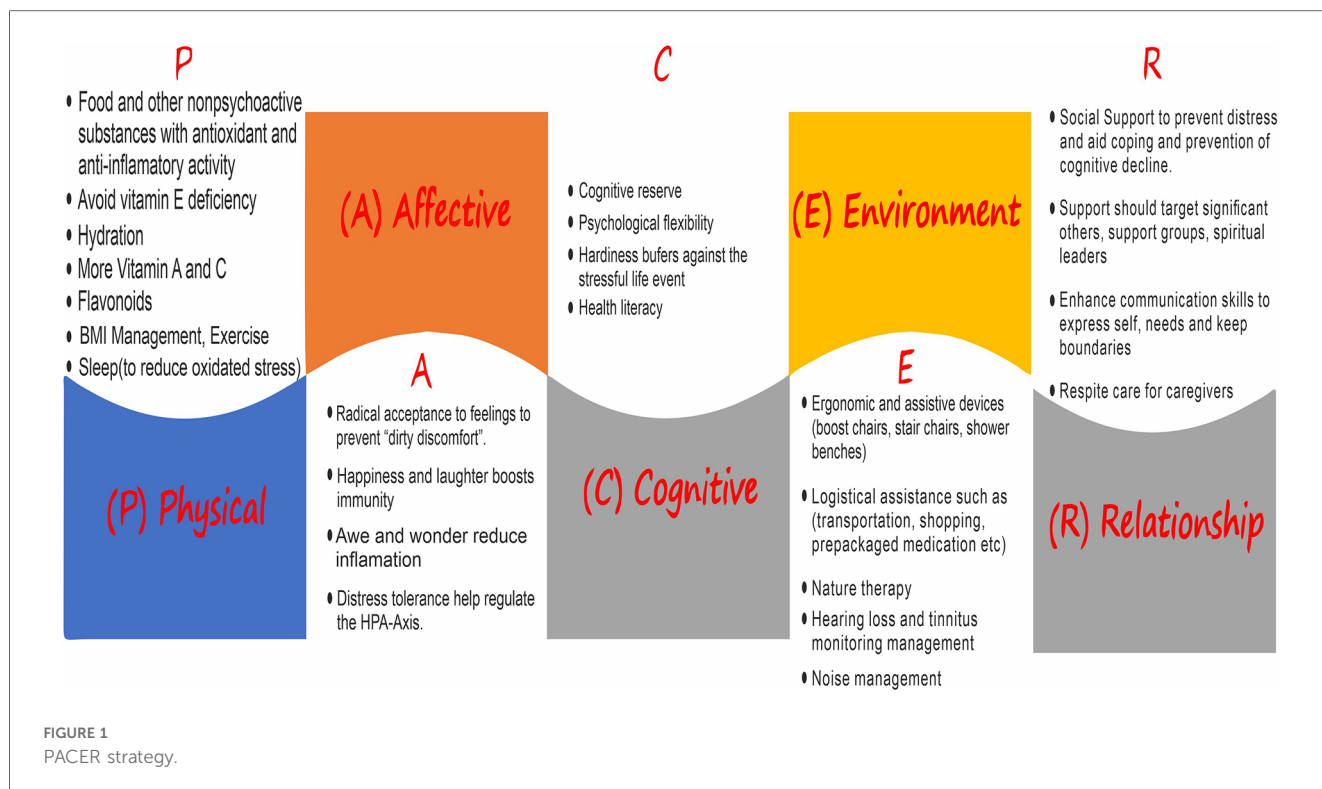
Target of collaborative care

Collaborative care should target the physical, affective, cognitive, environmental, and relationship (PACER) aspects (Figure 1). This could be carried out both proactively and reactively (33); however, we opine it should be informed by culture. Physical relates to sourcing for antioxidants and anti-inflammatory activity in food and other non-psychoactive substances, sleep, exercise, and hydration, among others. The affective deals with facing reality rather than denial through radical acceptance of feelings; trying to stay happy and still have reasons to laugh helps in reducing pain while increasing endorphins and boosting immunity. Cognitive entails cognitive reserve, psychological flexibility (mindful awareness and making a decision of best use of one's energy), and hardiness. Importantly, health literacy informs people and aids their understanding of how physical, affective, cognitive, environmental, and relationship aspects could help. Environment tackles ergonomics and logistical assistance such as transportation. Social support, enhanced communication skills, and respite care are central to the relationship component.

A case scenario

Raliat (real name withheld), a marketer in her late 30s, was diagnosed with ovarian cancer. She felt her life was about to come to an end and did not see reasons why she should do anything with or for anyone else. Considering she has not been on good terms with her mother-in-law, she was sure her diagnosis was a curse from her mother-in-law. She found comfort in getting drunk often as it temporarily helped her to forget her worries. Raliat hoped she died of cancer soon enough, or else she would have to end it all herself.

Although Raliat's husband could not help but wonder how his wife got cancer, the reality dawned on him that his wife was no longer interested in having sex. He dreaded life as a widower and felt ashamed of seeing his wife drunk. Raliat's children wondered what the fate of their mother would be, although friends at school had already told them their mother would die, and since cancer is hereditary, they would also have the diagnosis in a couple of years. Friends and neighbors mostly ignored them, while some laughed at them. What hurt them the most was their mother's irrational acts when drunk at night, which neighbors and passersby found amusing.

Neighbors believed that ovarian cancer, in particular, is a highly communicable consequence of adultery. They were resolute on isolating Raliat and excluded her from the community women's group and other social gatherings. Women in the community also warned their children and wards to stay away from Raliat's children and residence.

At work, the director observed that Raliat was not as prompt and timely as before. He was informed of Raliat's diagnosis and did not feel that should justify her lateness to work and lesser productivity. Rather, he sensed that a diagnosis of cancer among staff would send a wrong message to existing and prospective partners, hence the need to replace Raliat immediately. The scenario is illustrated in Figure 2.

Raliat's journey from the despair of an ovarian cancer diagnosis to finding hope and support emphasizes the necessity of a culturally informed PACER strategy in the management of

FIGURE 2
Cancer diagnosis of Raliat.
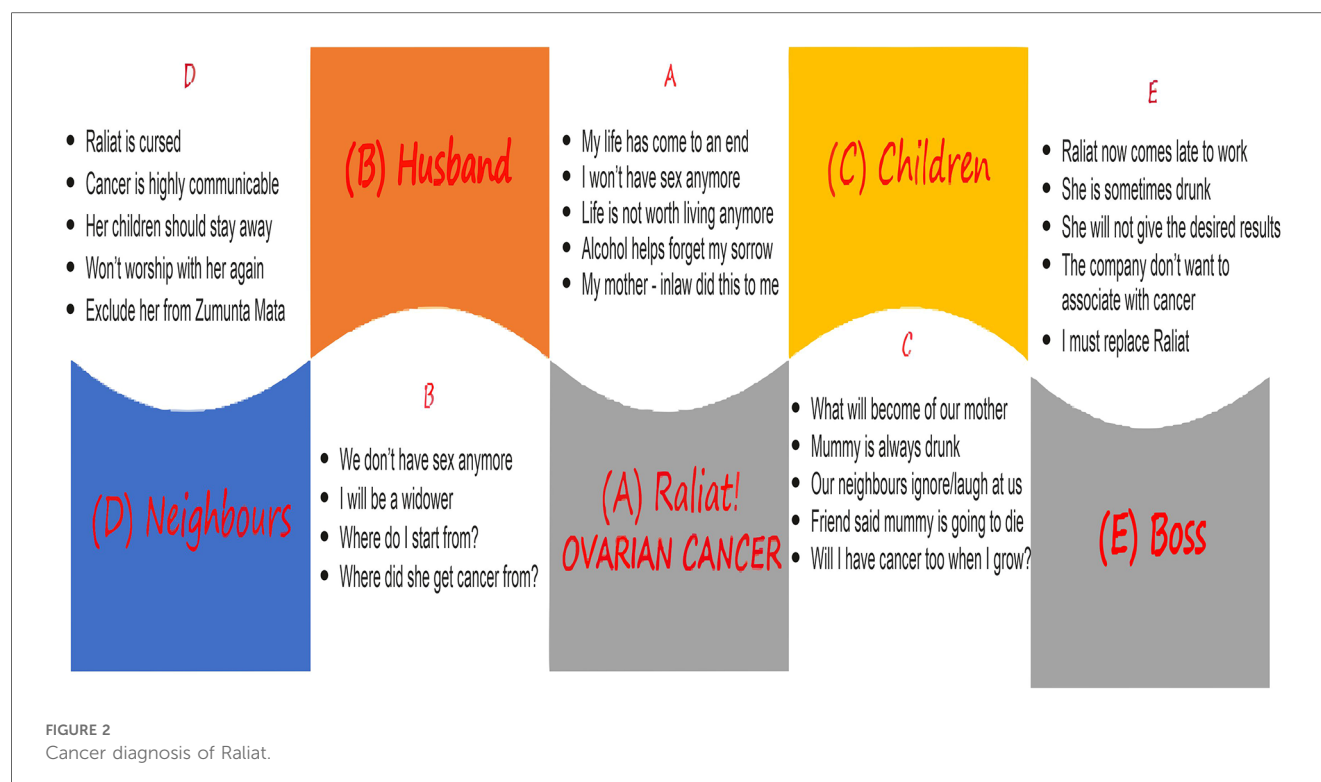
cancer patients. This approach holistically addresses her needs, taking into account the cultural context of her experience.

Interventions

Physical (P): Raliat was introduced to a tailored physical wellness program designed to mitigate the side effects of cancer treatment and enhance her overall wellbeing. This included nutritional guidance focused on local, culturally appropriate foods known for their anti-inflammatory and antioxidant properties, and a gentle exercise regimen aligned with her physical capacity and cultural preferences.

Affective (A): To address her emotional wellbeing, Raliat was provided with psycho-oncology support that included culturally sensitive counseling and therapy sessions. These interventions aimed at validating her feelings, reducing her emotional distress, and leveraging culturally relevant forms of expression, such as storytelling and music, to help her process her diagnosis and treatment journey.

Cognitive (C): Cognitive interventions focused on educating Raliat about her disease and treatment options in a culturally resonant manner. This included discussions on the importance of mental health in cancer care and training in cognitive-behavioral techniques (CBTs) to help her challenge negative thoughts and foster a positive, resilient mindset.

Environmental (E): Recognizing the impact of Raliat's surroundings on her recovery, efforts were made to engage her community and workplace in her care. Community outreach programs educated her neighbors and colleagues about cancer,

addressing myths and reducing stigma. Environmental modifications, such as creating a comfortable and soothing space at home and negotiating flexible working arrangements, were also implemented.

Relationship (R): To bolster Raliat's social support network, interventions included family counseling sessions to improve communication and understanding among her relatives and connect her with cancer support groups. These groups were carefully selected to ensure cultural compatibility, providing Raliat with a sense of community and belonging.

Outcomes

Physical and emotional wellbeing: Raliat experienced significant improvements in her physical health, reporting reduced treatment side effects and increased energy levels. Emotionally, she felt more balanced and hopeful, attributing this to the comprehensive support and understanding she received.

Enhanced knowledge and coping skills: Through cognitive and educational interventions, Raliat gained a deeper understanding of her condition and became adept at employing coping strategies to navigate her emotional response to cancer.

Community reintegration: The environmental and relationship interventions successfully mitigated Raliat's social isolation. She reconnected with her community, which now showed greater empathy and support, reducing the stigma she initially faced.

Strengthened family bonds: Family counseling sessions improved communication and empathy within Raliat's family, creating a stronger support system that empowered her throughout her treatment journey.

Sustained engagement with care: Empowered by a network of support and a comprehensive care plan, Raliat remained actively engaged in her treatment, demonstrating a high level of adherence and participation in decision-making processes.

Discussion

Raliat's case, characterized by a culturally informed PACER strategy, echoes findings from similar studies that emphasize the importance of holistic and integrated care approaches in oncology. Studies such as those by Kotronoulas et al. highlight the positive impacts of psycho-oncological interventions on patient wellbeing, similar to Raliat's improved mental and physical health outcomes (34). While Raliat's story illustrates the potential benefits of a PACER-based approach, its generalizability to other cultural contexts is limited. The effectiveness of certain interventions, particularly those involving community engagement and the use of culturally specific coping strategies, may not translate directly to settings with different cultural norms and healthcare systems.

Social ecological framework exploration

At an individual level, personal beliefs, genetic predispositions, and individual health behaviors play a critical role. Raliat's case emphasizes the importance of addressing personal coping mechanisms and psychological resilience in oncology care. Family dynamics, social support networks, and patient–provider relationships are key at the interpersonal level. In Raliat's scenario, family counseling and community education interventions were vital, reflecting findings that strong social support enhances patient outcomes.

At an organizational level, healthcare systems and oncology care settings influence the delivery and efficacy of interventions. The multidisciplinary approach in Raliat's case illustrates the benefit of cohesive care coordination within healthcare organizations. Cultural norms, stigma associated with cancer and mental health, and community support systems are influential at the community level. Raliat's engagement with her community and the educational outreach performed are examples of strategies to combat stigma and enhance communal support.

Policy level is representative of the healthcare policies, access to care, and national mental health strategies that shape the broader context within which care is delivered. The successful integration of mental health services into oncology care, as seen in Raliat's case, requires supportive policies and funding mechanisms.

A glance at Nigeria

In Nigeria, the development of a collaborative oncology care model is evolving (35), particularly with efforts focused on enhancing inter-professional collaboration and building capacity for conducting oncology clinical trials (36). A significant initiative in this regard involves partnerships with several Nigerian institutions aimed at strengthening local research capabilities and improving

facilities for conducting advanced oncology clinical trials. This model is underpinned by active engagement with various stakeholders, policymakers, and international collaborations that support and train local investigators (36).

However, the implementation of such models faces barriers, including the current low rate of inter-professional collaborative practice in healthcare settings. A study that assessed inter-professional collaborative practice at the tertiary care level in Nigeria found that health professionals rated the practice as low and perceived it as negatively impacting patient outcomes, professional performance, job satisfaction, and the frequency of conflicts and strike actions (35). Also, infrastructural limitations, insufficient maintenance of medical equipment, and a skills gap among local investigators and clinical trial staff were challenges highlighted during assessments of oncology centers, revealing deficiencies in areas such as laboratory and imaging capabilities, oncology nursing, chemotherapy facilities, and data management (36).

Possible models for collaborative care in Nigeria could involve policy formulation and commitment from healthcare professionals to embrace teamwork and patient-centered care. Such models would necessitate integrating various healthcare providers, including mental health specialists, into oncology care settings to ensure a culturally attuned holistic approach to patient care.

Conclusion

Several mental health conditions result from the diagnosis and treatment of cancer, necessitating collaborative efforts that involve mental health physicians. The implementation of the PACER (physical, affective, cognitive, environmental, relationship) collaborative care model within oncology represents a pivotal shift toward a more holistic and integrated approach to cancer care. This model not only acknowledges but actively incorporates the myriad of factors influencing patient outcomes into the care process, ranging from the biological to the psychosocial, and is grounded within a cultural context. By doing so, it sets forth a comprehensive framework that significantly enhances the traditional paradigms of oncology care.

Implications

In practice, the PACER model mandates a broadened scope of patient assessment, transcending physical symptoms to include psychological and social wellbeing, thereby fostering an informed understanding of patient needs. It expresses the importance of interdisciplinary collaboration by involving a mental health physician in a diverse team of healthcare professionals to offer a cohesive and personalized treatment plan. Furthermore, it places a strong emphasis on cultural competency, urging providers to tailor care strategies to respect and incorporate patients' cultural backgrounds and preferences.

From a policy perspective, the PACER model calls for robust support for integrated care models that blend mental and physical health services seamlessly. It advocates for policies that incentivize collaborative practices and cultural sensitivity in healthcare

delivery, emphasizing the need for resources and training that enable the implementation of such models. These policy changes are pivotal in creating a healthcare environment that supports the comprehensive care approach the PACER model represents.

Future research directions are clearly delineated by the implementation of the PACER model. Studies focusing on the effectiveness of PACER across diverse cultural and clinical settings are crucial for validating and refining the model. Longitudinal research on patient outcomes can provide deeper insights into the long-term benefits of collaborative care, while investigations into barriers to implementation can guide strategies for wider adoption.

The novel aspects of the PACER approach, including its multidimensional focus and emphasis on cultural sensitivity, introduce significant innovations to oncology care. By addressing the full spectrum of factors affecting cancer patients, the PACER model advocates for a transformative change in patient care, promising not only to enhance patient experiences and outcomes but also to set a new standard for holistic, patient-centered oncology care. Its successful implementation could mark a significant advancement in the field, leading to a paradigm shift in how cancer care is conceptualized and delivered.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Author contributions

AA: Conceptualization, Writing – original draft, Writing – review & editing. YA: Conceptualization, Writing – original draft.

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Conflict of interest

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Cervical cancer awareness, perception, and attitude among tertiary health institution students in northeastern Nigeria

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Background: The devastating scourge of cervical cancer in Africa is largely due to the absence of preventive interventions, driven by low awareness and poor perception of the disease in the continent. This work is a preliminary effort toward understanding key social drivers promoting this disease in our immediate environment with a view to mitigating it.

Method: Female students of two tertiary health institutions in Azare, northeastern Nigeria, were approached to participate in this cross-sectional descriptive study. A structured self-administered questionnaire was administered to consenting participants and covered questions on their socio-demographics, awareness, perception, and attitude about/toward cervical cancer and its prevention. The responses were scrutinized for coherency and categorized into themes using summary statistics, while a chi-square test was used to determine the association between awareness of cervical cancer and participant age, marital status, religion, screening uptake, and willingness to undergo screen.

Results: Awareness of cervical cancer was recorded among 174/230 (75.7%) respondents who enrolled in this study; 117 (67.2%) knew that it was preventable, but only three (1.3%) respondents had undergone screening. Among the aware participants, 91 (52.3%) and 131 (75.3%) knew that sexual intercourse and multiple sexual partners are risk factors for the disease, respectively. In contrast, knowledge of the etiology was poor; 82 (47.1%) respondents who knew it was preventable had heard about human papillomavirus (HPV), while 72 (41.4%) knew that HPV causes cervical cancer. Most (78%) of the participants expressed willingness to take a human papillomavirus vaccine or undergo screening (84.6%) if made available to them. Awareness was significantly associated with participants' age (p = 0.022) and willingness to undergo screening (p = 0.016).

Conclusion: This study revealed discordance between awareness and knowledge about cervical cancer. Educational initiatives reflective of population perception/knowledge of cervical cancer are needed to mitigate the rising incidence of this disease, especially among female healthcare providers.

Introduction

Cervical cancer is a malignant transformation of the mucosal lining of the uterine cervix caused by persistent infection by oncogenic human papillomavirus (HPV). Globally, an estimated 604,000 new cases and 342,000 deaths were recorded worldwide in 2020, with Africa alone contributing approximately one-fifth of this burden (117,360 new cases and 76,745 deaths) in 2020 (1, 2). Preventive efforts in developed countries such as screening for premalignant changes in the cervix and vaccination against HPV have drastically reduced the incidence of this deadly disease in developed countries (3, 4). These interventions are grossly limited in Nigeria and are made worse by suspected low levels of awareness and poor knowledge about the disease among the population, especially in parts of the north.

Knowledge about a disease positively affects an individual's ability to adopt preventative strategies and increases health-seeking behavior (5). This has been previously demonstrated among Nigerian women regarding cervical cancer (6). Studies in the northwest of Nigeria demonstrated a discordantly high level of awareness but poor knowledge about the disease (7, 8). A few studies have been reported from northeastern Nigeria describing very low awareness in some people but good knowledge in others (9, 10). Given that this zone of Nigeria is largely young with a high fertility rate, which is a risk factor for cervical cancer, it is imperative that knowledge about this disease is assessed, as this will determine their likelihood to seek appropriate care. This study therefore focused on tertiary health education institution students who, due to the nature of their studies, were hypothesized to have a high awareness, adequate knowledge, and good attitude toward the disease.

Materials, method, and study participants

Study design and participants

This was a cross-sectional questionnaire-based study conducted among female students of the Federal University of Health Sciences (FUHSA) and Adamu Adamu College of Nursing Sciences (AACNS), both in Azare, Bauchi State. These institutions are tertiary institutions that train students in medicine, nursing, midwifery, and other allied health sciences (FUHSA) or only nursing and midwifery (AACNS). At the time of this study, both institutions were in their first year (FUHSA) and second year (AACNS) of academic activities. Thus, the students enrolled in this study had had some but minimal exposure to clinical postings and were judged to be homogenous with regard to their knowledge of diseases generally because the first-year curriculum is uniform to a large extent.

The female population of both institutions was 711, comprising 387 from FUHSA and 324 from AACNS, all of whom were eligible to participate in the study. Using the Taro Yamane formula (11), a sample size of 256 was arrived at as suitable for the population. To increase the response rate, 300 self-administered questionnaires were distributed to consenting students by the research team over a period of 5 days. The convenience sampling method was adopted given the small size and homogeneity of the study population. To ensure equitable allocation of instruments to each site, a suitable ratio of the calculated sample size was determined using the following formula (12):

$$\text{Ratio of participants} = (n \times N1)/N,$$

where n is the sample size, in this case 300; N1 is the stratum size, that is, 387 students (for FUHSA) and 324 (for AACNS); and N is the total population of eligible female students (711).

From this calculation, 163 and 137 questionnaires were allotted to FUHSA and AACNS, respectively. Female students who declined consent and male students were excluded from the study.

Study instrument

The instrument used in this study was a self-developed, self-administered questionnaire written in English containing 35 questions divided into three thematic areas (Supplementary Datasheet 1). The first section contained a description of the study and consent information for the participants. It also sought participant's demographic information such as age (≤19 years, 20–29 years, and ≥30 years), religion, educational attainment,

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Abbreviations: HPV, human papillomavirus; FUHSA, Federal University of Health Sciences, Azare; AACNS, Adamu Adamu College of Nursing Sciences; SPSS, Statistical Package for Social Sciences.

occupation, and marital status. Educational and occupational information was added to ensure that non-students were not included in the responses or could be excluded during analysis. The next section addressed questions relating to risk factors for cervical cancer such as sexual intercourse, multiple sexual partners, and the use of barrier methods to prevent sexually transmitted infection. This section tested participants' perceptions of these risks and also evaluated what their attitudes would be in similar circumstances. The third section dealt with the awareness, knowledge, and attitude of participants toward cervical cancer screening. Questions were asked in reference to awareness of cervical cancer, its causative agent, HPV, preventive measures, screening methods, and screening uptake. Participants were also asked about their willingness to undergo screening and vaccination services if made available to them. The instrument underwent face validation by experts in public health who recommended adjustments in the order and manner of the questions.

Data analysis

Completed questionnaires were examined for coherence, consistency, and adequacy of responses, after which the information they contained was entered into an Excel spreadsheet and cleaned prior to analysis. The Statistical Package for Social Sciences (SPSS) software version 20 was used to analyze the data. A summary statistical tool was used to determine proportions for categorical variables and presented as frequencies and percentages under thematic sections. For questions on the Likert scale, responses with strongly agree and agree were classified as good or poor perception, while strongly disagree and disagree were combined as poor or good perception, as the situation may apply. All answers marked as undecided were treated as harmful, as it shows that the respondents may act in a negative manner when the situation presents itself. Hence, the value was added to poor perception each time. The association between awareness about cervical cancer and participants' age, religious background, marital status, uptake of cervical screening, and willingness to undergo screen was explored using chi-square, Fisher's exact, and likelihood ratio statistics at a two-tailed p-value of <0.05.

Result

Respondents' socio-demographic characteristics

Of the 300 questionnaires distributed, 230 were completed and returned, while the remaining questionnaires were either not returned or returned uncompleted, giving a response rate of 76.7%. Among the included respondents, 45.7% (105/230) were from the AACNS, while 54.3% (125/230) were from FUHSA. Shown in Figure 1 are the socio-demographic characteristics of the study participants. Most of the respondents, 135 (58.7%), were 19 years or younger, 217 were single (94.3%), and 172 were of a Christian religious affiliation(75%).

Awareness/knowledge about cervical cancer

Overall, 174 (75.7%) of the respondents had heard of cervical cancer. The contents of their knowledge of the disease are shown in Table 1. From the table, it is readily observed that the majority of them were aware that it affects only women, and approximately three-fifths knew that the cancer is preventable if detected early. Three out of every five participants were not aware that persistent HPV infection of the cervix is the major cause of cervical cancer, and more than half of the respondents were aware that HPV vaccination can prevent cervical cancer. As few as 13.5% had heard of places where HPV vaccine can be administered.

Cervical cancer risk factor perception

To test further the respondents' awareness of whether cervical cancer can be prevented or not, a set of sexual behavioral risk factors were presented as Likert scale questions. Most of the respondents agreed that sexual intercourse and engaging with multiple sexual partners are risk factors for contracting cervical cancer. Approximately 10.4%–26.5% were aware that the use of barriers like condoms prevents cervical cancer. In line with the above, approximately 54% of the respondents said that they would insist on using condoms during sex even if they trusted their partners. Also, few (36.1%–34.8%) believed that protecting oneself during sexual intercourse will make a difference (Table 2). The summarized result for this test is presented as good or poor perception as contained in Table 3.

Attitude of respondents toward cervical cancer screening and HPV vaccination

Table 4 contains the attitude participants opined that they would adopt regarding their knowledge or awareness about the disease. Of those who had heard of cervical cancer screening (58/230; 25.2%), three persons (accounting for 1.3% of overall study participants and 5.2% of those who had heard about screening) had undergone cervical cancer screening themselves. Attitude toward screening tests was positive, as approximately 80% demonstrated a willingness to undergo cervical screening. Also, a good attitude was displayed toward HPV vaccination, with 74.8% of the respondents showing a willingness to take an HPV vaccine if made available. Less than half (34.3%) of the respondents had heard of cervical cancer screening tests, and approximately one-fifth (21.3%) knew cervical screening test centers.

Reasons for not taking a cervical cancer screening test

The reasons for not undergoing cervical screening tests among respondents who were aware of cervical cancer, knew it is preventable, and had heard about screening but had not
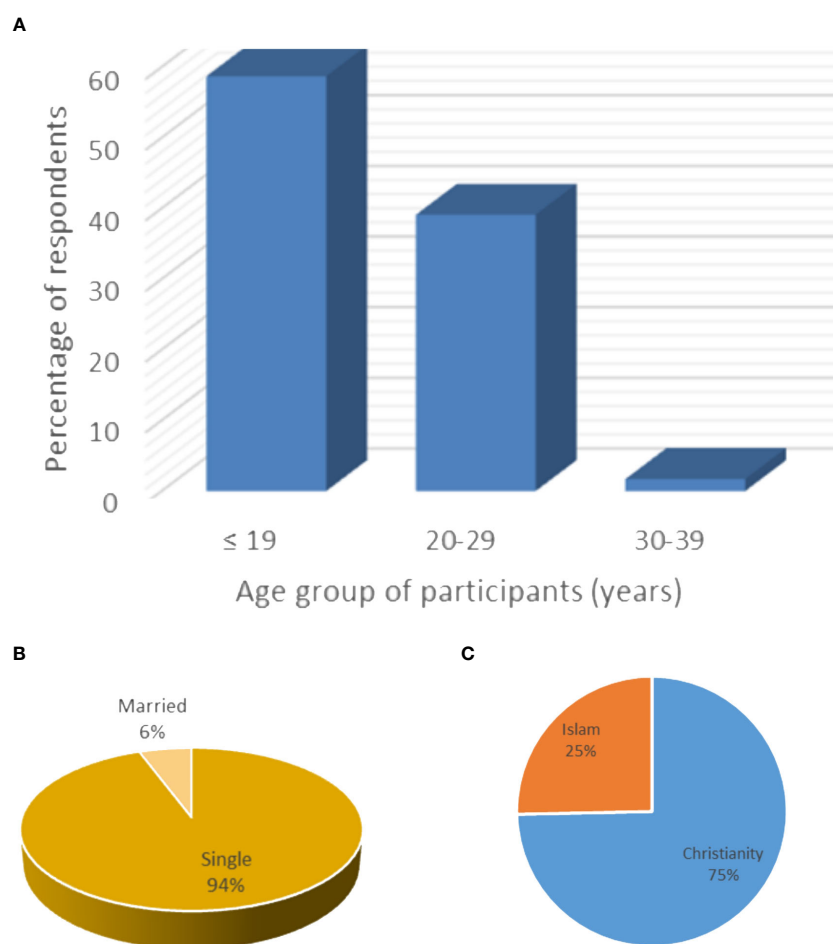
FIGURE 1
Demographic features of the respondents showing predominance of young **(A)** and single **(B)** women, most of whom identified as Christians **(C)**.

undergone screening are shown in Table 5. The most common deterrent from screening was participants' perception that they had not met the criteria for screening (29.1%), followed by far distance from testing centers (16.3%). Table 6 shows associations between

TABLE 1 Participants' content of awareness of cervical cancer.

Statement	Yes F (%)	No F (%)	Not sure F (%)
Cervical cancer affects only women.	149 (85.6)	22 (12.6)	3 (1.7)
Have you seen or heard of any woman affected by cervical cancer?	48 (27.6)	124 (88.5)	2 (1.5)
Cervical cancer is difficult to cure and may lead to death if not treated early.	124 (71.3)	47 (27.0)	3 (1.7)
Have you heard of human papillomavirus (HPV)?	82 (47.1)	89 (51.2)	3 (1.7)
Is cervical cancer caused by persistent HPV infection of the cervix?	72 (41.4)	99 (56.9)	3 (1.7)
Is cervical cancer preventable?	117 (67.2)	19 (11.0)	38 (21.8)

HPV, human papillomavirus.

respondents' reports of awareness about cervical cancer and their age, religious background, marital status, uptake of screening, and willingness to undergo testing. Of these, older age was associated with being aware of the disease condition, while awareness in turn was associated with willingness to take up screening services. Religious inclination and marital status did not significantly influence awareness or willingness to undergo testing. However, all the married women who responded to the question on willingness to undergo testing if made available to them responded in the affirmative.

Discussion

This study showed that approximately three-fourths of the respondents had heard about cervical cancer, a figure we regarded as high, considering that community-based studies in Nigeria had mostly documented a very low proportion of women who had heard about the disease. Wright et al. and Oluwole et al., both in Lagos, a cosmopolitan city, reported a disturbingly low awareness level of 37.2% and 15%, respectively (13, 14). However, a higher proportion of participants in the studies of Oluwole et al. and Wright et al. had low or no formal education, different from our

TABLE 2 Perception of the respondents about cervical cancer risk factors [F (%) = 174 (100%)].

Statement	SA F (%)	A F (%)	D F (%)	SD F (%)	UN F (%)
Sexual intercourse poses a risk of getting cervical cancer.	31 (17.8)	60 (34.5)	31 (17.8)	7 (4.0)	45 (25.9)
Multiple sexual partners increase the risk of getting cervical cancer.	59 (33.9)	72 (41.4)	13 (7.5)	3 (1.7)	27 (15.5)
Use of barriers such as condoms during sex prevents cervical cancer.	17 (9.8)	46 (26.4)	47 (27.0)	10 (5.7)	54 (31.0)
I trust my partner; therefore, I do not use condoms during sex.	13 (7.5)	22 (12.6)	50 (28.7)	25 (14.4)	64 (36.8)
I trust my partner; therefore, I do not insist on condom use during sex.	10 (5.7)	32 (18.4)	48 (27.4)	25 (14.4)	59 (33.9)
I am already sexually active; protecting myself will not make any difference.	3 (1.7)	6 (3.4)	58 (33.3)	61 (35.1)	46 (26.4)

SA, strongly agree; SD, strongly disagree; A, agree; D, disagree; UN, undecided.

population that is homogenously beyond secondary education and in health-related disciplines. This could therefore explain the higher level of awareness recorded in this study and suggests that education could have a positive effect on awareness about cervical cancer, as shown by similar previous studies among students of tertiary institutions in Nigeria (15–18). Maitanmi et al. at Babcock University Ogun State, Gborieneomie and Ibe at the University of Port Harcourt, Ogwunga et al. at the Federal University of Technology Owerri, and Ella et al. at the University of Calabar all found awareness levels of 68.4% to 98.6% (15–18). Our data are also similar to those among students in Ethiopia in the studies of Mengesha et al. and Zhang in China, with 65.1% and 87.9% awareness status, respectively (19, 20).

All the studies among students had similar age demographics and were predominantly younger than age 25 compared to the community population-based studies where more of the participants were likely to be older, as was the case in the study

by Wright et al. (13). A possible unifying factor among the students therefore could be their curiosity about their sexuality and reproductive health around this age, which could prompt them to seek related knowledge. This period could profitably be exploited to pass on the right information about cervical cancer that could lead to its reduction or elimination in the near future. Our data support this position given that younger women were significantly more likely to be unaware of this health condition and its risk factors.

Low perception of risk, etiologic, and preventive factors of cervical cancer in this study was divergent from the high number of people who had been told about the disease, and so was the finding in nearly all other tertiary institutions' reports both within and outside the country, except for that among nursing students in the University of Calabar Nigeria where a good level of knowledge was demonstrated (15–20). The majority did not recognize sexual intercourse, HPV infection, vaccination against HPV, and screening for premalignant lesions as risk, cause, and preventive factors in uterine cervix carcinogenesis. Perhaps a reasonable explanation for the positive knowledge among University of Calabar students was their advanced exposure to health information, as they were in the 300 level (year 3) of study and above in the school and could have

TABLE 3 Perception of the respondents as good or poor regarding sexual behavioral risk factors for cervical cancer.

Question item	Good perception F (%)	Poor perception F (%)
Sexual intercourse poses a risk of getting cervical cancer.	91 (52.3)	83 (47.7)
Multiple sexual partners increase the risk of getting cervical cancer.	131 (75.3)	43 (24.7)
Use of barriers such as condoms during sex prevents cervical cancer,	64 (36.8)	110 (63.2)
I trust my partner; therefore, I do not use condoms during sex.	75 (43.1)	99 (56.9)
I trust my partner; therefore, I do not insist on condom use during sex.	73 (42)	101 (58)
I am already sexually active; protecting myself will not make any difference.	67 (38.5)	107 (61.5)

TABLE 4 Knowledge about cervical cancer prevention among individuals who knew it can be prevented.

Variable	Yes	No	Unsure
Can vaccination against HPV infection prevent cervical cancer?	65 (55.6)	50 (42.7)	2 (1.7)
Have you heard of places where HPV vaccine is administered?	21 (17.9)	95 (81.2)	1 (0.9)
Would you take HPV vaccine if it is made available to you?	92 (78.6)	7 (6.0)	18 (15.4)
Have you heard of cervical cancer screening tests?	58 (49.6)	55 (47.0)	4 (3.4)
Have you heard of centers that do cervical cancer screening tests?	33 (28.2)	84 (71.8)	0 (0.0)
Have you undergone cervical screening tests in the past?	3 (2.6)	114 (97.4)	0 (0.0)
Would you like to undergo cervical cancer screening test if services are made available to you?	99 (84.6)	13 (11.1)	5 (4.3)

HPV, human papillomavirus.

TABLE 5   The reasons respondents have not undergone cervical cancer screening tests.

Variable	Frequency	Percentage (%)
I don't have cervical cancer.	5	9.1
I have not met the criteria.	16	29.1
Afraid of results.	3	5.5
Cervical cancer is not my portion.	3	5.5
My husband is not supportive.	1	1.8
It is costly.	2	3.6
It is far from where I live.	9	16.3
It is for married older women.	1	1.8
There is no time.	4	7.3
No response	11	20.0
Total	55	100.0

encountered cases of cervical cancer during their rotations in the wards and theater, compared to the index study where the students of both institutions were in their first year of study with no significant exposure to such patients. There is therefore a very high need to educate our girls and women more on issues relating to their health and not to assume that being in university would address this knowledge gap.

Cervical cancer screening uptake is negligible in Nigeria, and where screening services are available, patronage is often opportunistic. Studies that have examined this occurrence have reported approximately 5% uptake in the populations studied, even among students, although one study reported a value of 14.6% among students

TABLE 6   Association between awareness and age, religious background, marital status, test uptake, and willingness to undergo screen.

Data item	Category	Awareness			Sig
		No	Not sure	Yes	
Age (years)	≤19	34	7	90	0.022*
	20–29	9	4	73	
	≥30	0	0	4	
Religious background	Christianity	16	5	36	0.123
	Hindu	0	0	1	
	Islam	27	6	130	
Marital status	Married	0	0	12	0.051
	Single	43	11	155	
Screening uptake	No	40	10	161	0.143
	Yes	0	1	3	
Willingness to test	No	7	1	4	0.016*
	Not sure	4	1	17	
	Yes	26	11	162	

* Represents statistically significant p value (p < 0.05).

in Calabar (18, 21). This is higher than the 2.2% screening rate seen in the present study. Reasons for this poor outcome included poor accessibility to screening centers, while some believed screening is for those already suffering from the disease. Nevertheless, other reasons were fear of the screening outcome, lack of time, cost and lack of interest, not being sexually active, husband not supportive, and belief that single and young women are not included among the at-risk individuals. Similar opinions were observed in a study from Calabar, South-Southern Nigeria (18). Fortunately, a strong willingness by the respondents to receive HPV vaccination or undergo any of the screening tests if made available to them is encouraging. This finding has also been documented by other studies in Nigeria and shows a window of opportunity for targeted interventions, especially mass health education and enlightenment, which we found can significantly influence the uptake of screening (15, 22). While this manuscript was being prepared, the Nigerian government rolled out a comprehensive HPV vaccination program, signaling a commitment to address this need in the country. Public enlightenment is now required to drive uptake and tilt over the dissenting members of the population so that there will be universal coverage. Barriers to screening such as stigmatization and embarrassment (about seeking out screening) as well as breaks in vaccine supply due to high cost should also be removed through concerted efforts by both the government and donor/non-governmental organizations to ensure sustainability (17, 23).

The results presented in this study have inherent shortcomings because they are derived from self-reports. Thus, the discordance between the high level of awareness about cervical cancer and poor perceptions about risk, causative, and preventive factors could be dependent on this. In other words, awareness level may be lower than has been reported here. What this means is that information dissemination could be laden with false content that could be as harmful as the absence of it. Second, awareness of the role that infection by the human immunodeficiency virus plays in promoting HPV infection persistence and cervical cancer progression was not assessed in this survey. Knowledge of this could prompt a higher willingness to adopt risk-reducing behaviors and also attend screening for both infections. A more controlled study is required to further examine barriers to cervical cancer control programs among the populace.

A strength of this study is the heterogeneity of the studied population comprising students in various health disciplines who were in their early years of study and whose knowledge about diseases we suspect may not differ remarkably from that of the general population. In contrast, the homogeneity of their educational background poses a limitation, making it difficult to assess the likely effect of the level of education on awareness and perception of cervical cancer. However, given that discordance between awareness and perception was documented here even among these post-secondary education level young adults, there is an urgent need to initiate a massive health campaign to disseminate the right information about the disease in order to forestall risk propagation among at-risk individuals. Notwithstanding, a cross-sectional community survey is needed to test the level of awareness about this disease.

Conclusion

Awareness of cervical cancer and perception about its risk factors, cause, and preventive factors are divergent among the studied population and portend a significant setback in the fight against this disease, as these young women in their early reproductive age are not likely to adopt safe practices that will prevent them from developing cervical cancer in the future. Dedicated efforts should be committed to providing reliable fact-based information to the entire population. Vaccines should be made available, and parents should be encouraged to allow their children to receive them, as this is the most effective preventive method at present.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by the Research, ethics and review committee, Federal Medical Centre Azare. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

ZM: Conceptualization, Data curation, Writing – original draft, Writing – review & editing. UE: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. II: Conceptualization, Methodology, Writing – review & editing. DK: Conceptualization, Methodology, Supervision, Writing – review & editing. IU: Conceptualization, Data curation, Writing – original draft. SG: Conceptualization, Methodology, Supervision, Writing – review & editing. MS: Conceptualization, Methodology, Supervision, Writing – review & editing. BA: Conceptualization, Methodology, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fonc.2024.1415627/full#supplementary-material

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Emerging cancer disease burden in a rural sub-Saharan African population: northeast Nigeria in focus

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Introduction: Sub-Saharan Africa (SSA) is plagued by myriads of diseases, mostly infectious; but cancer disease burden is rising among non-communicable diseases. Nigeria has a high burden of cancer, however its remote underserved culturally-conserved populations have been understudied, a gap this study sought to fill.

Methods: This was a cross-sectional multi-institutional descriptive study of histologically diagnosed cancers over a four-year period (January 2019-December 2022) archived in the Departments of Pathology and Cancer Registries of six tertiary hospitals in the northeast of Nigeria. Data obtained included age at diagnosis, gender, tumor site and available cancer care

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Abbreviations: ASR, Age Specific Rate; ATBUTH, Abubakar Tafawa Balewa University Teaching Hospital; FMCA, Federal Medical Centre Azare; FMCN, Federal Medical Centre Nguru; FTHG, Federal Teaching Hospital Gombe; SSA, Sub-Saharan Africa; UMTH, University of Maiduguri Teaching; YSUTH, Yobe State University Teaching Hospital.

infrastructure. Population data of the study region and its demographics was obtained from the National Population Commission and used to calculate incident rates for the population studied.

Results: A total of 4,681 incident cancer cases from 2,770 females and 1,911 males were identified. The median age at diagnosis for females was 45 years (range 1–95yrs), and 56 years (range 1–99yrs) for males. Observed age-specific incidence rates (ASR) increased steadily for both genders reaching peaks in the age group 80 years and above with the highest ASR seen among males (321/100,000 persons) compared to females (215.5/100,000 persons). Breast, cervical, prostatic, colorectal and skin cancers were the five most common incident cancers. In females, breast, cervical, skin, ovarian and colorectal cancers were the top five malignancies; while prostate, haematolymphoid, skin, colorectal and urinary bladder cancers predominated in men.

Conclusion: Remote SSA communities are witnessing rising cancer disease burden. Proactive control programs inclusive of advocacy, vaccination, screening, and improved diagnostics are needed.

Introduction

Cancer is predicted to cause a mortality of about one million by 2030 in Africa (1). The continent was estimated to have contributed about 5.7% (1,100,100) incident and 7.2% (712,800) mortality rates to the global cancer burden in the year 2020 (2). In sub-Saharan Africa (SSA), cancer as a disease is expected to rise by about 85% based only on changing demographics characterized by population growth (3). Added to the lack of effective health care institutions, this will spell catastrophe for the continent in general, and Nigeria in particular, as Nigeria has a high cancer disease burden, ranking second after Egypt in Africa, and first in SSA (4). Additionally, the upward trend in globalization facilitated by increasing affordability of digital devices, has allowed an exchange of cultural and lifestyle preferences, some of which are cancer-promoting (such as dietary habits, smoking, and alcohol indulgences). These factors are easily adaptable to local communities (5–7).

The present generation of children will likely experience further increases in cancer cases in the near future if mitigating strategies are not initiated now. Indeed, it is estimated that low resource countries of the world will witness a greater increase in cancer incidence and mortality by 2040 (2). The state of unpreparedness of these economically disadvantaged countries is worsened by a lack of reliable cancer statistics to drive health system planning (8). Efforts in this direction have begun in Nigeria with the establishment of the Cancer Registry Network; however, not much of the population is covered by the participating registries, with only a few being Population-based (9, 10). Data from North-eastern Nigeria are far

from being harmonized and instructive as most have been on individual cancer site-specific case descriptions. This present study was therefore conceived to address this knowledge gap by piecing together information on confirmed cancer cases and presenting them as a unified report from most parts of the zone. It is also hoped that the findings will suggest areas of priority attention as a foundation for future forecasts and intervention planning.

Materials and methods

Study Design: This is a cross-sectional retrospective descriptive study of histologically confirmed malignancies in the tertiary hospitals in the Northeast of Nigeria over a four-year period (January 2019 to December 2022). De-identified archived histopathology reports in the Departments of Pathology and cancer registries data (where available) of the participating institutions were reviewed and data on cancer cases were retrieved together with information on age at diagnosis, gender, and tumor site. Also obtained was information on the available cancer infrastructure in each of the institutions to ascertain the cancer control capacity in the region. The retrieved information was double checked for clarity and validity by the collaborating Pathologists (USE, AIL, DES, AK, AIA, and MAK) prior to further analysis.

Geographical area of the study: Northeast Nigeria stretches from latitudes 6 28" N and 13 44" N to longitude 8 44" E and 14 38" E. It consists of six states namely, Adamawa, Bauchi, Borno, Gombe, Taraba

and Yobe as depicted in Figure 1. As at the 2006 census, the region's total population was put at 18, 984,299 or 13.52% of the total population of Nigeria, covering a landmass of about 272,395km^2, which is 29.45% of Nigeria's total landmass (11). With a projected annual growth rate averaging about 2.5% per annum, the population was projected to rise to 30,541,872 in 2022 (12).

Participating institutions: Six tertiary hospitals in four out of the six states in the northeast zone of Nigeria contributed data for this study. They are Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi and Federal Medical Centre Azare (FMCA), both in Bauchi State; University of Maiduguri Teaching Hospital (UMTH), Borno State; Federal Teaching Hospital Gombe (FTHG), Gombe State; Federal Medical Centre Nguru (FMCN), and Yobe State University Teaching Hospital (YSUTH), both in Yobe State (Figure 1 above). These institutions serve as referral centers for the secondary and primary health care facilities in the respective states and are strategically located to ensure accessibility to the populace.

Population distribution data by age and sex for the participating states were extracted from the Nigeria National Population Commission data of 2020 which incorporated projections for the year 2022, thus encompassing the study period (12).

Data analysis: Descriptive (frequency) statistics analysis was done using the statistical package for social sciences (IBM SPSS software) version 20. The output was categorized into cancer sites by proportions and presented as texts, tables and figures. Age-specific rates (ASR) were calculated for each cancer type, using the 2022 estimated population figures. 95% confidence intervals were

generated. Other malignancies with incidence rates less than 1% were aggregated together and classified as "others" for clarity of presentation.

Results

Demographic characteristics of study sites

The four participating states of the northeast zone have a combined population of 22,029,974 with 50.4% of them males. Bauchi state has the highest population density followed by Borno state (Supplementary Table 1). Persons younger than 50 years constituted 91.5% of the entire populace, and among these, individuals aged less than 30 years accounted for about 80% (Supplementary Table 2).

Cancer demographics

Case contribution by institution was highest in FTHG with 1,812 cases, followed by UMTH (1,071), ATBUTH (958), FMCA (314), FMCN (290) and YSUTH (256), giving a total of 4,701. Of these, 20 entries were adjudged inconsistent with cancer diagnosis and were excluded. Among the 4,681 cancer cases included in this study, 69% (2,770) of them were females giving a female-to-male ratio of 1.5:1. The median age at diagnosis for the entire cohort was 50 years (range 1–99 years, interquartile range
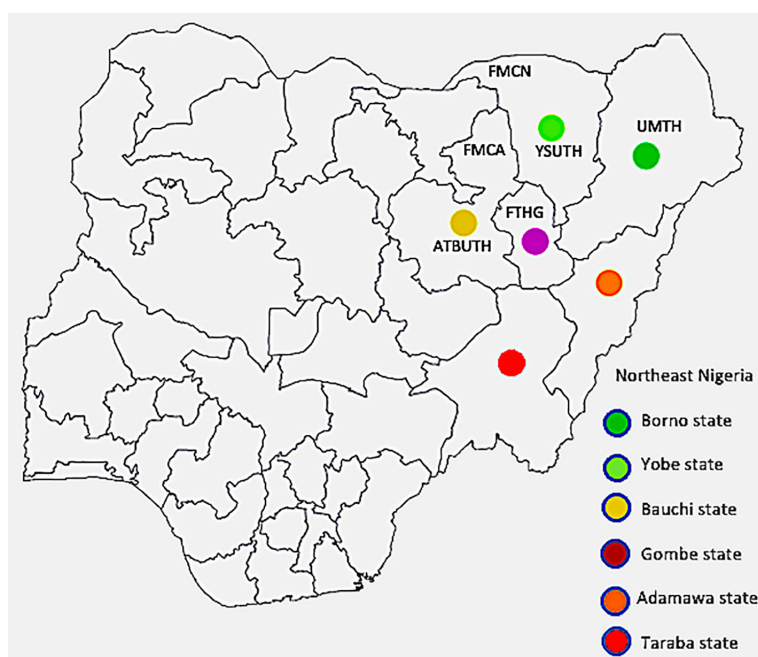
FIGURE 1
Map of Nigeria with the northeast states highlighted The institutions from which data was obtained are indicated by their abbreviations (FMCN, Federal Medical Centre Nguru; YSUTh, Yobe State University Teaching Hospital; UMTH, University of Maiduguri Teaching Hospital; FTHG, Federal Teaching Hospital Gombe; FMCA, Federal Medical Centre Azare; and ATBUTH, Abubakar Tafawa Balewa University Teaching Hospital), with Bauchi and Yobe states each having two tertiary hospitals, while Borno and Gombe have one hospital each. The position each institution is placed is only a rough approximation of its location within the respective states.

36 years), the 25th and 75th percentiles of the age being 25 and 61 years respectively. Females presented on average a decade earlier than males (45 years vs 56 years) as shown in Figure 2, but with a narrow difference in age at presentation in the first quartile for both sexes (36 years for females and 38 years for males). This gap broadened again at the third quartile (59 years for females; 70 years for males).

Grouping the age demographics by decades, an increase in cancer incidence was observed with increasing age. About 7.5% (349/4681) of the cases were recorded among children and adolescents while 15.5% (725/4681) occurred in the more elderly individuals (70–99 years). There was a subtle plateau in occurrence of cases between the fifth and seventh decades of life with a minimal drop in the number of cases as the years went by. Fifty-one (1.1%) of the cases had no documented age.

Gender-matched age distribution is displayed in Figure 3. Overall, males had a more sustained rise in number of cases across all age groups, while females had a somewhat bell-shaped distribution. This is influenced by the differences in the peak age group for both genders; the modal age for females was 40–49 years while the males at 60–69 years, although both tailed off at their extremes of age.

Crude ASR for all sites and genders was 15.9/100,000 persons; and 12.4 and 18.3, for males and females, respectively. Further segregation according to gender revealed that the ASR increased steadily in both genders reaching a peak in those aged 80 years and older. The highest ASR of 321 per 100,000 persons was seen among males (Figure 4).

Cancer distribution by disease site is presented in Table 1, in the order of decreasing frequency.

FIGURE 2
Age distribution in years of females and males diagnosed with cancer. F, Females; M, Males.

FIGURE 3
Age distribution comparing females and males by decades as observed in the population.
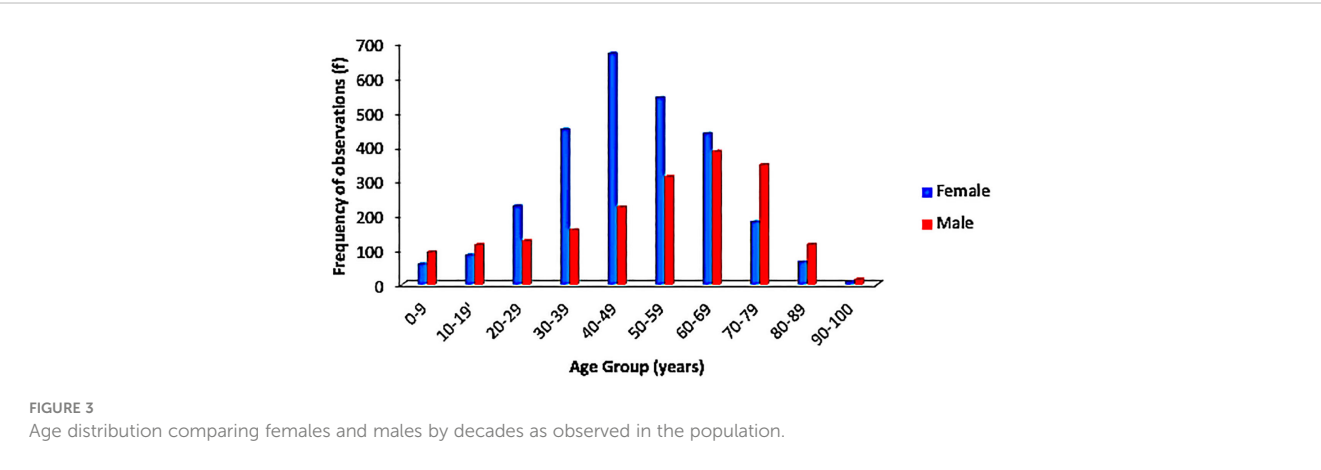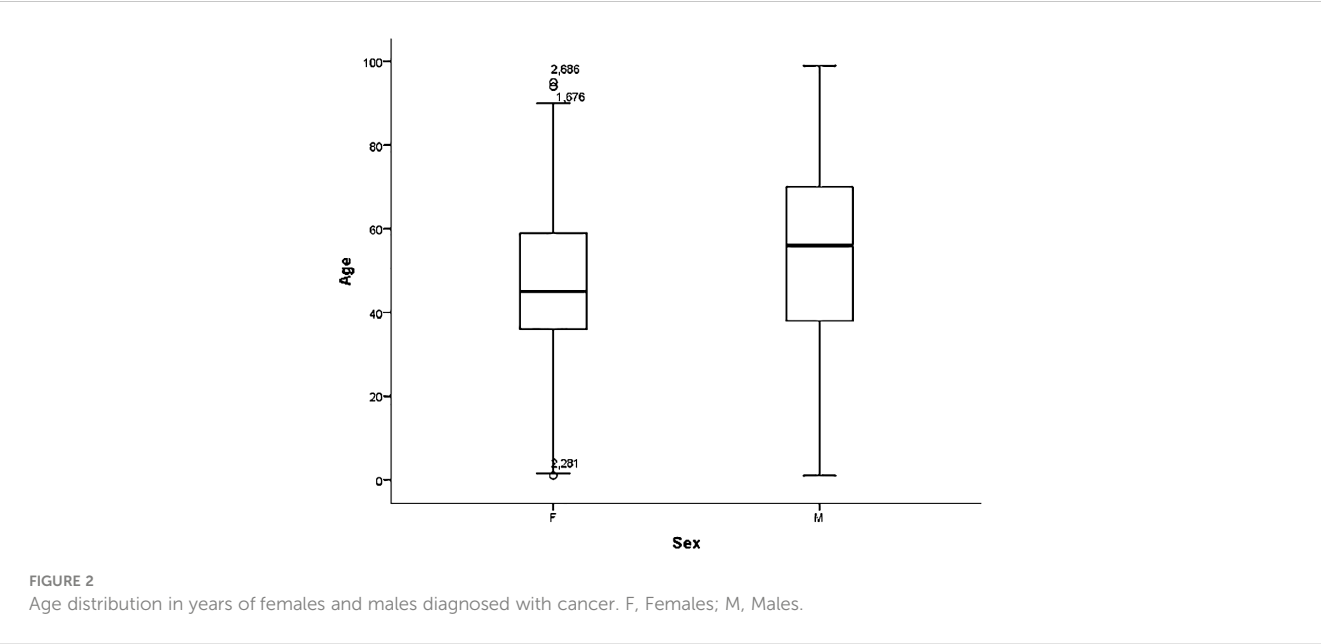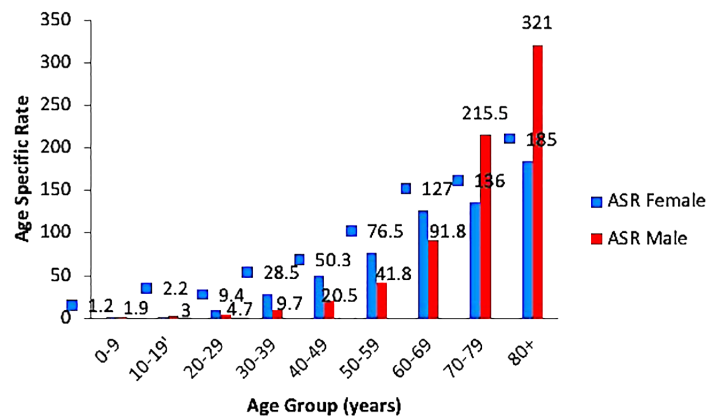
Age-specific rates for both females and males.

Breast cancer ranked highest among the cases followed by cancer of the uterine cervix and then prostate cancer. Renal, nasopharyngeal, and ocular cancers were among the least common sites involved. Table 2 shows the incidence by gender and median age of each cancer type. Assumed age-standardized incidence rate (ASR) is also calculated for these tumors. Low ASR for some adult cancer types is noted when such cancers occur in children or early adolescent age as seen for colorectal cancer. Besides the gender related malignancies, there was consistent male preponderance for every cancer type.

In males, prostate cancer was the most common, accounting for about one-fourth of all cancers, and followed by haematolymphoid malignancies, skin, colorectal and bladder cancers in that order (Figure 5A). These cases accounted for greater than three-fifths (77.5%; 1481) of all incident male cancers.

Among the females, breast, cervix, skin, ovary and uterus were the most common cancer sites. Breast and cervical cancers accounted for over half of all incident cases overall (Figure 5B). These top 10 female cancers (breast, cervix, colorectal, haematolymphoid, ovary, skin, uterus, stomach, liver, bone/soft tissue) account for over four-fifths (85.3%; 2362) of female cancers during the period under review.

Cancer care infrastructure

Two out of the four teaching hospitals (FTHG and UMTH) had at the time of collection of data one brachytherapy and 3 radiotherapy machines. None had a positron emission tomography (PET) machine. There were 2 radiotherapists, one medical physicist, one surgical oncologist, one medical oncologist, and one pediatric oncologist serving the entire 6 states of northeast Nigeria with a population of about 30 million people. None of the institutions had a palliative care service in place.

Discussion

The observed frequency of cancer cases of 4,681 in the studied location is high considering the fact that the region is predominantly a rural and semi-urban agrarian population with low per capita income (13). A decade earlier, Jedy-Agba et al. reported a similar frequency of 4,521 from two large population-based cancer registries

TABLE 1 Cancer incidence by anatomical sites.

Cancer Site	Frequency (f)	Percentage (%)
Breast	1072	22.9
Cervix	576	12.3
Prostate	483	10.3
Colorectal (including Anorectum)	324	6.9
Skin	312	6.7
Haematolymphoid	284	6.1
Bone and soft tissues	190	4.1
Bladder	159	3.4
Ovary	128	2.7
Liver	124	2.6
Uterus	112	2.4
Stomach	109	2.3
Kidney	78	1.7
Nasopharynx	59	1.3
Ocular	63	1.3
Others	429	9.2
Tumor site missing	179	3.8
Total	**4,681**	**100**

TABLE 2 Cancer distribution by anatomical site, age, gender, and age specific rates.

Site	Number	Age (years)	Sex		ASR (95% CI)
		Median(range)	Male	Female	
Breast	1072	45 (16–90)	37	1035	7.9 (7.4-8.4)
Cervix	576	50 (20-94)	–	576	8.7 (8.0-9.4)
Prostate	483	70 (32-98)	483	–	11.9 (10.8-13.0)
Colorectal	324	50 (20-92)	180	144	2.4 (2.1-2.7)
Skin	312	50 (3-93)	177	135	1.0 (0.9-1.1)
Haematolymphoid	284	37 (3-90)	187	97	0.9 (0.8-1.0)
Bone and Soft Tissue	190	25 (1-85)	118	72	0.6 (0.5-0.7)
Bladder	159	57.5 (11-87)	126	33	0.8 (-0.8-2.4)
Ovary	128	48.5 (8-78)	–	128	1.2 (1.1-1.3)
Liver	124	48 (2-85)	87	37	0.4 (0.3-0.5)
Uterus	112	55 (20-95)	–	112	1.7 (1.4-2.0)
Stomach	109	57 (25-85)	60	49	1.0 (0.8-1.2)
Kidney	78	9 (1-88)	44	34	0.3 (0.2-0.4)
Ocular	62	14 (1-97)	40	22	0.2 (0.1-0.3)
Nasopharynx	59	39 (2-72)	36	23	0.2 (0.1-0.3)
Total	**4072**		**1,575**	**2,497**	

Numbers presented here represents only cases with documented anatomic sites.

in Nigeria, namely, Ibadan in Southwest, and Abuja in North central of Nigeria (14). Credence to this is that ASR in our adult population approximates slightly with those found in Ibadan and Abuja. Although the authors only reported their findings over a two-year period (2009–2010), their studied population was also smaller numbering about 7,922,435 as at year 2010 compared to the present study population (Bauchi, Borno, Gombe and Yobe states) of 22,029,974 as at year 2022 (12) which might downplay the size effect of this disease in the index locality (12). However, the use of hospital-based registry data in this study strongly suggests under-reporting of cases as opposed to population-based registry data in

Ibadan and Abuja. Furthermore, it needs to be emphasized that Abuja, Nigeria's capital city, and Ibadan, a cosmopolitan city in Nigeria's economic west, are likely experiencing remarkable higher impact of urbanization, westernization and globalization, and these are known risk factors driving cancer incidence in countries with high human development indices (2, 3, 14). Recording a similar figure in the present study suggests a need for more research to understand the determinants of cancer diseases in our environment and similar sub-Saharan Africa communities.

Cancer spectrum in this study is somewhat similar with national, regional (Africa) and global picture except for little

FIGURE 5
Top 10 cancers in males **(A)** and females **(B)**.
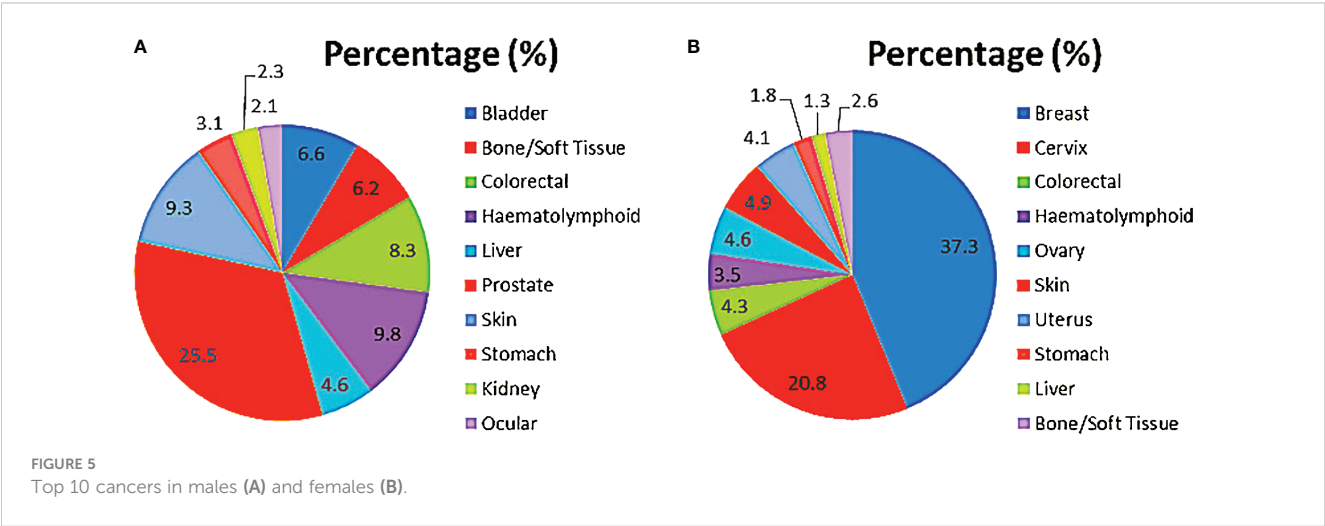
differences. Worldwide, breast (11.7%), lung (11.4%), colorectal (10.0%), prostate (7.3%) and gastric (5.3%) cancers were the top five malignancies in 2020, breast cancer dominating in the present study by nearly double (22.9%) its global proportion (2). In Asia, lung cancer was the commonest (13.8%), followed by breast (10.8%), colorectal (10.6%), stomach (8.9%) and liver cancers (6.9%); while in Europe, breast (13.1%), colorectal (12.9%), lung (11.8%) and prostate (11.7%) cancers were the top four cancers in that order, breast cancer proportion in our study again doubling those in these studies (15, 16). Except for the absence of liver cancer in the top five cancers in the present study, we found a striking similarity with data in the African continent which had breast (16.8%), cervical (10.6%), prostate (8.4%), liver (6.4%) and colorectal (6.0%) cancers as the top five cancers (4). Likewise, population-based registries in Nigeria also reported breast, cervical and prostate cancers as the commonest in the country, similar to our finding (14).

While lung and liver cancers featured prominently among the top incident malignancies globally, lung cancer did not feature in the top 10 in the present study, while liver cancer ranked 10th. Whereas the effect of smoking as a cause of lung cancer requires long duration to manifest, hepatitis virus infection in Africa often occurs very early, with mother-to-child transmission assuming a worrisome proportion as a cause of liver cancer (7, 17). Thus, younger age and reduced life-expectancy in the continent may support lower rate of lung cancer in our environment, in addition to the effect of under-diagnosis arising from lack of skilled personnel and diagnostic facilities (7, 18, 19). On the other hand, lower liver cancer cases could be due to non-documentation in the Pathology departments because most hepatologists presently avoid liver biopsy, rather relying on clinical features, serum alpha-fetoprotein levels and radiological imaging for diagnosis. Considering the influence of missed cases on policy making about the disease, it is therefore expedient to expand data gathering across the zone and indeed other similar practice settings to include clinically diagnosed cases in order to reasonably study the epidemiology of these cancers and accommodate them in the control and response strategy design (19).

There is similarity in the gender predilection of cancers in this study and others from Nigeria and Africa among women (4, 14). In contrast, global and United States estimates are dominated by male preponderance (2, 20). This difference is driven by the high prevalence of female breast and cervical cancers in Africa. The high incidence of female breast cancer follows a varying pattern of risk factors globally. For example, while screening mammography, older age, fewer births with associated lower breastfeeding practice, obesity, alcohol intake and younger age at menarche characterize the high economic index societies, these factors are less evident in low and middle income countries of SSA (21). Rather, the trend observed in Africa could be accounted for by rapid population growth (22). As the economic fortunes of SSA improves, higher earning may lead to a rise in all of the aforementioned risk factors with sustained high incidence rates of breast cancer (7, 21, 23).

Concerning cervical cancer, the determinants are skewed against African countries due to the persistent high incidence rate of cervical cancer driven by ignorance about the disease and low health literacy generally, as well as lack of institutionalized

screening programs (3, 24, 25). Studies in Nigeria have shown that awareness and knowledge about cervical cancer and its preventive strategies could go as low as 8% in some population with uptake of screening ranging from 1.5% to 8.0% (26–28). As has been demonstrated elsewhere, for example in the United States, cervical cancer incidence can decline if public health policy such as advocacy and vaccination against the human papilloma virus is implemented at the population level (20). This is urgently needed in low income communities such as the present study environment if the likely future cervical cancer epidemic is to be averted. The first rollout of HPV vaccination has just been commenced in Nigeria and this is expected to yield significant reductions in cervical cancer in few decades to come.

Young age at diagnosis of cancer among Africans is once more upheld in this study and this stretches the age bracket included in the analysis of age specific rates for each cancer type making most of them appear rare (3). Recent studies showed that cancer among adolescents and young adults is on the increase globally; although resource-limited communities are more affected. This could suggest disparities in risk exposures while the associated high mortality among the low economic group points to poor access to diagnostic services with most presenting at late stages (15, 29, 30). There is therefore the need to create awareness that would encourage early presentation, institute screening services for early detection, and enhance research to unravel familial or genetic risk factors prevalent in the population (15, 24).

The pattern of female cancers in this study is more consistent with other studies in Nigeria and globally being predominantly composed of breast, cervix, ovary, skin and uterine cancers, but that of males differed remarkably (2, 14). Haematolymphoid malignancies ranked high on the list of male cancers after prostate cancer in the index study but fifth in that documented by Jedy-Agba et al. in Abuja and Ibadan, Nigeria (14). Also, the finding of urinary bladder carcinomas in the first five cancers among males is similar to that reported among Americans by Siegel et al; in contrast, both lymphomas and urinary bladder cancers did not feature among top five male cancers globally in 2020 (2, 20). The northeast of Nigeria has a dual topography with rocks being very abundant as evidence of volcanic activity in time past that could emit ionizing radiation into the environment affecting the males more while they engaged in mining, arable and pastoral farming activities (11). Also, urinary bladder cancer could be due to a high burden of schistosomiasis as a remarkable proportion was squamous cell carcinoma, while the urothelial carcinoma histological subtype seen might suggest exposures to occupational risks and cigarette smoking (7). These all showed that epidemiological studies are needed in this region to first understand peculiarities of the disease among the people in order to design effective tailored control efforts for the region.

Given the burden of malignant diseases seen in this study, a high cancer mortality rate can be anticipated in the nearest future if preventive actions are not instituted immediately. This is more urgent because of the added severe lack of cancer care infrastructure in the region as highlighted in this study. Although survival data was not documented for this study, evaluation of cancer survival in Maiduguri, one of the sites included in this study, reported a

mortality of about 85% for some cancers (31). Therefore, opportunities abound in SSA for multifaceted interventions that will help mitigate any catastrophic surge in cancer incidence and mortality rates in the next decade (7). Prevention should be prioritized as the malignancies with the most incident rates can be prevented through screening (32). Next, SSA countries should aim to retain the few available personnel to help sustain existing services and possibly reach the underserved populations. Thirdly, investments should be made to improve physical and human infrastructure in the hospitals for diagnosis and treatment of cancer patients on one hand, and to improve personnel capacity for research through training (3, 23–25). Partnership is required to achieve these, thus, Governments, Non-Governmental organizations, philanthropists, international partners, and Africa diaspora professionals have a role to play in birthing a SSA with extinct cancer mortality (3).

Limitations

Data used in this study was hospital-based and consisted of only histologically diagnosed cases. This means that malignancies that are largely diagnosed clinically, such as liver and lung cancers may not be fairly represented. We recommend that the hospital cancer registries be expanded to population-based registries to cover cases diagnosed outside the tertiary hospitals. Also, clinically and radiologically diagnosed cancer cases should be included in the registry data and reflected in future studies to give a more reliable data estimates of the disease burden. Secondly, data was not received from two states in the region, therefore extrapolation of the findings of this study should be done with caution. Thirdly, we did not collect patient-level clinical and demographic data, nor did we assess for differences in survival. Future studies should evaluate these factors to test for their effects on cancer demographics in our population.

Conclusion

Cancer incidence in this Nigerian community demonstrates a substantial burden which the existing cancer care system may not curtail. A multifactorial approach that includes prevention, screening/early detection, and effective treatment infrastructure is recommended to successfully address this disease. Relevant government institutions and donor agencies are enjoined to collaborate to bridge this gap. Further research efforts should aim at interventions targeting the top five cancers with the goal to reduce their incidences. Regular updates of this study data are also required to monitor the impact of control strategies.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Research Ethics and Review Committee Federal Medical Centre Azare. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The author(s) declared that they were an editorial board member of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fonc.2024.1380615/full#supplementary-material

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Incidence of childhood cancers in the North East geopolitical zone of Nigeria

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Introduction: Cancers are a major cause of childhood mortality worldwide especially in LMICs where underdiagnoses and lack of quality cancer data hampers effective cancer control efforts. This study aimed to document and describe the patterns and characteristics of childhood cancers in the North East geopolitical zone of Nigeria.

Methods: This was a retrospective cross-sectional study that collected cancer data from 4 out of the 6 states in the North East of Nigeria. The data included all malignancies diagnosed in children aged 0-19 years between 2019 and 2022. The age-specific incidence rates were also calculated for the individual 5-year age groups (0–4 years, 5–9 years, 10–14 years, and 15–19 years). The crude incidence rates (CIR) were calculated as the weighted averages of the respective ASRs in each age range within 0-14 years and 0-19 years respectively. The cancers were grouped according to the International Incidence of Childhood Cancers, volume 3 (IICC3).

Results: Cancers in people <20 years accounted for 7.3% of all cancers diagnosed over the same period. The crude incidence rates (CIR) for cancers in children and adolescents were 20.9 per million children aged 0-19 years and 18.8 per million children aged 0-14 years respectively, while the age-standardized rates (ASR) were 1.80 and 1.63 per million person-years respectively. There was a variation in the most commonly diagnosed cancers across all age groups. However, lymphomas were the most commonly diagnosed cancers overall, while CNS tumors were overwhelmingly rare.

Conclusion: Despite data limitations, this study provides useful insights into patterns of cancers in the region and will hopefully provide a basis for the strengthening of pediatric oncology care, childhood cancer control programs and population-based cancer registries.

Introduction

Cancers are a major cause of morbidity and mortality in children and adolescents worldwide with an estimated 400, 000 children and adolescents being afflicted by cancer annually (1–3). The relative rarity of cancers in children compared to adults places a lot of psychosocial concerns on parents and caregivers when these cancers are diagnosed. Childhood cancer figures may be much higher than available data suggests, especially in low- and middle-income countries (LMICs) where a lack of advanced diagnostic facilities and the presence of more prevalent infectious and nutritional diseases may result in missed diagnoses (4). The latter scenario is particularly true for leukemia in childhood, where fever due to superimposed infection is a common mode of presentation, resulting in confusions with more common infectious processes (4, 5). In sub-Saharan Africa, about 90% of children diagnosed with cancer each year are likely to die from the disease, in stark contrast to high-income nations where a roughly 85% overall survival rate is the norm, mainly due to the availability of advanced diagnostic and therapeutic facilities (6).

Comprehensive cancer data are also generally lacking in LMICs and this dearth of data may be worse for the relatively rare childhood cancers (7). Most available data come from the few hospital- and population-based cancer registries. Unfortunately, some of the data available in these registries are incomplete (3). These paucity of quality and reliable data may be one of the contributory factors to the relative neglect of pediatric cancers in cancer control efforts (7). Quality data on pediatric cancers may assist in the prioritization of health resources and the formulation of relevant policies and control programs related to childhood cancer control (7).

Childhood cancers are a heterogenous group of tumors occurring between the age range 0-14 years. However, in the publication of the International Incidence of Childhood Cancer, volume 3 (IICC-3), the target age range was extended to 0-19 years to capture the transition period between childhood and adulthood (2). In general, childhood cancers differ from the adult counterparts in several respects, including biologic behavior, clinical presentation, therapeutic options and treatment outcomes (4). The classification of childhood cancers is mainly based on morphology and topography and on this basis, the 3rd edition of the International Classification of Childhood Cancers (ICCC-3) organizes the various cancer types occurring in childhood into 12 main diagnostic categories (8).

To the best of our knowledge, this study will be the first attempt at a comprehensive documentation of pediatric cancers in the North-East Region of Nigeria and will hopefully provide a basis for awareness creation and policy formulation against these cancers in various states of the region.

Methodology

Study area

The North East geopolitical zone of Nigeria consists of six (6) states namely: Adamawa Bauchi, Borno, Gombe, Taraba and Yobe. The population estimates based on the 2006 data indicates that the region accounts for 13.5% of the total population of Nigeria (roughly 19 million people) (9, 10). By 2022, the population of the region is expected to be around 30 million, based on projected annual population growth rate of 2.5% per annum (10).

Study design

This is a retrospective, descriptive study that collected data on all pathologically confirmed cancers occurring in children and adolescents aged 0-19 years in the tertiary centers of the North East of Nigeria. These centers were selected conveniently as they represent the centers for the diagnosis and management of cancers in the region. The participating centers are six (6) referral tertiary centers located in four out of the six states of the region. These hospitals include the Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi and Federal Medical Centre Azare (FMCA), both in Bauchi State; University of Maiduguri Teaching Hospital (UMTH), Borno State; Federal Teaching Hospital Gombe (FTHG), Gombe State; Federal Medical Centre Nguru (FMCN), and Yobe State University Teaching Hospital (YSUTH), Damaturu, both in Yobe State. Data from two tertiary centers in the Northeast geopolitical zone- Modibbo Adama University Teaching Hospital (MAUTH). Yola and Federal Medical Centre (FMC), Jalingo, was unavailable at the time of this study.

The data sources were from the hospital-based cancer registries and pathology departmental registers for cancers in these hospitals. Data collected include basic biodata, topography/site and pathological diagnosis.

Population distribution data by age and sex for the participating states were extracted from the Nigeria National Population Commission data of 2020 (Supplementary Table 1) which contained population projections for the year 2022 (11).

Data analysis

The various cancers were categorized and sub-categorized according to the ICCC-3 (8). Descriptive statistical analysis was applied on the data obtained using the statistical package for social sciences (SPSS) version 20 (12). The output was categorized into cancer sites by proportions and presented as texts, tables and figures (charts and box and whisker plots). Statistical tests of significance were carried out where necessary and p-value of <.05 was considered significant.

Crude estimates of age-specific incidence rates were calculated for each 5-year age groups (0–4 years, 5–9 years, 10–14 years, and 15–19 years) as the quotient of the number of cases and the total number of persons in each sex and geographical area based on recent population projections by the year 2022 (Supplementary Table 1) (2, 11). The overall crude incidence rates (CIR) were calculated as the weighted averages of the respective age-specific incidence rates in each age range for 0-14 years and 0-19 years respectively. All the crude rates were adjusted to the world standard population in order to derive the overall age-standardized rates (ASR) for the population (13).

Ethical considerations

Ethical approval for the study was obtained from the Health Research and Ethics committee of Federal Medical Centre, Azare, Bauchi State.

Results

Demographic characteristics of children and adolescents in study sites

Children and adolescents aged 0-19 years in the four participating states of the northeast geopolitical zone had a combined population of 17,178,825 (Supplementary Table 1). 50.6% of these are males while 49.4% are females.

Childhood cancer demographics

A total of 346 cancer cases in children and adolescents were included in the analysis after exclusion of cases with incomplete demographic data, no specification of cancer location or cases that were inconsistent with the diagnosis of cancer. Over the same study period, a total of 4681 confirmed cancers were diagnosed in the region resulting in a proportion of pediatric cancers of 7.3%. There were 206 males and 140 females with an incidence sex ratio (male to female) of 1.47:1 that was statistically significant (p=0.001; χ^2 = 114).

The overall crude incidence rates (CIR) for childhood cancers were 20.9 per million (for 0-19 years) and 18.8 per million (for 0-14 years) respectively. The overall age-standardized incidence rates (ASR) for childhood cancers in this study was 7.21 per million (0-19 years) and 4.90 per million population (0-14 years) respectively. The respective ASR for males and females aged 0-19 years were 8.43 and 5.97 per million population, respectively.

The median age at diagnosis was 10.5 years {inter-quartile range (IQR)= 6-16years} with a slightly earlier median age of diagnosis for males (Figure 1).

The crude and age-standardized incidence rates (ASR) for cancers in each 5-year age group is shown in Table 1. The highest absolute proportion of cases were found in the 10-14 years age group; however, the age group 15-19 years had the highest ASR of 2.31 per million population.

Cumulatively, children aged 0-14 years constituted 73.1% (253 cases) while adolescents aged 15-19 years constitute 26.9% of cases. There was a significant variation in cancer incidence across age groups (p < 0.0001, Cramér's V = 0.45). The peak age range at diagnosis of pediatric cancers within the period under review was 10-14 years (Figure 2). However, the 15-19 years age group had the highest ASR as shown in Table 1.

Diagnostic grouping of childhood cancer cases

The distribution of the cancers by ICCC-3 diagnostic groups is presented in Table 2. Lymphomas (23.4%) constitute the most commonly diagnosed childhood cancers while CNS neoplasms (0.6%) were the least frequently diagnosed cancers.

FIGURE 1
Box and Whisker plots showing median ages (and interquartile ranges) of male and female children with Childhood cancer in North-East Nigeria, 2019-2022.
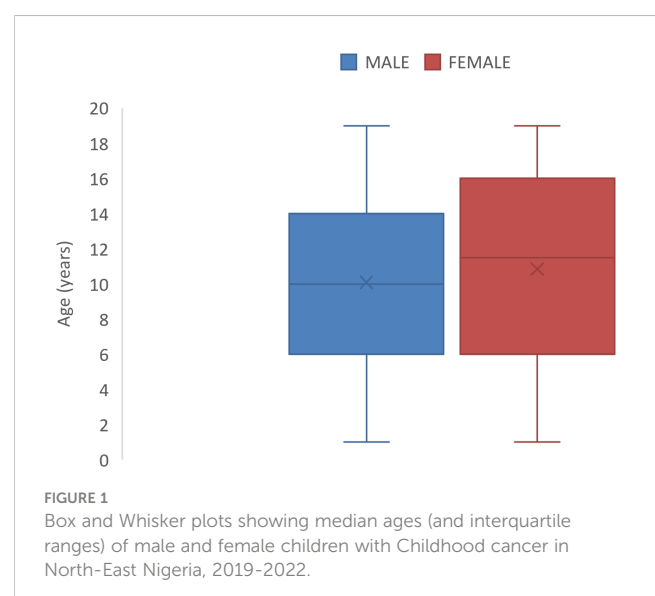
TABLE 1 Incidence rates of childhood cancers in North East Nigeria (2019-2022).

Age group (years)	No. of cancer cases (%)	Crude age-specific incidence rates (per million person-years)	Age-standardized rates (per million population)
0-4	63 (18.2)	12.3	1.09
5-9	88 (25.4)	19.6	1.70
10-14	102 (29.5)	24.5	2.11
15-19	93 (26.9)	27.3	2.31
Total	346 (100.0)		7.21

Overall, the top 5 commonly diagnosed cancers in the age 0-19 years in descending order of frequency includes Lymphomas (23.4%); Soft tissue sarcomas (14.5%); Malignant epithelial neoplasms (14.5%); Malignant renal tumors (11.8%) and Malignant bone tumors (8.1%). However, in children aged 0-14 years, the top 5 commonest cancers were lymphoma (26.9%); renal cancer (15.8%), soft tissue sarcoma (15.4%), retinoblastoma (9.5%) and epithelial cancers (8.7%). The corresponding top 5 commonest cancers in adolescents aged 15-19 years were epithelial cancers (30.1%), Bone cancers (21.5%), lymphoma (14.0%), soft tissue sarcoma (11.8%) and other unspecified malignant neoplasms (10.8%).

Age group characteristics

There was a remarkable variation in the range of cancer types across different age groups (Figure 3). In the age group from birth to 4 years, neuroblastoma and renal tumors (mainly nephroblastoma) were the predominant cancers. Lymphoma, renal tumors and retinoblastoma predominated in the 5-9 years age group while lymphoma and soft tissue sarcomas constituted the most common cancers in the 10-14 years age group. Carcinomas, bone cancers and

lymphoma were the most common tumors diagnosed in the 15-19 years age group.

Lymphomas

Lymphomas constituted the most frequently diagnosed childhood cancers with a median age at diagnosis of 11 years (IQR: 8-13 years) and a male: female ratio of 2.7:1 (Table 1). Hodgkin lymphoma was the most commonly diagnosed lymphoma constituting 37.0% of all lymphomas. They occurred at a median age of 12.5 (IQR: 10-15.3) years (Figure 4). All the cases in this study occurred in the cervical lymph nodes. Non-Hodgkin lymphomas (excluding Burkitt) constituted 32.1% of all lymphomas with median age at diagnosis of 11 (IQR: 7.8-13) years (Table 1). Burkitt lymphoma constituted 29.6% of lymphomas diagnosed in this study and occurred at a median age of 8 years (IQR: 6.3-11 years) as shown in Figure 4. Majority (87.5%) of the Burkitt lymphomas occurred in extra-nodal locations with the jaw (58.3%) being the most common site of occurrence, followed by intra-abdominal locations (20.8%).

Malignant soft tissue tumors

Soft tissue sarcomas were the 2nd most commonly diagnosed malignancies of childhood and adolescence constituting 14.5% of all cancers in these age groups with a median age at diagnosis of 12 (IQR: 5-14) years (Table 2). An overwhelming majority of the tumors were rhabdomyosarcomas (72.0%).

Malignant epithelial neoplasms

Malignant epithelial neoplasms were the joint 2nd commonest group of neoplasms in this study accounting for 14.5% of all cancers. The median age at diagnosis was 15 (IQR: 12.8-17) years (Table 2) and cutaneous carcinomas were the most commonly diagnosed cancers in this diagnostic category.

Malignant renal tumors

Renal malignancies constituted the 4th most common group of cancers in children with a median age at diagnosis of 5 (IQR: 3-8) years

FIGURE 2
Age group distribution of childhood cancer cases in North-East Nigeria, 2019-2022.
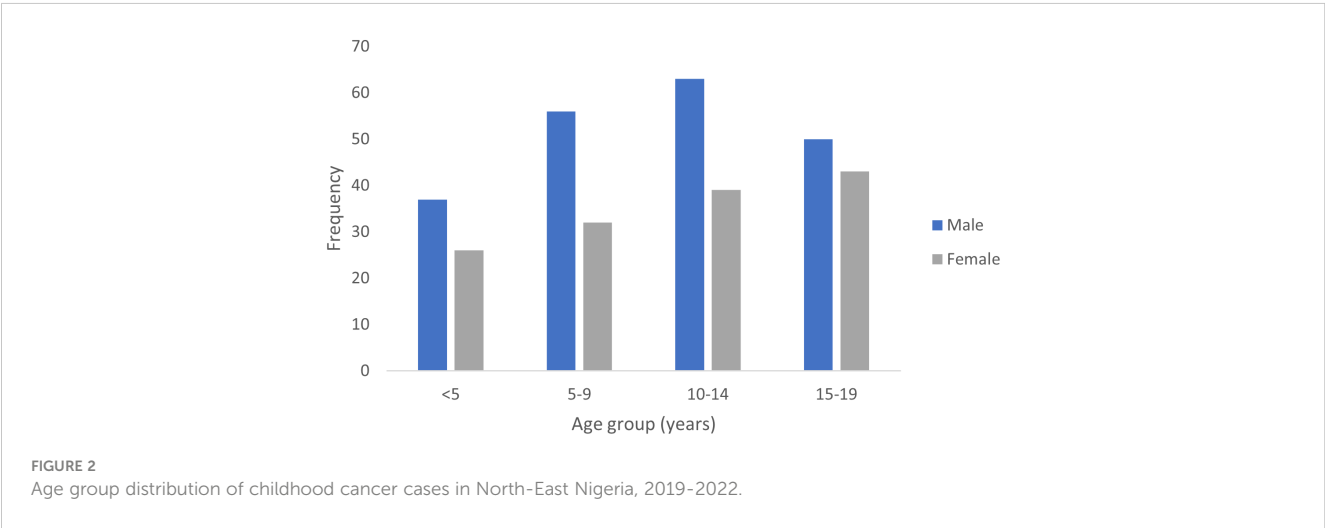
TABLE 2   The Distribution of childhood cancers in North East Nigeria (2019-2022).

Diagnostic Group	Frequency (%)	Median Age (minimum-maximum) in years	Male: Female ratio
I. Leukemia, MPD & MDS	20 (5.8)	8.5 (3-18)	5.6:1
ALL	*9 (45.0)*	8 (4-15)	-
AML	*7 (35.0)*	13 (7-17)	-
Chronic MPDs	*2 (10.0)*	-	-
Unspecified leukemia	*2 (10.0)*	-	-
Subtotal	20 (100.0)		
II. Lymphomas and RE neoplasms	81 (23.4)	11 (4-19)	2.7:1
Hodgkin	*30 (37.0)*	12.5 (6-19)	5:1
Non-Hodgkin, non-Burkitt	*26 (32.2)*	11 (4-18)	3.3:1
Burkitt	*24 (29.6)*	8 (4-14)	1.2:1
Unspecified	*1(1.2)*	-	-
Subtotal	*81(100.0)*		
III. CNS neoplasms	2 (0.6)	5.5 (3-8)	–
IV. Neuroblastoma	22 (6.3)	3 (1-17)	1:1
V. Retinoblastoma	24 (6.9)	5.5 (1-14)	1.4:1
VI. Renal tumors	41 (11.8)	5 (1-17)	1.4:1
Nephroblastoma	*39 (95.2)*	5 (1-13)	1.4:1
Renal carcinomas	*1 (2.4)*	-	-
Unspecified	*1 (2.4)*	-	-
Subtotal	41 (100.0)		
VII. Hepatic tumors	3 (0.9)	11 (2-24)	-
Hepatoblastoma	*1 (33.3)*	-	-
Undifferentiated embryonal sarcoma	*2 (66.7)*	-	-
Subtotal	*3(100.0)*		
VIII. Malignant bone tumors	28 (8.1)	17 (3-18)	2:1
Osteosarcoma	*26 (92.8)*	17 (10-19)	2.1:1
Chondrosarcoma	*1 (3.6)*	-	-
Round cell sarcoma, NOS	*1 (3.6)*	-	-
Subtotal	28 (100.0)		
IX. Soft Tissues and other extra-osseous neoplasms	50 (14.5)	12 (1-19)	1.2:1
Rhabdomyosarcoma	*36 (72.0)*	10 (1-19)	2:1
MPNST	*2(4.0)*	-	-
Synovial sarcoma	*3 (6.0)*	-	-
Kaposi sarcoma	*2 (4.0)*	-	-
Alveolar soft part sarcoma	*1 (2.0)*	-	-
Liposarcoma	*1 (2.0)*	-	-
Unspecified round cell & spindle cell sarcomas	*5 (10.0)*	-	-
Subtotal	50 (100.0)		
X. Germ cell, trophoblastic & gonadal neoplasms	8 (2.3)	15.5 (5-19)	1:7
Extragonadal germ cell tumors	*2 (25.0)*	-	-
Gonadal germ cell tumors	*5 (62.5)*	-	-
Gestational choriocarcinoma	*1 (12.5)*	-	-
Subtotal	8 (100.0)		
XI. Other Malignant epithelial neoplasms and melanomas	50 (14.5)	15 (3-19)	1:1.2
Thyroid carcinoma	*1 (2.0)*	-	-
Nasopharyngeal carcinoma	*10 (20.0)*	16.5 (4-19)	1:1
Cutaneous carcinoma	*17 (34.0)*	14 (3-19)	-
Salivary gland carcinoma	*4 (8.0)*	-	-
Colorectal carcinoma	*6 (12.0)*	17 (14-18)	1:5
Ocular carcinoma	*3 (6.0)*	-	-
Breast carcinoma	*6 (12.0)*	16.5 (7-18)	-
Esophagus	*1 (2.0)*	-	-
Urinary bladder	*1 (2.0)*	-	-
Cervix	*1 (2.0)*	-	-
Subtotal	50 (100.0)		
XII. Other and Unspecified Malignant Neoplasms	17 (4.9)	16 (4-18)	0.89:1
Total	346		

ALL, Acute lymphoblastic leukemia; AML, Acute myeloblastic leukemia; CNS, Central nervous system; MPD & MDS, Myeloproliferative disorders and Myelodysplastic syndrome; MPNST, Malignant peripheral nerve sheath tumor; NOS, Not otherwise specified; RE, Reticuloendothelial.
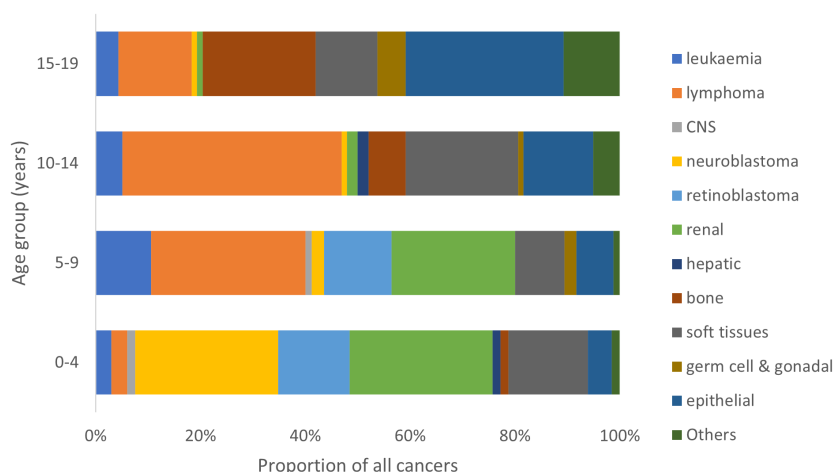
FIGURE 3
Proportional distribution of cancer types by age group of children in North-East Nigeria, 2019-2022.

(Table 2). Majority of these malignancies were nephroblastoma with only occasional cases of renal carcinomas (Table 1).

Malignant bone tumors

Bone cancers constituted the 5th most commonly diagnosed malignancy accounting for 8.1% of all malignancies in childhood and adolescence in this study. The median age at diagnosis was 17 (13-18) years (Table 2), and roughly 93% of these cancers were osteosarcoma.

Discussion

With the aid of available data from the contributing tertiary health institutions in North-East Nigeria, we report the estimated incidence rates of cancer in children aged 0-19 years between 2019-2022: 20.9 per million children (0-19 years) and 18.8 per million children (0-14) years respectively. The respective ASR were 7.21 and 4.90 per million. These values are far lower than overall ASR estimates for sub-Saharan Africa (50-150 per million) reported by Steliarova-Foucher et al. in the IICC3 (2). This obvious discrepancy is not altogether surprising considering that the IICC3 report is based on data from high quality population-based cancer registries, which was generally lacking in our study. Because most of our data were from institution-based departmental registers, there is likely to be an under-estimation of cancer cases with less likelihood of data quality assurance. In addition, only microscopically confirmed cancer cases were included in this study. Previous population-based registry reports in Africa have revealed varying ASR for childhood cancers across the continent from as low as 26.8 per million children in The Eastern cape of the Republic of South Africa (2003-2012), to as high as 308.2 per million children in Blantyre, Malawi (2003-2010) (14). An ASR of 80.6 per million was also previously reported from the Ibadan cancer registry, Nigeria (2003-2012). The strong possibility of under-estimation of

childhood cancer cases in this study underscores the importance of establishing and strengthening population-based cancer registries in the North East and other parts of Nigeria.

The proportion of childhood malignancies in this study in relation to the total number of malignancies over the study period (7.3%) falls within the range of 1.4-10% reported by most studies within the sub-Saharan African sub region (5, 15–17). It is noteworthy that most of these studies were on cancers occurring within the age ranges of 0-14 years in contrast to our study in which the age range is extended to 19 years. In this study, if only the age group 0-14 years is considered, then the proportion of childhood cancers drops down to about 5.4% of all cancers over the study period.

This study revealed a median age at diagnosis of 10.5 years. One institution-based study in Nigeria reported a median age of 4.75 years at diagnosis (18). However, the study collected cancer data from children less than 15 years. In other parts of sub-Saharan
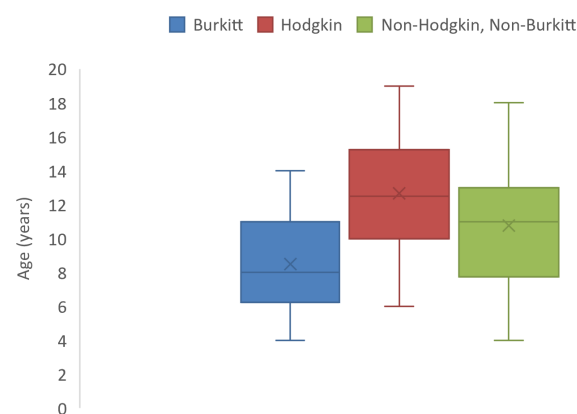
FIGURE 4
Box and whisker plot showing median ages (and interquartile ranges) of lymphoma cases of children in North-East Nigeria, 2019-2022.

Africa, a study based on two (2) population-based cancer registries in Zimbabwe and Uganda that collected cancer data for people aged 0-19 years, reported an overall median age of occurrence of 9 years (19). Another study at a Ugandan Cancer Institute reported a median age at diagnosis to be 7 years among people aged 0-19 years (20).

The slightly higher incidence of the cancers in boys (sex ratio 1.47:1) is in keeping with most other national and continental studies of pediatric cancer as well as global estimates (2, 7, 15, 18). The reasons why cancers are commoner in boys than girls remain elusive. Boys and girls share similar genetic and environmental risks for childhood cancers and are therefore expected to have similar cancer incidence. However, some authors have observed in very early studies that male children are more likely to be sent to receive specialist medical care in countries with low gross domestic product (GDP), due to prevailing cultural practices that favors the male child (21, 22). There is currently no evidence to suggest that our finding reflects gender discrimination in health-seeking behavior. However, this possibility may need to be examined in more detail in other studies.

Lymphomas were the most frequently diagnosed childhood malignancies with a median age at diagnosis of 11 years. This is in keeping with previous observations in Nigeria and other parts of Africa (13–16, 20). However, in contrast to most previous studies where Burkitt lymphoma constituted the predominant lymphoma subtype, Hodgkin lymphoma and non-Hodgkin, non-Burkitt lymphoma both outnumbered Burkitt lymphoma in our series. This may be due to the extension of the study participants to 19 years in this study whereas other studies covered only the 0-14 years age range and the fact that endemic Burkitt lymphoma rarely occurs beyond the age of 17 years. Despite the wider age range, the median ages of occurrence of all the 3 lymphoma subtypes were <15 years (Hodgkin, 12.5 years; non-Hodgkin non-Burkitt, 11 years; and Burkitt, 8 years). It would appear that there is a changing pattern in the occurrence of various lymphoma subtypes, however more large-scale studies on the subject are required before such conclusions can be drawn.

Leukemia is considered to be the most common cancer of children worldwide (2). However, our study, just like most other African studies did not reveal a preponderance of leukaemia (15, 16, 20). A notable exception is a 4-year Ghanaian series in which leukemias were the 2nd most commonly diagnosed cancer in childhood (23). In this study, it is the 6th and 7th most common cancer in the age ranges 0-14 years and 15-19 years respectively and did not feature as a top 5 cancer in any age group except for the age 5-9 years where it ranked 4th. Underdiagnosis/misdiagnosis of leukemia due to inadequate diagnostic and treatment facilities, is often touted as the likely reason for the low incidence of leukemia in African populations (24, 25). It is however worthy of note that a low leukemia incidence has also been observed among African American children of the USA in comparison to other ethnic groups (2). While the possibility of certain genetic alleles conferred by the common African ancestry may be a factor in this observation, it may also have resulted from reduced access to health care as a result of lower socioeconomic status of this population group (26, 27).

Soft tissue sarcomas (mainly rhabdomyosarcomas) were a significant contributor to childhood cancer burden in this study and was the 2nd only to lymphoma as the most common cancer in people aged 0-19 years. This finding is in agreement with data from the cancer registry of Ibadan, Nigeria (2003-2012) where soft tissue sarcoma (predominantly rhabdomyosarcoma) was the 2nd commonest cancer after lymphoma (14). The data from other parts of Africa show varied results that range from being the 3rd commonest childhood cancer in Ethiopia and Kenya to not being among the top 5 paediatric cancers in most other countries (14, 17). It is noteworthy that national cancer registry data from Zambia and Zimbabwe show that Kaposi sarcoma is the most commonly diagnosed soft tissue sarcoma rather than rhabdomyosarcoma observed from other African countries (17). This may reflect the effect of HIV prevalence and morbidity in these locations.

As expected, epithelial cancers (carcinomas) were the most commonly diagnosed cancers (30.1%) in the 15-19 years age group, but it was also a relatively significant cancer type in the 10-14 years age group (12.7%) where it was the 3rd most commonly diagnosed group of cancers. An overwhelming majority of these carcinomas were cutaneous squamous cell carcinoma, many of which were related to chronic scars and discharging sinuses. In the much younger age groups, carcinoma often occurred in exceptional circumstances such as the occurrence of rare cutaneous and conjunctival carcinomas in association with xeroderma pigmentosum (28, 29). In general, it appears that the incidence of carcinomas in childhood increases with the age of the child.

A striking observation in this study is the paucity of cases of CNS neoplasms, which is one of the major neoplasms occurring in children in high-income countries (2). As has been previously observed, the lower incident cases of CNS neoplasms in children of low and middle income countries (LMICs) likely reflect the paucity of paediatric neurosurgical and neuro-imaging facilities and personnel (2, 30).

The IICC3 category XII titled 'Other and Unspecified malignant neoplasms' constitute about 4.9% of all cancers in this study. A significant proportion of the cancers in this group were "malignant small round blue cell tumors" and metastatic carcinomas of undetermined origin. This implies that at least some of the cancers in this category reflects limitations in specialized and ancillary diagnostic facilities required for specific characterization of these malignancies.

Limitations

Notable limitations were inherent in this study, mostly affecting data accrual and quality. As a hospital cancer registry-derived data, the cases presented here reflect the available skill capacity and infrastructure available in the region, and not necessarily a true reflection of the disease burden in the index population. Likewise, systematic follow up of the patients was not documented, hence information on therapy, survival and mortality is also lacking in the study. Additionally, not all the states in the zone had their data included in this analysis, hence, caution is required in extending our findings to the entire northeast region. Future studies should therefore incorporate clinically diagnosed cancers, cover the entire

geographical area and search for survival data that could elucidate on what therapy options are more likely to be effective in the population, while suggesting preventive strategies.

Conclusion

This study provides useful insights into the pattern of occurrence of childhood cancers in this region and can serve as a baseline for more robust studies in the country. There is an urgent need to upscale existing infrastructure, as well as establish and/or strengthen population-based cancer registries in the region and country at large so as to ensure the availability of high-quality data that will be invaluable to childhood cancer control efforts. There is also a need to improve capacity-building in the diagnosis and management of childhood cancers in our environment to ensure that the number of ambiguous or non-specific diagnoses are markedly reduced.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study of human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/patients legal guardian/next of kin was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fonc.2024.1379968/full#supplementary-material

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Addressing knowledge and behavior gaps in breast cancer risks: implications for health promotion and intervention strategies

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Introduction: The growing incidence and high mortality rate of breast cancer (BC) in Nigeria is attributed to increased risk levels, poor prognosis and late detection.

Methods: This study aimed at identifying education-based disparities in BC risk knowledge, lifestyle/ dietary patterns among females in Ogun state, Nigeria. Questionnaires were used to obtain data from 1135 study participants across various levels of education and analyzed using Epi-info software and Graphpad prism.

Results: The lifestyle/dietary pattern assessment revealed that the participants in the secondary level smoked the most (4.50%), accompanied by high red wine (31.00%), fruits and vegetable (73.00%) consumption. Graduates had the highest antibiotics intake (54.50%) and alcohol consumption (12.00%), the undergraduates were the most physically inactive (63.90%) with the highest consumption of carbonated drinks (73.90%), postgraduates consumed red meat/ smoked foods the most (70.70%).

Discussion: The knowledge of BC risk positively impacted carbonated drinks, physical inactivity, smoking, antibiotics and alcohol intake. However, it did not affect family history, red meat/smoked foods, fruits and vegetables consumption. Overall, Education has an impact on the knowledge of BC risks which influences the lifestyle/dietary patterns of females in Nigeria.

KEYWORDS

breast cancer, risk assessment, education levels, knowledge, females, Nigeria, prevention

1 Introduction

The human body is made up of cells with similar genetic makeup and DNA sequences. To guarantee the appropriate functioning of the human body, these cells undergo regulated growth, specialization, and death (1). Cancer, a condition defined by abnormal cell proliferation, affects normal cell function, resulting in uncontrolled growth and death resistance (2). Breast cancer (BC) is the most commonly diagnosed cancer, accounting for an estimated 2.3 million new cases each year globally and ranking fifth in terms of cancer mortality (3). The rising prevalence of BC has been related to a variety of causes and risk factors, including inheritance, nutrition, lifestyle, and environmental toxins (4).

Breast cancer remains a major public health concern worldwide, and Nigeria is no exception. Breast cancer is the most common cancer among women worldwide, putting a significant strain on healthcare systems and communities alike (5, 6). While breakthroughs in therapy have increased survival rates, the emphasis has switched to prevention as a more sustainable and successful approach (7, 8). In Nigeria, the rising incidence of breast cancer is exacerbated by late presentation, with around 70% of cases presenting at advanced stages of the disease. This late presentation forces patients to consider complex therapeutic procedures, which are typically prohibitively expensive and limited. Therefore, prioritizing prevention over treatment appears to be a convincing approach to combating the illness.

Breast cancer prevention involves a wide range of strategies aimed at lowering the chance of acquiring breast cancer. These strategies vary from lifestyle changes and early detection through screening to mitigating environmental and genetic risks (9). By addressing the underlying causes of the disease, prevention provides a proactive approach that may avoid the need for costly and invasive therapies in the future. In a resource-constrained setting like Nigeria, where healthcare facilities and financing may be insufficient to fulfill the demands of treating advanced cases, investing in prevention becomes not only practical but also necessary.

Studies by Gwarzo et al. (10), Effiong et al. (11), Ibitoye et al. (12), Ifediora et al. (13), Sadoh et al. (14), Awogbayila et al. (15), Uruntie et al. (16), Udoh et al. (17), Olayide et al. (18), Isara et al. (19), Awodele et al. (20), and Effiong et al. (21), have evaluated the level of BC awareness and prevention practices among Nigerian women of varying ages. Some studies carried out intervention programs to examine the effect of BC education on reducing BC risks and incidence (16). Regardless, wide disparities exist in the level of BC knowledge especially with regards to BC risk factors which translates into the lifestyle and dietary practices of the populace (22). Lifestyle and dietary practices such as physical inactivity, antibiotics intake, smoking, consumption of red meat/ smoked foods, carbonated drinks, fruits and vegetables, among others constitutes modifiable risk factors of BC (23) accounting for over 90% of BC cases, while 10% are caused by heredity. This disproportionality in the underlying cause of BC from modifiable risk factors compared to non-modifiable risk factors, highlights the need for a tailored approach that can identify the gaps between

knowledge of BC risks and practice so as to inform better intervention strategies and increase effectiveness.

The first step to BC prevention is increased awareness and education on BC risks and associated factors which has the potential to inform lifestyle/dietary pattern changes and reduced BC incidence (24, 25). However, individual heterogeneity exists, in the capacity to comprehend BC related information and translate into practice. Studies have shown that individuals with higher educational qualification possess higher critical thinking abilities and comprehension levels which can enable them process information and translate into action, compared to individuals with lower educational exposure (26). The level of female education in Nigeria has a very wide range, while some persons are fully educated to the graduate level, others have a low level of education stopping at the primary/secondary levels and a few reaching the zenith of educational achievements into holding postgraduate qualifications such as doctorates and professorship (27). All these influences the approach that will be utilized in creating effective awareness, lifestyle/dietary pattern changes while emphasizing the ineffectiveness of the one size fits all approach in BC prevention. This was further supported by a report by Effiong et al. (21), which highlighted differences in BC awareness and channels of communication across levels of education.

The presence of education-based disparity and its significant influence on breast cancer knowledge and lifestyle/dietary patterns informed the need for this study. This study aimed at identifying education-based disparities in breast cancer risk knowledge, lifestyle/ dietary patterns among females in Ogun state, Nigeria with a view of developing tailored approaches, bridge the gaps identified, increase effectiveness and reduce the overall BC incidence.

2 Methods

2.1 Sampling technique

This cross-sectional survey was done using a three-stage stratified random sample method. The first stage involves selecting six educational institutions in Ota, Ado-Odo Local Government Area, Ogun State, Nigeria, based on their large and diverse population sizes. The second stage entailed stratifying the participants in the selected institutions based on their levels of education, and the third stage involved picking persons at random from their educational levels based on the inclusion and exclusion criteria shown in Figure 1. The inclusion criteria were females aged 13 and up who had started menstruating and had breasts. This study properly followed ethical guidelines, got informed consent from the necessary authorities, and avoided actions that violated confidentiality or constituted a risk to human life. The total population size was 11,350, with a 10% sample size of 1135 people.

2.2 Data collection

Questionnaires were utilized as the research instrument, consisting of closed-ended questions with single and multiple
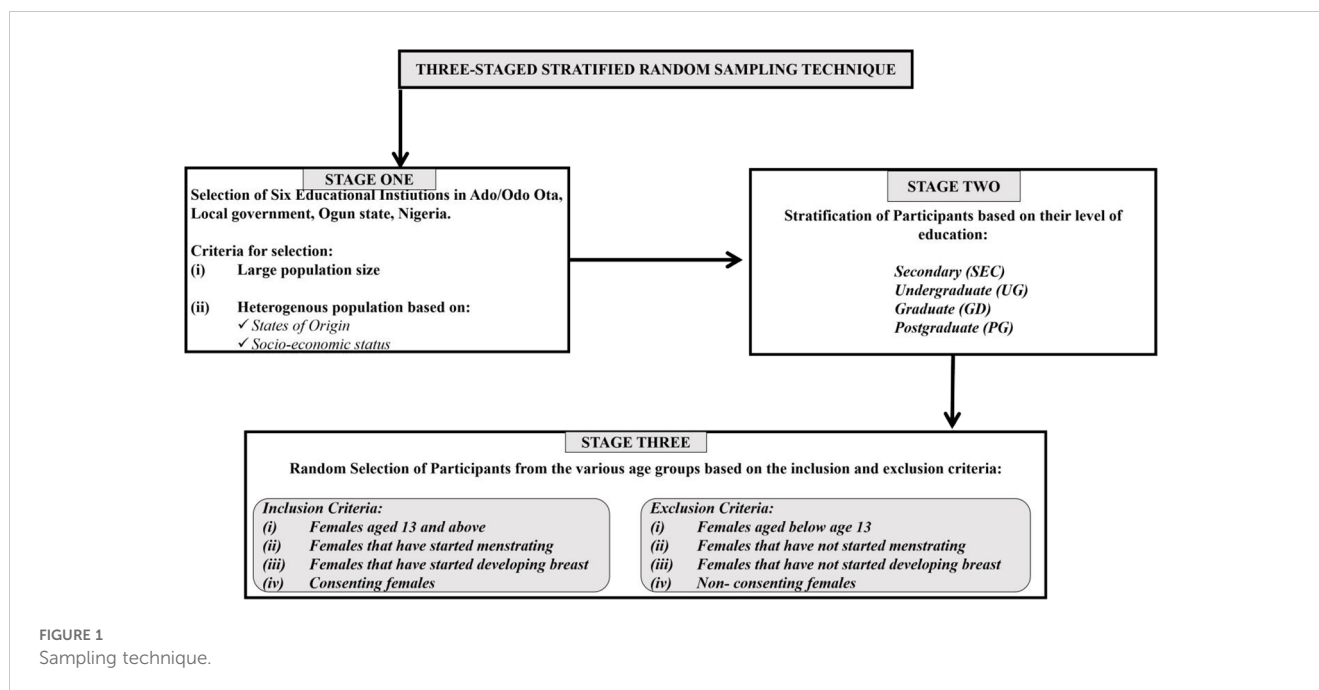
correct answers related to the study's objectives and the Nigerian setting, following the protocols outlined by (13, 28). The questionnaire was divided into three sections: participant socio-demographic information, awareness of breast cancer risk factors, and lifestyle/dietary habits. The questionnaires were distributed physically. The questionnaire's reliability was tested using the test-retest approach, and its validity was assessed by a health researcher and a demographer.

2.3 Statistical analysis

Epi-info, Microsoft Excel, and SPSS version 20 statistical tools were used to collect and evaluate data. Frequencies, percentages, averages, and standard deviations were used to compare the data. The p-values and levels of association were calculated using regression and correlation studies.

2.4 Scales of measurement

This study used two measurement scales. There were two assessment scales: knowledge and lifestyle/dietary pattern.

2.4.1 Knowledge assessment scale

A knowledge scale was created to evaluate respondents' understanding of breast cancer risk. The questionnaire's knowledge component included four test items with various correct and incorrect answers. The correct answers received one point, while the erroneous options received zero. Overall knowledge scores for each exam question were coded as 100% correct (2 marks), > 50% partially correct (1 mark), and < 50% incorrect (0 marks).

2.4.2 Lifestyle and dietary pattern assessment scale

The respondents' lifestyle and nutritional habits were evaluated using a frequency-based value assignment scale. The questionnaire's lifestyle and eating pattern component included nine test items with numerous alternatives for determining the frequency of behaviors. Higher frequencies correlated with higher scores. Options such as never, yearly, monthly, weekly, biweekly, and daily received scores of '1', '2', '3', '4', '5', and '6'.

3 Results

3.1 Response rate

The study included 1135 female participants. A total of 1200 questionnaires were distributed; 1135 were completed and returned, yielding a response rate of 94.58%.

3.2 Socio-demographic characteristics

Table 1 depicts the participants' demographic information, such as age, occupation, religion, marital status and level of education. The participants were from six educational institutions consisting of a university and five secondary schools (two government schools and three private schools). 544 participants (47.93%) were from the university institution and 591 participants (52.07%) were from secondary schools. The participants' ages ranged from 13 to 60 years, with a mean of 21. Participants were recruited from two types of institutions: 591 (52.07%) were from secondary schools, and 544 (47.93%) were from the university. Participants were broadly divided into two groups: staff and students. 218 (19.21%)

Characteristics	University 544 (47.93)	Secondary School 591 (52.07)	Total 1135 (100)
Age groups			
13 - 19	470 (55.04)	384 (44.96)	854 (75.24)
20 - 30	59 (43.07)	78 (56.93)	137 (12.07)
31 - 40	14 (18.67)	61 (81.33)	75 (6.61)
41 - 50	0 (0.00)	47 (100.00)	47 (4.14)
51 - 60	1 (4.54)	21 (95.45)	22 (1.94)
STAFF AND STUDENTS			
Staff			
Lecturers	10 (100.00)	0 (0.00)	10 (0.88)
Teachers	0 (0.00)	180 (100.00)	180 (15.86)
Non-Teaching Staff (Health workers, Cleaners, etc)	1 (0.18)	27 (4.57)	28 (2.47)
Students			
Secondary students	0 (0.00)	384 (100.00)	384 (33.83)
Undergraduate students	470 (100.00)	0 (0.00)	470 (41.41)
Postgraduate students	63 (100.00)	0 (0.00)	63 (5.55)
LEVEL OF EDUCATION			
Secondary	1 (0.18)	411 (69.54)	412 (36.30)
Undergraduate	470 (86.40)	0 (0.00)	470 (41.41)
Graduate	6 (1.10)	155 (26.23)	161 (14.19)
Postgraduate	67 (12.32)	25 (4.23)	92 (8.11)
MARITAL STATUS			
Single	534 (98.16)	459 (77.66)	993 (87.49)
Married	10 (1.83)	128 (21.66)	138 (12.16)
Divorced/Separated	0 (0.00)	2 (0.34)	2 (0.18)
Widow	0 (0.00)	2 (0.34)	2 (0.18)
RELIGION			
Christianity	544 (100.00)	554 (93.74)	1098 (96.74)
Islam	0 (0.00)	37 (6.26)	37 (3.26)

participants were staff, consisting of lecturers (4.59%), teachers (82.57%) and non-teaching staff (12.84%). 917 (80.79%) of the participants were students consisting of secondary students (41.88%), undergraduate students (51.25%) and postgraduate students (6.87%).

The participants were drawn from various levels of education, 412 (36.30%) participants had a secondary level qualification, 470 (41.41%) had an undergraduate qualification, 161 (14.19%) had a graduate qualification and 92 (8.11%) had a postgraduate

qualification. 12.16% of the participants were married, 87.49% were single, and the rest were widowed and divorced. The participants' religions were exclusively Christianity (96.74%) and Islam (3.26%).

3.3 Knowledge of breast cancer risk factors

The knowledge of BC risk factors, causes of BC, foods associated with increased and decreased breast cancer risk was assessed across the levels of educational qualification (Supplementary Table 2). The knowledge of various factors consisting of actual breast cancer risk factors and non-risk factors were assessed. The secondary level participants identified radiation (20.87%) and smoking (23.54%) as the major risk factors associated with BC, however, the least identified were early menstruation (0.00%), and late pregnancy (0.49%). The most and least identified BC risk factor was similar among the undergraduates, graduates and postgraduates. Based on the total knowledge score assessment, the knowledge of BC risk factors increased with increase in education. However, there was no significant difference (p < 0.05) in the level of knowledge of BC risk factors across the levels of education (Figure 2A).

Knowledge of various causes of breast cancer was assessed across the education levels. The secondary level participants identified always wearing brassiere (44.66%), as the major causes of breast cancer. This was similar to the identified causes by the graduate level participants (32.92%) with heredity (54.66%) as an additional cause. The undergraduates and postgraduates had similar identified major causes of BC. They opted for heredity (48.51% and 60.87% respectively) and poor diet (32.77% and 32.61% respectively). Across all levels of education, the least identified cause of BC was the will of God. The overall, knowledge assessment score revealed that the postgraduates had the highest score (21.02%), while the secondary level participants had the least (13.84%) with no significant difference (p < 0.05) between them (Figure 2B).

Across all levels of education, the most identified food associated with increased BC risk was high fatty food and alcohol. The least identified was carbonated drinks by the secondary (12.14%), undergraduates (15.96%) and graduate (21.12%) level participants. The postgraduate participants identified red meat/smoked foods (26.09%) as the least cause of BC. The undergraduates had the least knowledge score of BC foods that increase BC risk (26.52%) while the postgraduates had the highest score (30.80%) with no significant difference (p < 0.05) between them (Figure 2C). The knowledge of foods associated with decreased breast cancer risk was also assessed. Fruits and vegetables were the most identified BC risk reducing food by the secondary (55.83%), undergraduates (66.81%), graduates (72.67%) and postgraduates (79.35%). The least identified by the secondary (5.10%), undergraduates (10.85%) and graduates (6.83%) was yogurt, however, the postgraduates opted for milk (8.70%) as the least associated with decreased BC risk. The undergraduates had the least knowledge score of BC causes (26.52%) while the postgraduates had the highest score (30.80%) (Figure 2D).
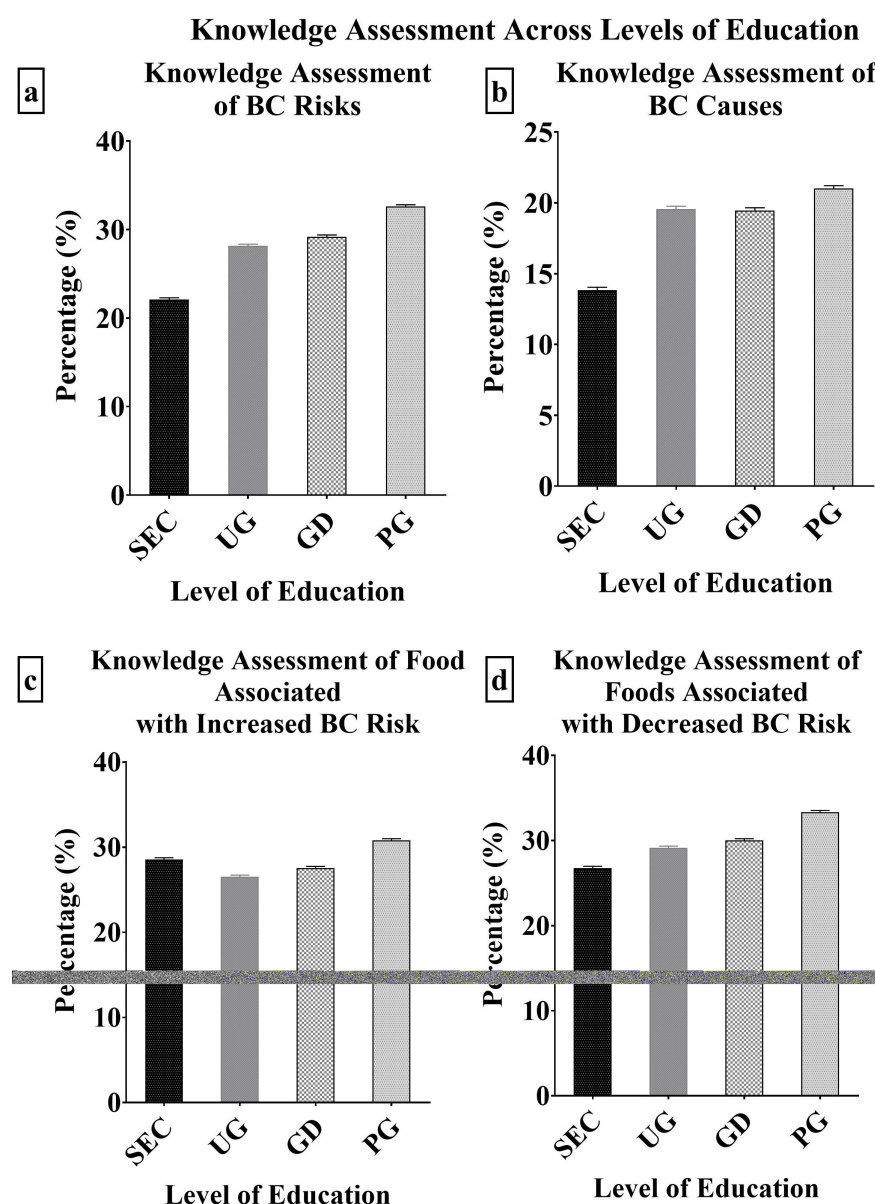
FIGURE 2
(A–D): Knowledge Assessment of BC risks, causes and foods associated with BC across levels of education.

3.4 Lifestyle and dietary patterns across age groups

The individuals' lifestyle and nutritional habits that influence breast cancer risk were evaluated (Figure 3; Supplementary Table 3). The secondary level participants smoked the most (4.50%), followed by the postgraduates (3.80%), undergraduates (2.00%) and graduates (1.90%) (Figure 3A). There was no particular trend observed for family history (Figure 3B). Graduate level participants consumed the most alcohol (12.00%), followed by the postgraduates (5.50%), while the undergraduates consumed the least (4.90%) (Figure 3C). Carbonated drink intake was highest among undergraduates (73.90%), followed by secondary (69.00%), graduates (63.20%) and the lowest among the postgraduates (54.20%) (Figure 3D). The undergraduates were the most physically inactive (63.90%), followed by secondary (62.00%), graduates (48.40%) and postgraduates (44.60%) as the least (Figure 3E). There was a direct relationship between antibiotic use (Figure 3F) and increase in the level of education. Same was observed in the red meat and smoke foods consumption pattern (Figure 3G). The secondary level participants consumed the most red wine (31.00%), fruits and vegetables (73.00%) while the undergraduates consumed the least (20.20% and 62.00% respectively) (Figures 3H, I).

FIGURE 3
(A−I): Lifestyle/Dietary patterns across levels of education.
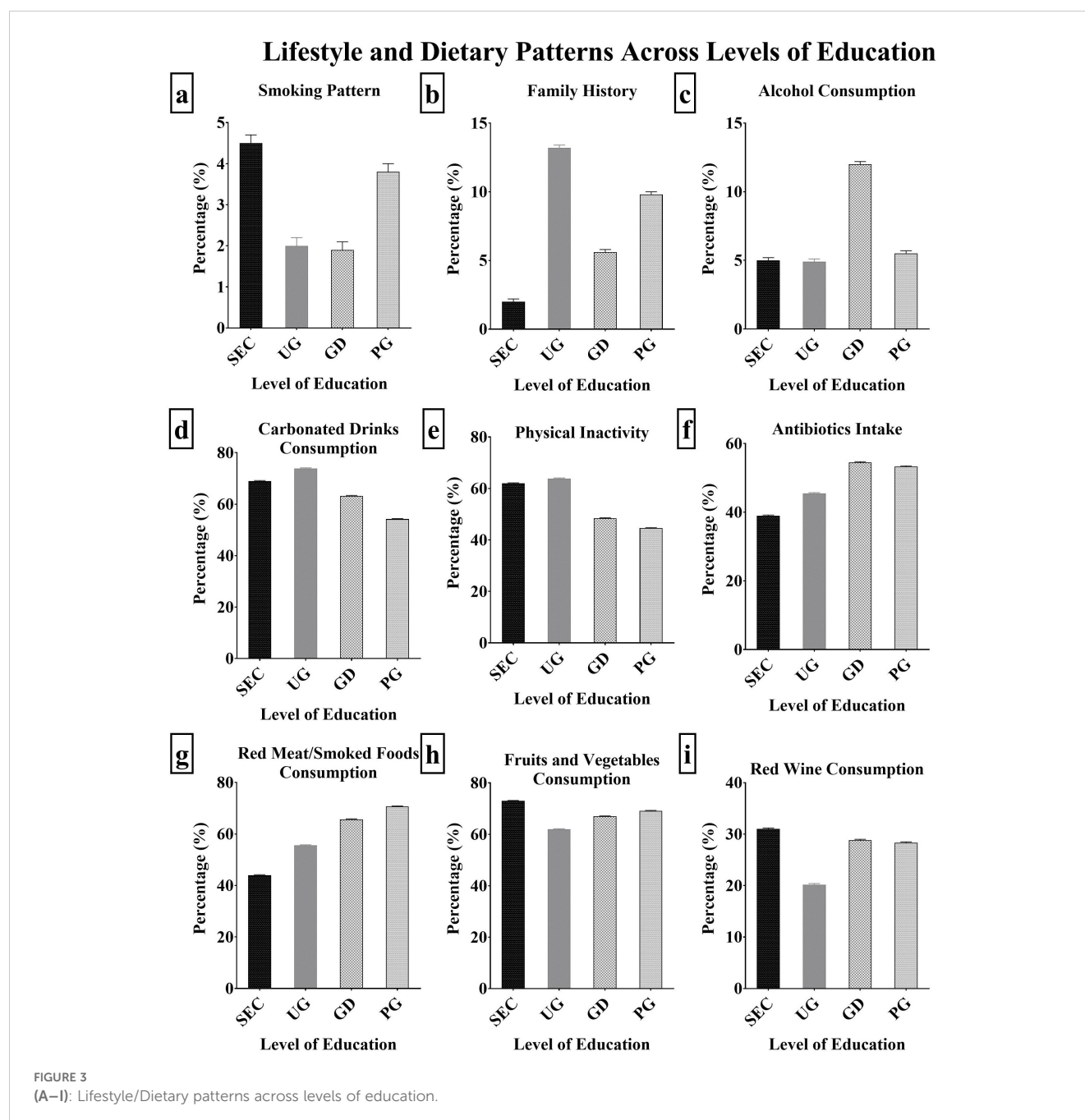
3.5 Impact of BC knowledge on the lifestyle and dietary patterns of the participants

The effect of BC knowledge on participants' lifestyle and food patterns was examined across levels of education (Supplementary Table 3). The awareness of breast cancer risk factors had a varying impact on the lifestyle and eating patterns of participants (Figure 4). The knowledge of BC risk had a direct positive impact on the level of consumption of carbonated drinks (Figure 4A), physical inactivity level (Figure 4D), smoking (Figure 4G), antibiotics (Figure 4F) and alcohol intake (Figure 4B). The secondary level participants had the least understanding of the effects of smoking

(23.54%) and physical inactivity level (10.68%) on BC risk (Figures 4G, D), this reflected in their high smoking (4.50%) and physical inactivity (62.00%) compared to other levels of education. The undergraduates had the highest level of carbonated drinks consumption (73.90%) which corresponded to their low knowledge of the risk implication its consumption (15.96%). The graduate level participants had the least knowledge of the implication of antibiotics intake (11.18%) and alcohol consumption (37.89%) on BC risk, which reflected in their high antibiotics intake (54.50%) and alcohol consumption (12.00%). There was no defined impact of the knowledge of BC risk on the consumption of red meat/smoked foods, family history, fruits and vegetables across the levels of education.

Knowledge of BC risks and lifestyle/dietary patterns across Levels of Education

Knowledge of BC risks and lifestyle/dietary patterns across Levels of Education
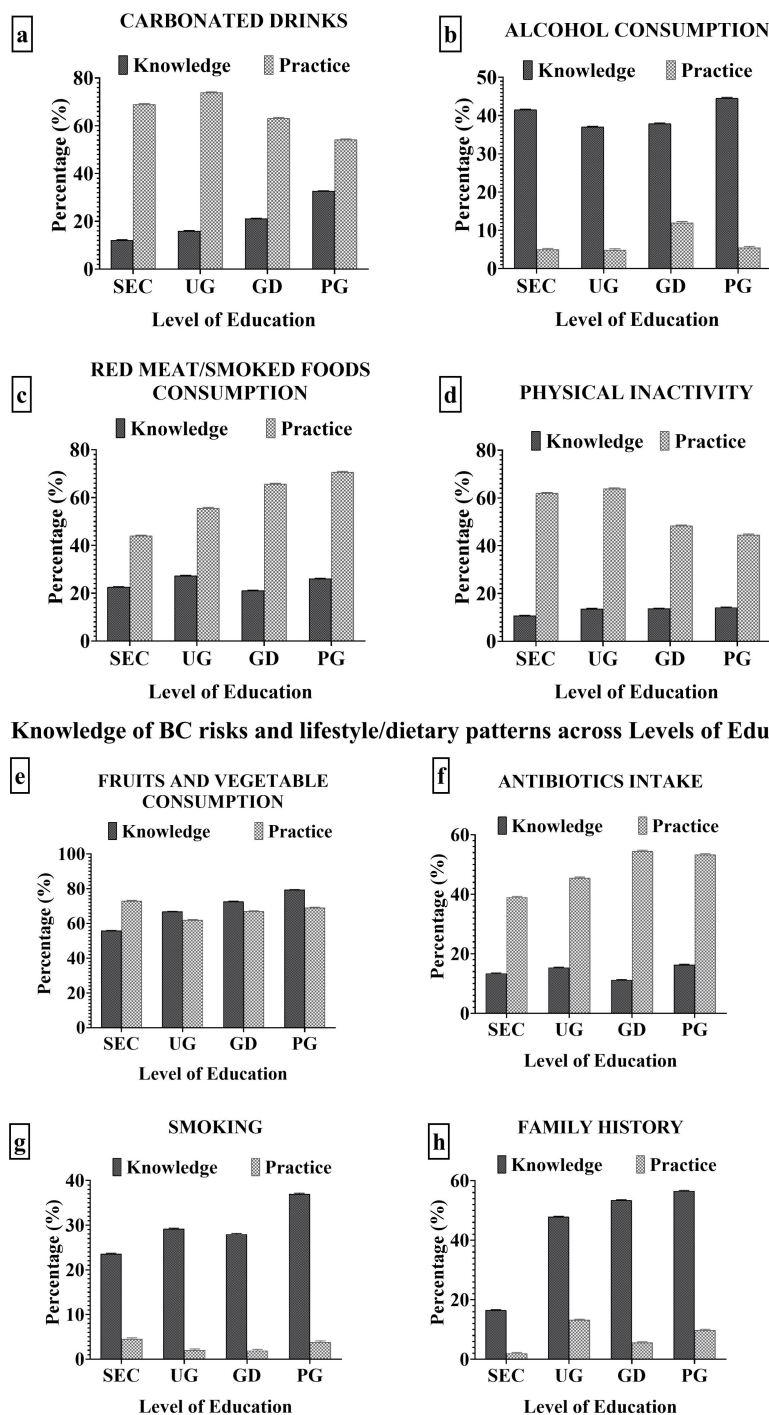
FIGURE 4
(A-D) Impact of BC knowledge on the lifestyle and dietary patterns of the participants. **(E-H)** Impact of BC knowledge on the lifestyle and dietary patterns of the participants.

4 Discussion

Breast cancer is a public health issue that has attracted global attention due to its increasing incidence and fatality rates (29, 30).

Breast cancer is related with an aggressive subtype, low survival rates, and a high mortality rate in Nigeria (31). The Nigerian environment has exacerbated the disease's complexity due to high levels of carcinogen exposure, bad food patterns, and lifestyle (4, 32).

4.1 Impact of education on the knowledge of breast cancer risks

Understanding the risk factors for breast cancer is critical for early identification, personalized risk assessment, preventative interventions, and informed decision-making (33, 34). This study evaluated the disparities in the knowledge of BC risk factors and their impact on the lifestyle and dietary patterns across various levels of education. There was a direct positive impact of educational qualification on the knowledge of breast cancer risk factors. Higher educational credentials were found to have a direct favourable impact on knowledge of breast cancer risk factors which was similar to the findings by (21). This could be attributed to more access to resources, higher levels of health literacy, and a better grasp of breast cancer risk factors as educational qualification increases (35, 36). This disparity highlights the need for a targeted intervention with greater focus on lower levels of education.

4.2 Lifestyle/dietary patterns across levels of education

Breast cancer risk factors are characteristics that raise a person's chances of developing the disease (37). Breast cancer risk factors include family history, age, physical inactivity, smoking, a high intake of red meat, processed foods, fizzy beverages, alcohol, antibiotics, and a low intake of fibre, fruits and vegetables, red wine, and so on (21, 38). The lifestyle/dietary patterns of an Individual can be used to adapt recommendations by healthcare practitioners using personalized risk assessment and create preventive actions., such as keeping a healthy weight, exercising regularly, limiting alcohol use and genetic testing, so as to minimize the risk of developing breast cancer (39, 40).

The consumption of red meat and smoked foods are linked to increased breast cancer risks and mortality due to high levels of heme iron, sulphur-containing substances, and mutagens (41, 42), which promote breast carcinogenesis (43, 44), oxidative stress, and reduced gut barrier function (45, 46). The results showed that the consumption of red meat and smoked foods increased with levels of education. This implies that participants at higher education levels are more susceptible to breast cancer via the red meat-induced alterations in the body's signal transduction and redox homeostasis imbalance. One probable explanation could be socioeconomic factors such as increased income levels associated with higher educational attainment. Persons with higher incomes may have access to a larger variety of foods, including red meat. These findings were not in agreement with Frank et al. (47), and Klink et al. (48), that highlighted that persons with lower educational qualification are more likely to consume red meat than those with higher qualifications.

Alcohol intake raises the risk of breast cancer through hormonal changes, acetaldehyde formation, oxidative stress (49), decreased nutritional absorption, immune system suppression (50), and interactions with other risk factors (51, 52). The results exhibited highest consumption of alcohol among the graduates and least among the participants with secondary school qualification (Figure 3). This could be attributable to their enhanced purchasing power, among other things, as evidenced by the employment rate of graduate participants, which was 98.14%, higher than the 51.09%, 0.00%, and 0.00% of postgraduates, undergraduates, and secondary level participants, respectively. Likewise, higher degrees of education may result in higher alcohol use in social and professional situations which exposes people to a variety of social circles that can influence their drinking habits (53).

Smoking is associated with an increased risk of breast cancer, it can change hormone levels, especially oestrogen, disrupting the natural hormonal balance and contributing to the development of breast cancer (54–56). Participants with secondary qualification had the highest level of smoking while the undergraduates and graduates had the least smoking level. This could be as a result of peer pressure, the drive to explore new things, utilization of smoking as a coping mechanisms and lower exposure to anti-smoking efforts and health education initiatives. Individuals may be exposed to anti-smoking efforts and health education initiatives through higher education, which may reduce smoking rates. These findings are consistent with the findings of Adeloye et al. (57),, who showed an overall drop in the level of active smoking in Nigeria, particularly among females.

Physical inactivity has been related to an increased risk of a variety of health problems, including breast cancer (58, 59), through various mechanisms such as hormonal changes, body weight and fat distribution, insulin sensitivity (60, 61), inflammation, immunological function, and biomarker changes (62, 63). Regular exercise lowers circulating oestrogen, a hormone important in the development of breast cancer (64). The American Cancer Society suggests 150 minutes per week of moderate-intensity exercise or 75 minutes per week of vigorous-intensity exercise, as well as muscle-strengthening activities (65). In Nigeria, physical inactivity related deaths have increased by 29% amongst females (66). The results showed that the physical inactivity levels were highest among the undergraduates. This is not agreement with the findings of Adeloye et al. (59), which highlighted that physical inactivity levels are higher among more educated persons. However, the findings of Awotidebe et al. (67), on the decrease in physical inactivity with education levels were consistent with this study.

Antibiotics may raise the risk of breast cancer owing to a variety of causes. These include changes to the immune system, disturbance of the gut flora (68), influence inflammatory reactions and oxidative stress which is critical for overall health (69) The intake of antibiotics across various levels of education was highest among the graduates and least among the secondary level participants. Graduates may have better access to healthcare services, higher health knowledge, and a more proactive approach to obtaining medical care. They may also have more interactions with healthcare experts, increasing their chances of receiving antibiotic prescriptions (70). Higher educational qualifications may also provide more finances to pay for healthcare services and prescriptions (71).

Carbonated drinks, due to their high sugar content, may indirectly increase the risk of breast cancer. Its excessive consumption can lead to insulin resistance and inflammation (72). The results of the study revealed that the undergraduates

consumed carbonated drinks the most and the postgraduates the least (Figure 4B). There was an inverse relationship between the consumption of carbonated drinks and level of education which is similar to the reports by Okop et al. (73). This was replicated in the results of this study as the undergraduates had the highest carbonated drinks consumption. These dietary choices are influenced by social and peer influences, with undergraduates being more social and peer-oriented, whereas postgraduates may have a different social background or lifestyle (74–76) and stress levels can lead to a desire for comfort foods and beverages (77).

The rapid urbanization in Nigeria grossly affects the level of physical activity, lifestyle and food choices. These makes the consumption of certain healthy and highly beneficial foods to go distinct whilst less healthy, junks and fatty foods takes predominance (66). Red wine, fruits and vegetables are associated with decreased breast cancer risk. Red wine contains resveratrol, a potent anti-carcinogenic phytochemical which reduces breast cancer risk (78). Also, fruits and vegetables contains antioxidants, vitamins, minerals, phytochemicals and fibre (42). These substances boast the immune system and maintains the redox homeostasis, preventing oxidative stress, inflammation and cancer (52). The consumption of red wine, fruits and vegetables was highest among the secondary level participants, compared to other levels of education. In both cases, there were least among the undergraduates. These results are in agreement with the findings of Okop et al. (73). Therefore, a tailored intervention on nutrition education is highly required as reported by Bundala et al. (79). Family history of breast cancer increases a persons chance of having the disease. It involves inheriting a mutation in key breast cancer genes such as BRCA1, BRCA2 etc, which increases breast cancer risk (80, 81), although more education frequently leads to better access to healthcare resources and tests. The family history levels across various levels of education (Figure 4) was highest among the postgraduates and least among the secondary level participants. This could be as a result of increased health consciousness and awareness, and those with higher educational qualifications may be more proactive in controlling their health.

5 Conclusion

The research findings highlight significant gaps in knowledge regarding breast cancer risks among participants at different educational levels. Specifically, secondary level participants exhibited the least awareness of the effects of smoking and physical inactivity, which corresponded to their lifestyle choices marked by high smoking and low physical activity levels. Undergraduates demonstrated limited understanding of the impact of carbonated drinks consumption on breast cancer risks, reflected in their high intake of such beverages. Similarly, graduate-level participants lacked awareness regarding breast cancer risks associated with antibiotics, alcohol, and red meat/smoked foods, leading to dietary patterns characterized by elevated consumption of these items. Interestingly, postgraduate participants showed the highest knowledge level regarding the risks of red meat/smoked food consumption, yet this knowledge did not translate into healthier dietary habits. Therefore, there is a pressing need for targeted educational interventions aimed

at enhancing awareness of breast cancer risks across all educational levels, coupled with strategies to bridge the gap between knowledge and behavior to promote healthier lifestyle choices and reduce breast cancer incidence.

6 Recommendation

This study proposes that future research should look into the factors that influence differences in knowledge and behavior about breast cancer risks across educational levels in Nigeria. Qualitative research approaches, such as interviews and focus group discussions, could be utilized to better understand the reasons for various lifestyle and nutritional patterns. A geographically diversified sample, including females from other states or rural areas, would provide a more comprehensive understanding of the impact of cultural, economic, and social variables on BC risk behaviors. Longitudinal studies could look into the long-term effects of educational interventions on lifestyle and nutritional changes.

The findings of this study highlights the importance of customized health promotion efforts suited to different educational levels. These could include raising breast cancer awareness in schools, encouraging frequent screenings and early detection, and integrating community-based programs. Collaboration among government, educational institutions, and healthcare providers is critical for developing long-term interventions that promote healthy lifestyle choices and lower the incidence and mortality rate of breast cancer in Nigeria.

7 Ethical consideration

The research team obtained approval from the management of Covenant University to carry out the study. Applications were also made to the participating institutions for their approval to carry out the study. The study was devoid of activities that poses risk or harm to human life and property. The study team utilized the standard research ethics covering informed consent, anonymity of the respondents and their willingness to participate.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Covenant University Health Research Ethics Committee (CHREC) with the number CU/HREC/EME/204/23. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

ME: Formal analysis, Funding acquisition, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. IA: Conceptualization, Formal analysis, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review & editing. SC: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fonc.2024.1456080/full#supplementary-material

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The top 100 papers on prostate cancer-associated exosomes on social media: an altmetric study from the MENA region

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Purpose: This altmetric analysis aimed to identify and describe the top 100 papers on prostate cancer-associated exosomes in the Middle East and North Africa (MENA) region cited on social media.

Design/methodology/approach: As an applied study with an altmetric approach, this research included all Science Citation Index (SCI) Expanded indexed papers on prostate cancer-associated exosomes in the MENA region during 1970–2023. Altmetric Attention Scores (AASs) were extracted from the Altmetric Explorer, and Excel and SPSS were used for data analysis.

Finding: Twitter ranked first in mentioning 73.55 of the top 100 studied papers. The highest score of mentions on Twitter equaled 187, and that of AAS was 516, which belonged to an original research article. However, the top paper in citation counts was a guideline (AAS = 116; citation count = 5,664 =). The *Journal of Urology* published most papers (n = 21), with total AAS = 1,094. Most papers were international collaborations (n = 82). There was no significant relationship between the AASs of papers and those of Web of Science (WoS) citation counts (R^2 = 0.1284, p-value = 0.2054).

Practical implications: Showing a broad perspective on the research priorities and new directions in prostate cancer-associated exosomes, this study can be a guideline for finding main papers on diagnosing, treating, and preventing prostate cancer. It helps researchers, professionals, and policymakers in developing the use of social media in disseminating related information.

Originality: By providing helpful information on prostate cancer-associated exosomes, this study can inform researchers and administrators of the state of research on the topic and consequent health promotion among the public.

Introduction

Prostate cancer is the second most common cancer diagnosed among men and the fifth cause of mortalities worldwide (1). It is most common among old men (2); 1.41 million new cases of prostate cancer have been diagnosed in the world (3). It badly affects the lives of old men (4). This causes individuals to highly consider its monitoring and studies to deeply study the ways and procedures of its treatment (5).

The mortality caused by prostate cancer is heavily associated with age and is common in men who are more than 65 years old, and there is no evidence of its prevention procedures (1). In many cases, its treatment is difficult due to delayed diagnosis and speedy metastasis (6). In many cases, the cancer resists treatment with androgens and progresses to metastatic castration-resistant prostate cancer (mCRPC) (7). An effective treatment needs some biological signs predicting mCRPC that support individual treatments (8). Some quantitative measures have been developed for monitoring advanced prostate cancer (9). Exosomes are extracellular vesicles that can be used as a new tool in different treatment protocols (10) and act as biological signs for the prognosis, diagnosis, and treatment of prostate cancer (11). In the past decade, studies on the topic have increased.

Nowadays, most medical journals tend to increase their visibility and accessibility and consequently increase their audiences using social media (12). This invisible academy has heavily affected the ways of disseminating scientific research (13), mainly via Web 2.0 or the social web, making an interactive and communicable environment (14). Considering the communicative and social nature of science, most researchers use social media, blogs, warehouses, and sharing platforms for accessing scientific information. Altmetrics is a scientific field that traces back the social effects and impact of scientific research on social media (15–17).

Regardless of some systematic reviews on exosomes (18–20) and studies on the relationship between exosomes and cancers (19, 21) as well as a bibliometric/altmetric study on the global research output of lutetium-177 PSMA in prostate cancer (22) and the global status of research in prostate cancer bone metastasis (23), there is no altmetric study on prostate cancer-associated exosomes (24). As altmetric studies can provide a broad perspective on studies in the field, this altmetric study aimed at identifying and describing the top 100 highly cited papers on prostate cancer-associated exosomes in the Middle East and North Africa (MENA) countries. This study can identify research priorities and future directions in the field and results in playing a role in prostate cancer diagnosis, treatment, prevention, and clinical guidelines.

Methods

This cross-sectional study included all papers published on prostate cancer-associated exosomes in the MENA region from 1970 to December 2023. MENA countries include the Middle East and North Africa. The reason for selecting the scientific products of these countries for analysis was that in MENA countries, prostate cancer incidence and prevalence rates increased during 1990–2019

(25). In addition, in 2020, the Middle East documented an estimated 51,649 new prostate cancer diagnoses, accounting for 3.7% of global cases (26). Therefore, prostate cancer incidence in the MENA is steadily increasing, which may be explained by acculturation and lifestyle modifications (27). For these and other reasons, it was necessary to examine the characteristics of the scientific productions of these countries in the field of prostate cancer, which have received much attention.

Therefore, the following search syntax was used in Science Citation Index Expanded:

Results for (((((((((TS=(("exosom*" OR "exosc*"))) NOT TS=(("exoscreen" OR "exoscop*" OR "exosca*"))) AND TS=(("prostat*" NEAR/1 "cancer*"))) OR TS=(("prostat*" NEAR/1 "tumor*"))) OR TS=(("prostat*" NEAR/1 "tumor*"))) OR TS=(("prostat*" NEAR/1 "oncology"))) OR TS=(("prostat*" NEAR/1 "neoplasm*"))) OR TS=(("prostat*" NEAR/1 "carcinoma*"))) OR TS=(("prostat*" NEAR/1 "adenocarcinoma*"))) OR TS=(("prostat*" NEAR/1 "adenocarcinoma*")) and ALGERIA or EGYPT or IRAN or IRAQ or ISRAEL or JORDAN or KUWAIT or LEBANON or LIBYA or MOROCCO or OMAN or QATAR or SAUDI ARABIA or SYRIA or TUNISIA or TURKEY or TURKIYE or U ARAB EMIRATES or YEMEN (Countries/Regions) and Retraction (Exclude – Document Types).

After excluding one extracted paper, 1,281 papers with DOIs were analyzed out of all 1,561 retrieved papers. Out of papers with DOIs, only 592 papers (46%) had an Altmetric score and were mentioned at least one time on social media. Then, based on recent studies such as (28–31), 100 papers with the highest altmetric scores were selected for further analysis. Thus, all papers were then sorted from the highest to lowest altmetric score. Finally, the top 100 papers with higher Altmetric Attention Scores (AASs) were extracted from the Altmetric Explorer, and their bibliometric/altmetric indicators were examined. Therefore, the top 100 articles were based on the altmetric score.

The following indicators were extracted for mention counts: news mentions, blog mentions, policy mentions, Twitter mentions, Facebook mentions, Wikipedia mentions, Reddit mentions, Mendeley readers, Google+ mentions, F1000 mentions, Patent mentions, and the number of Dimensions citations.

Altmetrics was created in 2011 by Euran Adie with the support of Digital Science (32). Altmetrics studies social attention originating from social media, including Twitter, Facebook, Google+, Pinterest, traditional blogs, online references, Mendeley, and CiteULike. With a special algorithm, the AAS of a paper is measured based on the number of its mentions on social media (17, 33, 34).

Actually, for each different indicator, AAS uses a different weight (Table 1) (28).

The more the AAS of a paper is, the higher its social influence. Different colors reflect different sources for more visibility. Some main publishers (such as Elsevier, Springer, Nature Publishing Group, Taylor & Francis Group, and Biomed Central) as well as free access publishers (such as F1000, PLOS, and PeerJ have accepted altmetrics (35). Altmetrics has some priorities over citation-based indicators due to its wide scope, variety, speediness, and open accessibility (36). In spite of citation-based measures that focus on scientific performance in a controlled

TABLE 1 Altmetric attention score weight.

Data	Weight
News	8
Blog	5
Policy document (per source)	
Patent	3
Wikipedia	
Peer review (Publons and PubPeer)	
Weibo	
Google +	1
F1000	
Open Syllabus	
LinkedIn	0.5
Twitter	
Facebook	
Reddit	
Pinterest	0.25
Q&A	
YouTube	

TABLE 2 Characteristics and components of the top 100 prostate cancer-associated exosome articles by AAS.

Characteristics	Values
Altmetric score, median (range)	18 (8–516)
Traditional citation, median (range)	28.5 (0–5,664)
News mentions, n (range)	336 (0–103)
Blog mentions, n (range)	47 (0–6)
Policy mentions, n (range)	21 (0–3)
Twitter mentions, n (range)	2,203 (0–187)
Facebook mentions, n (range)	39 (0–6)
Wikipedia mentions, n (range)	50 (0–21)
Reddit mentions, n (range)	2 (0–1)
F1000 mentions, n (range)	6 (0–2)
Patent mentions, n (range)	193 (0–28)
Google+ mentions, n (range)	98 (0–92)
Mendeley readers, n (range)	15,309 (1–5,000)
Dimensions citations, n (range)	17,670 (0–6,733)
Article types, n (%)	
Original	74 (74)
Review	24 (24)
Guidelines	2 (2)
Study design of original articles (n = 74), n (%)	
In vitro or in *In vivo*	23 (33)
Cross-sectional	12 (16)
Cohort study	11 (15)
Case–control	10 (13)
Clinical trial	7 (9)
Comparative study	3 (4)
Diagnostic tests	3 (4)
Randomized controlled trial	3 (4)
Bibliometric study	1 (1)
Ecologic	1 (1)

AAS, Altmetric Attention Score.

academic environment, altmetrics measures scientific performance based on the formal and/or informal use of scientific papers in all social media (37).

Based on the affiliations, authors' countries of origin were identified. If the authors were from more than one country, their papers were conceived as international collaborations. After all, the relationship between the citation rate in Science Citation Index (SCI) Expanded and AAS in the Altmetric Explorer was measured for the top 100 papers by applying Spearman's correlational test.

Statistical analyses were performed using the Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, Version 23.0; IBM Corp., Armonk, NY, USA). p-Values less than 0.05 were considered statistically significant. A simple correlation analysis was used to visualize the relationship between AAS and Total Citation (TC). Spearman's correlation coefficient was used to verify the correlation between AAS and TC. Sensitivity analyses were considered according to the publication years.

Results

Table 2 shows the altmetric indicators, paper types, and study designs of original articles among the top 100 papers on prostate cancer-associated exosomes in MENA countries. Forty-six papers were open-access, and 74, 24, and 2 papers were original research, reviews, and guidelines, respectively. The top three study designs of original research articles were *in vitro*/*in vivo* (34 papers), cross-sectional (16 papers), and cohort study (15 papers). Out of 2,995

social media platforms for these papers, Twitter ranked first with 73.55% (2,203/2,995) mentions. The top highly mentioned paper on Twitter (n = 187) was entitled "Anticancer and apoptosis-inducing effects of quercetin *in vitro* and *in vivo*". The top ASS paper (n = 516) was original research entitled "A randomized trial of partial gland ablation with vascular targeted phototherapy versus active surveillance for low risk prostate cancer: extended follow-up and analyses of effectiveness" (38). However, the top highly cited paper was a guideline published in 2018 for updating MISEV2014 instructions (ASS = 116; citation count = 5,664). The mean ASS and mean citation rate were 18 and 28.5, respectively. A guideline

entitled "Minimal information for studies of extracellular vesicles 2018 (MISEV2018): a position statement of the International Society for Extracellular Vesicles and update of the MISEV2014 guidelines" with more than 300 authors had the highest Mendeley score (n = 5,000 =). This paper was the top-ranked paper in Dimensions citation and Web of Science (WoS) citation counts (n = 6,733 =).

The studied papers were published in 67 journals; most of them were urology journals. Table 3 shows the top 10 sources in publishing the top 100 high AAS papers. The *Journal of Urology* published the most papers (n = 21) with total AAS = 1,094. These papers were mentioned mostly in news (n = 144), blogs (n = 7), and policy (n = 7).

Table 4 shows the most productive countries in publishing the top 100 papers. Most papers were published internationally (n = 82), followed by Israel (n = 10) and Turkey (N = 4).

Table 5 shows some altmetric indicators of the top 10 papers in AASs among the top 100 highly mentioned ones. The first-ranked paper (AAS = 516) was entitled "Randomized trial of Partial Gland Ablation with Vascular Targeted Phototherapy versus Active Surveillance for Low Risk Prostate Cancer: Extended follow-up and analyses of effectiveness". It was published in 2018 in the *Journal of Urology* and mentioned in news outlets = 103. It was twitted 13 times, blogged once, and read 101 times in Mendeley. The second and third ranks belonged to the papers entitled "Dissecting the association between Metabolic Syndrome and Prostate Cancer" (AAS = 393) and "Liposome-mediated delivery of the p21 activated kinase-1 (PAK-1) inhibitor IPA-3 limits prostate tumor growth *in vivo*", respectively (ASS = 202).

Table 6 shows descriptive statistics related to AAS and TC.

Table 7 shows that due to the significant probability values being less than 0.05, the normality of the distribution of AAS and TC data was not accepted. Therefore, Spearman's rank correlation was used to examine the relationship between these two variables.

Figure 1 shows the correlational matrix of the relationship between AASs and WoS citation counts in the studied papers. There was no significant relationship in this regard (R^2 = 0.1284, p-value = 0.2054).

Simple correlation between AAS and TC

The scatter plot depicting AAS in TC is presented in Figure 2. Notably, the R^2 was 0.013. Spearman's correlation coefficient was employed to assess the relationship between AAS and TC. It is important to emphasize that correlation does not equate to causation; a strong correlation between two variables does not necessarily indicate that one causes the other. There could be a third variable affecting both.

Correlation between AAS and TC according to the year of publication

To provide a more comprehensive analysis of the relationship between AAS and TC, we applied sensitivity analysis by year of publication. Sensitivity analysis showed that the year of publication was the important and influential correlation between AAS and TC. The highest R^2 was observed for years before 2010 (Figure 3).

Discussion

Prostate cancer is one of the most common cancers among men worldwide (37), and expanding knowledge of its mechanisms sets a context for diagnosing invasive tumors and developing treatment procedures (22). Recent studies have shown that increasing

TABLE 3 The top 10 journals in the publication of 100 articles with the highest AAS in the field of prostate cancer-associated exosomes.

Journal	NP*	Altmetric Attention Score	Citation count	Article types (n)	Dimensions citations
The Journal of Urology	21	1,094	1,186	Original (18), review (3)	1,428
European Urology	6	551	68	Original (5), review (1)	790
British Journal of Urology	3	43	241	Original (3)	284
Cancer Research	2	19	228	Original (2)	233
International Journal of Cancer	2	18	178	Original (2)	192
International Journal of Molecular Sciences	2	214	23	Review (2)	27
Urologic Oncology	2	17	4	Original (2)	4
World Journal of Urology	2	32	39	Review (2)	33
ACS Chemical Biology	1	18	13	Original (1)	13
ACS Nano	1	32	366	Review (1)	383

AAS, Altmetric Attention Score.
*Number of publications.

TABLE 4 Top 100 articles with the highest Altmetric Attention Scores according to country of origin.

Country	Articles, n
Israel	10
Turkey	4
Iran	2
Beirut	1
Saudi Arabia	1
International collaboration	82
Total	100

exosome levels in prostate cancer cells increases disease progress as well as being a treatment target (39–41). Exosomes are nano-sized molecules with different biological roles in prostate cancer. Capsulated molecules of exosomes are potential signs of prostate cancer diagnosis and can be helpful procedures in therapeutic interventions during disease monitoring and treatment. The high resistance and high biological consistency of exosomes reflect their potential of being drug therapy and prospective tools for prostate cancer diagnosis and treatment (40).

In studying the effect of exosomes on prostate cancer, altmetric indicators can be helpful as new tools for measuring the impact of and access to related publications. These indicators reflect the extent

to which scientific research interacts within digital platforms and online social media. Altmetric indicators allow for a more realistic assessment of the importance of scientific productions among the general public as well as research communities.

This study found that the top 100 papers on prostate cancer-associated exosomes in MENA countries had AASs between 8 and 516 with a median rate of 18. It indicates readers' and researchers' relatively high attention to the papers on the field of social media. This can be a sign of some evolution in diagnosis and treatment procedures. Online social media draws immediate attention to a paper rather than citations that need a long process (42).

Out of these top papers, the first and second ranks belonged to original studies (n = 74) and review articles, respectively (n = 24). The finding is in line with that of two previous studies (43, 44).

The highest mentions belonged to Twitter as found in a previous study (44). The highest AAS belonged to original research (n = 516), and the highest citation belonged to a guideline (n = 5,664). A paper with the most authors had the highest Mendeley score, and the paper with the highest Dimensions citation counts was the guideline with the highest Mendeley score and the highest WoS citation counts. It can be argued that online media, especially Twitter and Mendeley, are powerful tools for analyzing altmetric data (45, 46).

Most studied papers were published in urology journals, with the *Journal of Urology* at the top with papers having the higher AASs. The papers of this journal highly considered prostate cancer-associated exosomes in news, blogs, and policy. However, the

TABLE 5 Top 10 articles with the highest Altmetric Attention Scores.

Rank	AAS	Title/PD	Journal	News	X	Blog	Mendeley
1	516	Randomized Trial of Partial Gland Ablation with Vascular Targeted Phototherapy versus Active Surveillance for Low Risk Prostate Cancer: Extended Follow up and Analyses of Effectiveness/2018	*The Journal of Urology*	103	13	1	101
2	393	Dissecting the Association Between Metabolic Syndrome and Prostate Cancer Risk: Analysis of a Large Clinical Cohort/2015	*European Urology*	49	6	0	96
3	202	Liposome-mediated delivery of the p21 activated kinase-1 (PAK-1) inhibitor IPA-3 limits prostate tumor growth *in vivo*/2016	*Nanomedicine: Nanotechnology, Biology and Medicine*	25	3	3	23
4	192	The Role of Epac in Cancer Progression/2020	*International Journal of Molecular Sciences*	25	2	0	28
5	143	An evidence based review of proton beam therapy: The report of ASTRO's emerging technology committee/2012	*Radiotherapy & Oncology*	11	24	5	249
6	116	Minimal information for studies of extracellular vesicles 2018 (MISEV2018): a position statement of the International Society for Extracellular Vesicles and update of the MISEV2014 guidelines/2018	*Journal of Extracellular Vesicles*	2	181	2	5,000
7	102	Inhibitory Effects of Rosemary Extracts, Carnosic Acid and Rosmarinic Acid on the Growth of Various Human Cancer Cell Lines/2010	*Plant Foods for Human Nutrition*	1	2	0	226
8	80	Clinical Validation of IsoPSA^{TM}, a Single Parameter, Structure Based Assay for Improved Detection of High Grade Prostate Cancer/2019	*The Journal of Urology*	10	18	0	38
9	76	The Proteome of Primary Prostate Cancer/2016	*European Urology*	10	5	0	168
10	70	Continuous enzalutamide after progression of metastatic castration-resistant prostate cancer treated with docetaxel (PRESIDE): an international, randomised, phase 3b study/2022	*Lancet Oncology*	3	89	3	23

AAS, Altmetric Attention Score; PD, publication date.

TABLE 6 Descriptive statistics of AAS and TC.

			Statistic— AAS	Std. error—AAS	Statistic— TC	Std. error—TC
AAS	Mean		39.4242	7.01183	160.1010	
	95% confidence interval for mean	Lower bound	25.5095	40.2659		
		Upper bound	53.3390	279.9361		
	5% trimmed mean		27.2116		67.9074	
	Median		18.0000		29.0000	
	Variance		4,867.410		361,006.704	
	Std. deviation		69.76683		600.83833	
	Minimum		8.00		0.00	
	Maximum		516.00		5,664.00	
	Range		508.00		5,664.00	
	Interquartile range		30.00		101.00	
	Skewness		4.942	0.243	8.162	0.243
	Kurtosis		28.347	0.481	73.588	0.481

AAS, Altmetric Attention Score.

Journal of Nuclear Medicine was at the top in studying the global research output of lutetium-177 PSMA in prostate cancer (22).

Most papers were internationally authored collaborations. In a study on the global research output of lutetium-177 PSMA in prostate cancer (22) and a study on the correlation between AAS and citation in the urological cancer literature (44), Germany was the first-ranked country in publishing the related papers. The USA was the first-ranked collaborating country in prostate cancer-associated exosomes, followed by China and Italy (5).

Other results regarding Spearman's correlation test in examining the relationship between altmetric scores and Web of Science citations showed that there is a weak linear relationship between altmetric scores and citations that is not significant. Despite the results of some studies (22, 44, 47), there was no significant relationship between AASs and WoS citation counts of the papers. It is important to emphasize that correlation does not equate to causation; a strong correlation between two variables does not necessarily indicate that one causes the other. There could be a third variable affecting both.

The results of the study by So WZ et al., which examined the correlation between traditional measures and social media in the field of urology, showed that there was a very strong correlation between all three traditional measures and alternative social

TABLE 7 Tests of normality.

	Kolmogorov−Smirnov[a]			Shapiro−Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
AAS	0.326	99	0.000	0.438	99	0.000
TC	0.395	99	0.000	0.236	99	0.000

AAS, Altmetric Attention Score.

measures (rs = 0.714 to 0.821), which is inconsistent with the results of the present study (48). Some studies have reported the same results in other medical fields (47, 49, 50). The results of this study, like those of Nocera et al., show that altmetrics alone may not be a sufficient surrogate for article citations (50).

The results of the study by O'Connor EM et al. in the *Journal of Urology* showed that there was a weak positive correlation between citations and altmetric score (rs = 0.35, 95% confidence interval 0.16–0.52, p < 0.001) (51).

To provide a more comprehensive analysis of the relationship between AAS and TC, we applied sensitivity analysis based on the year of publication. The sensitivity analysis showed that the year of publication was the important and influential correlation between AAS and TC. The highest R^2 was also observed for the years before 2010.

The top articles based on altmetric scores were not highly cited, suggesting that publications receiving the most media attention may not be the most scientifically rigorous or that this audience places greater value on different subjects than the scientific community.

Considering the insignificant relationship between altmetric scores and citation counts, it can be said that social interactions and scientific communications can pass in different ways. Continuous citation counts as a sign of scientific prestige need several years, but sharing papers on social media creates an immediate impact and updated evaluation made by the public and social communities (50).

In fact, citations, which are often made in scientific journals and by the academic community, indicate the scientific impact and credibility of an article. In contrast, altmetric scores, which come from interactions on social networks, blogs, and other online platforms, focus more on public and social attention. It should be noted, however, that articles that cover popular or controversial

FIGURE 1
Relationship between citations (in SCI-Expanded) and Altmetric Attention Scores (AASs) for top 100 papers. SCI-Expanded, Science Citation Index (SCI) Expanded.
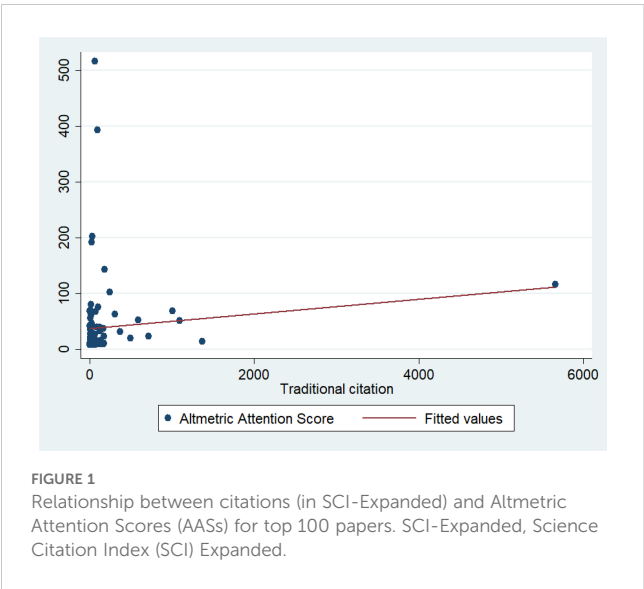
topics may receive more attention on social networks, even if they have fewer scientific citations. However, articles that have high citations may receive less attention on social networks due to their specialized nature. Therefore, altmetrics and bibliometrics can complete each other for better research evaluation and scientific policymaking.

Of course, it can be said that the lack of a direct relationship between altmetric scores and traditional citation metrics can be due to several reasons: traditional citation metrics are usually calculated based on scientific articles and their citations in scientific journals. In contrast, altmetric metrics include a wider range of data, including social interactions, mentions on blogs, social networks, and other online platforms, which may not be directly related to the scientific quality of the article. Also, citations usually take longer to collect and analyze and are formed over time, but altmetrics can be collected

quickly and in real time, which can lead to large fluctuations in results.

The content of studies in different fields also affects the number of citations and altmetric scores received; some scientific fields may receive more public attention than others and receive higher altmetric scores and fewer citations. However, traditional citation indicators are usually accepted as a measure of scientific quality and impact, while altmetrics may be influenced by factors such as advertising or ephemeral trends and do not necessarily indicate scientific quality.

Given the lack of a relationship between altmetric scores and citation rate in the present study, altmetric indicators can be used as a complement to scientometric indicators and not as a substitute in research evaluation and scientific impact calculation. However, it should be noted that altmetrics alone may not be a sufficient substitute for citations to an article. Because citation indicators are still considered a valid and fundamental tool for evaluating research and validating the results of researchers, researchers and policymakers should consider both bibliometric and altmetric approaches to more fully understand the impact of scientific documents and use them in decisions related to scientific and research policies.

Implications

Bibliometric and altmetric studies in the MENA region are of particular importance in terms of analyzing research trends. These analyses are influential in the decision-making of policymakers in the countries of this region in the field of creating the necessary infrastructure for the development of scientific research. However, they lead to the identification of emerging research areas in these countries that are seeking scientific and technological development. Also, these studies in the MENA region can identify the weaknesses

FIGURE 2
The correlation between AAS and TC for top 100 papers. AAS, Altmetric Attention Score.
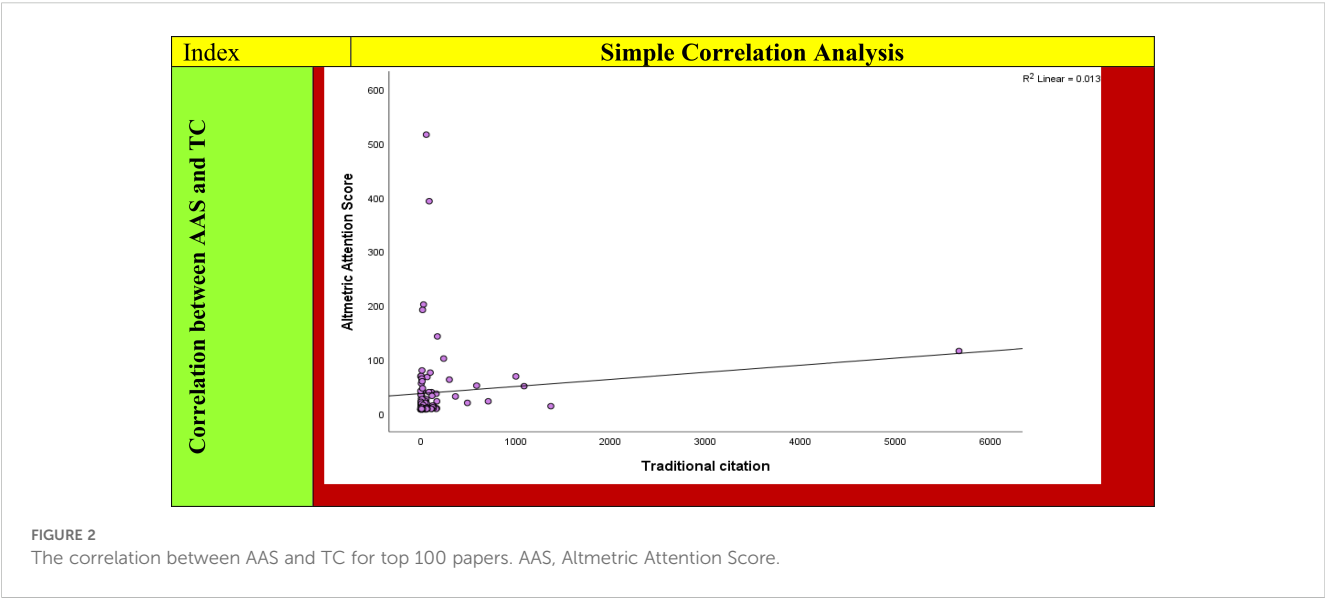
FIGURE 3
Sensitivity analysis of the input variables (AAS and TC) by year of publication. **(A)** The correlation between AAS and TC before years before 2010.
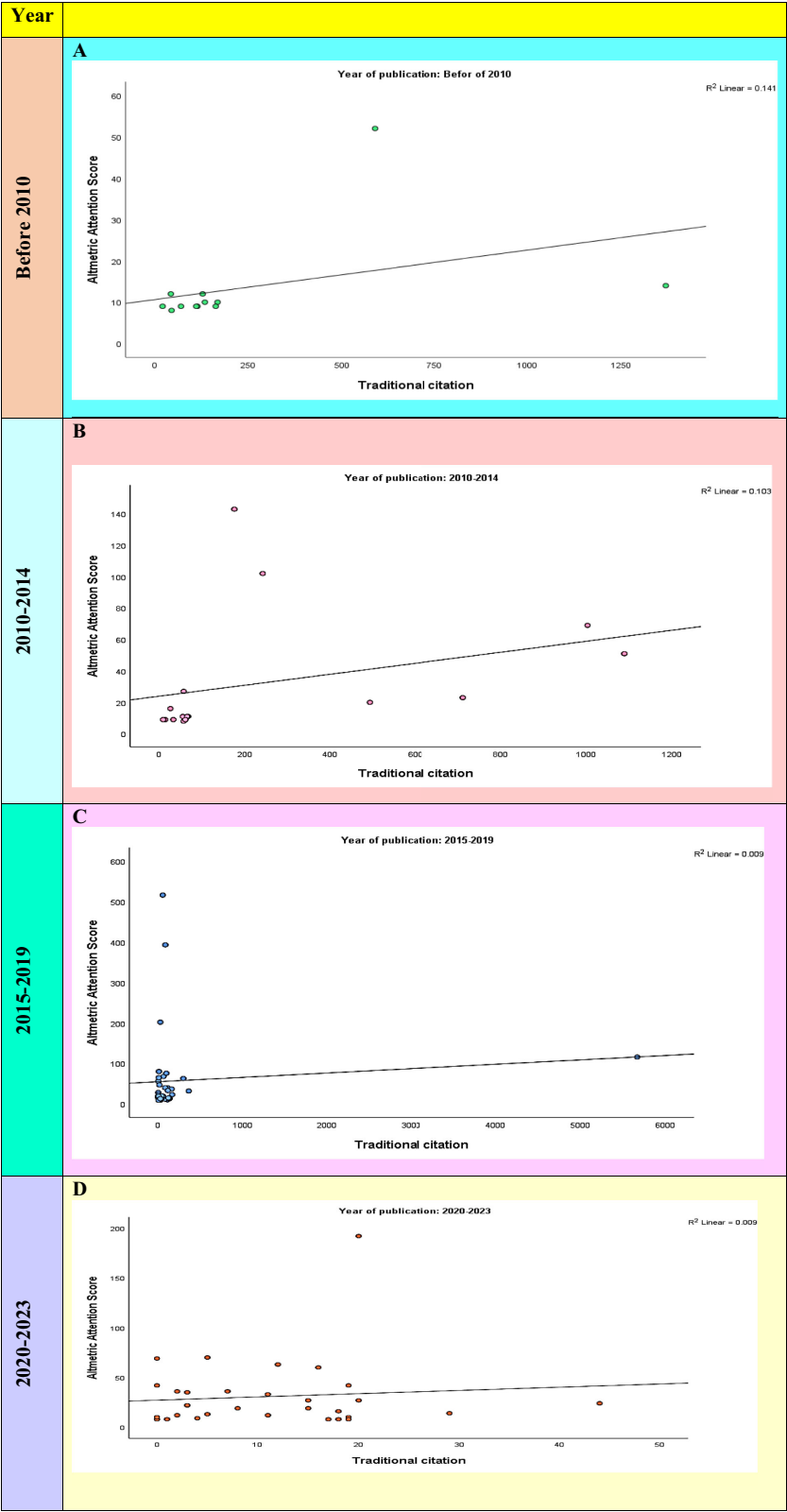**(B)** The correlation between AAS and TC during the years 2010–2014. **(C)** The correlation between AAS and TC during the years 2015–2019.
(D) The correlation between AAS and TC during the years 2020 to 2023.

and strengths of international cooperation and the exchange of knowledge and experiences.

Therefore, in general, it can be said that bibliometric and altmetric studies are important tools for evaluating and improving the scientific and research situation in the MENA region countries and can contribute to the sustainable development and scientific progress of these countries.

However, it should be noted that altmetrics, while providing valuable insights, has several potential limitations:

1. Variability in data sources: Altmetrics relies on various online platforms (e.g., Twitter, Facebook, blogs, and news sites), which can lead to inconsistencies in data collection and interpretation. Not all platforms may be equally relevant or reliable for academic impact.
2. Susceptibility to manipulation: The nature of online engagement means that altmetrics can be influenced by deliberate efforts to boost visibility or by artificial means (e.g., bots).
3. Contextual factors: Altmetrics do not always capture the context of engagement. For example, a high number of tweets may not equate to meaningful academic impact or quality.
4. Short-term focus: Altmetrics often reflect immediate reactions and trends rather than long-term impact. A paper may receive much attention shortly after publication but lose relevance over time.
5. Disciplinary differences: Different fields of study engage with online platforms to varying degrees. For instance, social sciences may generate more altmetric activity than mathematics or engineering, leading to biases in the assessment of impact across disciplines.

However, it should be noted that while altmetrics provides valuable insights, it has several potential limitations that can be overcome by using them alongside traditional metrics.

Limitations

Despite a relatively comprehensive data analysis conducted in this altmetric study using related papers indexed in SCI-Expanded, it can be argued that SCI-Expanded includes high-quality scientific publications, and a search in one individual database may not result in a completed deduction. Main non-English papers may not be included due to the possibility of not covering all non-English studies. Comparative studies combined with extracting data from other related databases and other regions and countries can fill the gap.

Conclusions

Altmetrics is one of the approaches to evidence-based research. This study found that prostate cancer-associated exosome research

has been heavily cited on social media, reflecting its high potentiality in diagnostic and clinical studies. Using the altmetric approach to evaluating scientific research results in more accurate scientific research in medical fields. Therefore, online social media have a main role in facilitating and speeding up knowledge sharing in interdisciplinary interactions and international collaborations. Their role in public health can be achieved by informing the public and providing immediate information. Such studies can help science policymakers in evidence-based decision-making and improve people's life quality. In addition, altmetric indicators are complementary to traditional bibliometric indicators such as citation counts and facilitate instant access and immediate impact of scientific items. These indicators create new perspectives on scientific evaluation and knowledge impact by providing interactive digital data. Therefore, it is recommended that research and the scientific community consider both altmetric and bibliometric indicators to make scientific publications more accessible and visible. Altmetric studies can inform authors and interesting researchers of the hot topics in prostate cancer-associated exosomes and related subjects.

Data availability statement

Raw data was initially obtained from the Web of Science database. Secondary data was also obtained from Altmetric Explorer. However, Raw data and Secondary data supporting the findings of this study are available from the corresponding author AO on request.

Author contributions

NA: Writing – original draft, Writing – review & editing. FB: Data curation, Writing – review & editing. MM: Data curation, Writing – review & editing. RR: Software, Writing – review & editing. AO: Methodology, Project administration, Writing – original draft, Writing – review & editing, Software.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Spectrum of gynecologic malignancies in Northeastern Nigeria

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Background: The burden of female genital tract cancers in low—and middle-income countries (LIMC) is not yet well investigated. Although available studies are few, they are mainly based on single institutions. Here, four-year multi-institutional data on gynecologic cancers in northeastern Nigeria were examined to determine their distribution by age and subtype.

Patient and Methods: This is a cross-sectional descriptive study using available data on histologically diagnosed gynecologic cancers archived in the pathology departments and/or cancer registries of six tertiary hospitals in northeastern Nigeria over four years. Alongside tumor type (according to site), patient age and presenting complaints were also documented. Descriptive statistics were used to present categorical variables as proportions, while quantitative variables of age were presented as medians.

Results: A total of 863 gynecologic cancers were included in this study. The median age was 50 years (3 – 95 years) with a peak at 40 – 49 years. The uterine cervix was the most common site of cancer (66.6%, 575/863), while uterine corpus (15.5%, 134/863) and ovarian cancers (14.8%; 128/863) were nearly equal in proportion. Squamous cell cancer was the commonest histotype overall, while ovarian cancers had a preponderance of epithelial tumors in 67.9% (87/128) over sex cord stromal (12.5%; 16/128) and germ cell (9.4%, 12/128) tumors. The most common symptom was abnormal vaginal bleeding (38%) followed by abdominal swelling (21.1%) and foul-smelling vaginal discharge (14.1%). Population-based data also showed high parity among women in the region, ranging from 4 births to 7 births per woman in a reproductive lifetime (total fertility rate, TFR).

Conclusion: The spectrum of cancers of the female genital tract in this study mirrors the population demographics characterized by a high proportion of young women in their reproductive age. Efforts to reduce the burden of this disease are urgently warranted.

Introduction

Gynecological cancers (GC) are a significant public health concern globally. They affect the female reproductive system such as the vulva, vagina, cervix, uterus, fallopian tubes and ovaries. Recent global estimates report that about 1,473,427 new cases of GCs and 680,372 deaths occur annually [1]. Risk factors vary depending on the type of cancer, and despite advancements in prevention, diagnosis and treatment, metastasis and recurrence remain a significant challenge in the disease control effort. Hence, early detection through screening and awareness of symptoms is crucial for improved outcomes [2].

Africa has the highest burden of GC, specifically, East Africa, with an age-standardized incidence rate (ASIR) of 50 per 100,000 person-years compared to the global rate of 30.3 per 100,000 person-years [1]. Examining the component cancers reveals differences in predisposing factors. For example, cervical, vaginal and vulva cancers share in common an interplay between Human papillomavirus (HPV) infection and modifying lifestyle behaviors such as early age at sexual debut, multiple sexual partners, and cigarette smoking [3, 4]. Multiparity, dietary habits and exposure to talcum powder are factors significantly associated with ovarian cancer, while hormonal influence and genetic predispositions contribute to endometrial cancer [5–7]. These varying risk factors highlight the need for appropriate screening and diagnostic interventions at proper ages to prevent or treat the disease. Unfortunately, low- and middle-income countries (LMICs) continue to suffer from these cancers due to inadequate screening and treatment services in place to manage them.

GC affects women in diverse ways, either from the disease or its treatment. Changes in body image, sexual identity and perceived desirability, for instance, can strain social relations and ties [8]. Also, fertility and reproductive functioning can be compromised, raising worries for the patient [9]. These, in addition to the huge financial burden of care, can induce anxiety and depression in the patient [10]

To drive the needed policy towards reducing or eradicating the burden of GC in LMICs, credible epidemiological data reporting is pivotal. Nigeria, like other sub-Saharan African countries, is still grappling with a high burden of communicable diseases [11]. However, accumulating evidence shows that incidence of NCDs are on the rise, even though poorly documented [12]. Studies describing comprehensive aggregate national data on GC in the country are rare. Available data are single-institution based, often describing a single GC disease component [13–15]. This underscores the need for a study to collectively document these diseases on a regional and nationwide level for effective policy formulation and interventional strategies.

The present study used multi-institutional data on GC to determine the disease burden in northeastern Nigeria. It highlighted existing gaps and proposed remedies to address care disparities in the region. The findings are hoped to be relevant to further discussions on GC care approaches in the region and similar populations elsewhere.

Patients and methods

A review of available histopathological data on gynecological cancers diagnosed over 4 years (January 2019 – December 2022) in tertiary hospitals within northeastern Nigeria was conducted retrospectively. The zone has six states – Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe – with eight tertiary hospitals, Bauchi and Yobe having two each. Data retrieved included cancer organ or site, (uterine cervix, uterine corpus, fallopian tube, ovary, vagina, and vulva), patient age at diagnosis, and presenting complaints. All cases diagnosed within the study period were eligible for inclusion in the study, while all cases outside this range were excluded. Accrued data were reviewed by the pathologists in each of the contributing centers for conformity and reliability of information. When indicated, the histology slides were retrieved and examined using a light microscope to ascertain the proper classification of the cancer. Cases with doubtful classification and for which the slides were not available for review were further excluded. However, cases obtained from cancer registries were checked for accuracy of documentation as" cancer" and to ensure that they arose from the female reproductive tract. Otherwise, they were excluded.

Abbreviations: hrHPV, High risk Human papilloma virus; HPV, Human papilloma virus; HRT, Hormone replacement therapy; HDI, Human development index; FIGO, International Federation of Gynecology and Obstetrics (FIGO); GCT, Germ Cell tumors; CONSORT, Consolidated Standard of Reporting Trails; HIV - Human immunodeficiency virus.

The female population demographics for the geographical area were derived from the National Population Commission statistics report for 2020 (16). All required ethical and institutional approvals were obtained from the participating institutions. At the same time, the tumors were histologically classified based on the 5th Edition of the World Health Organization protocol on the classification of tumors of the female genital tracts (17). Fallopian tube cancers were classified together with ovarian cancers, as recommended by the International Federation of Gynecology and Obstetrics (FIGO) (18).

Patient data was deidentified before retrieval and analysis. Frequency statistics was used to categorize nominal and ordinal variables into proportions and percentages while the median age of patients was calculated using measures of central tendency (median) statistical tool. The results are presented as tables, figures and in textual formats.

Results

Population of interest demographics in the Northeast zone

Six tertiary hospitals from four states in the region provided data for this study (Supplementary 1). These hospitals include the University of Maiduguri Teaching Hospital Borno State, Yobe State University Teaching Hospital, Yobe State, Federal Medical Center Nguru, Yobe State, Federal Teaching Hospital Gombe State, Federal Medical Center Azare, Bauchi State, and Abubakar Tafawa Balewa University Teaching Hospital, Bauchi State. Together, they serve a

population of about 22 million people, females making up about 49.4%. The population distribution of the states from which data were drawn is shown in Supplementary 2. Two landmark age groups are displayed: 0 -49 years representing birth, early childhood and reproductive age groups; while 50 - 80+ years encompasses the period of fertility decline, menopause, and older age characterized by hormone replacement use, and upsurge in the risk for those malignancies that are dependent on hormone and genetics as risk factors. Illustrated in Supplementary 3 is the Total Fertility Rate (TFR) for the women throughout their expected fertility years and describes a decline from the year 2008 through to the period under review (2019 – 2022). Borno state had the most decline followed by Yobe state while Bauchi state had the least reduction in fertility rate.

Cancer data by sites, age and histological variants

A total of 863 histologically confirmed GC were eligible for inclusion in the study. Stepwise exclusion of ineligible cases is shown in the CONSORT flowchart in Supplementary 4. Figure 1 illustrates the age distribution of the patients. The median age was 50 years (range 3 – 95 years), with peak incidence in the 5th decade followed by a second peak in the 7th decade. Figure 2 shows the various median ages of occurrence for the different cancer sites. Cervical cancer occurred at a higher age compared to ovarian and uterine corpus cancers, while cancers of the vagina and vulva had the least median age.

Table 1 shows the proportions and percentages of the various cancers observed in the study period. Cervical cancer was the most
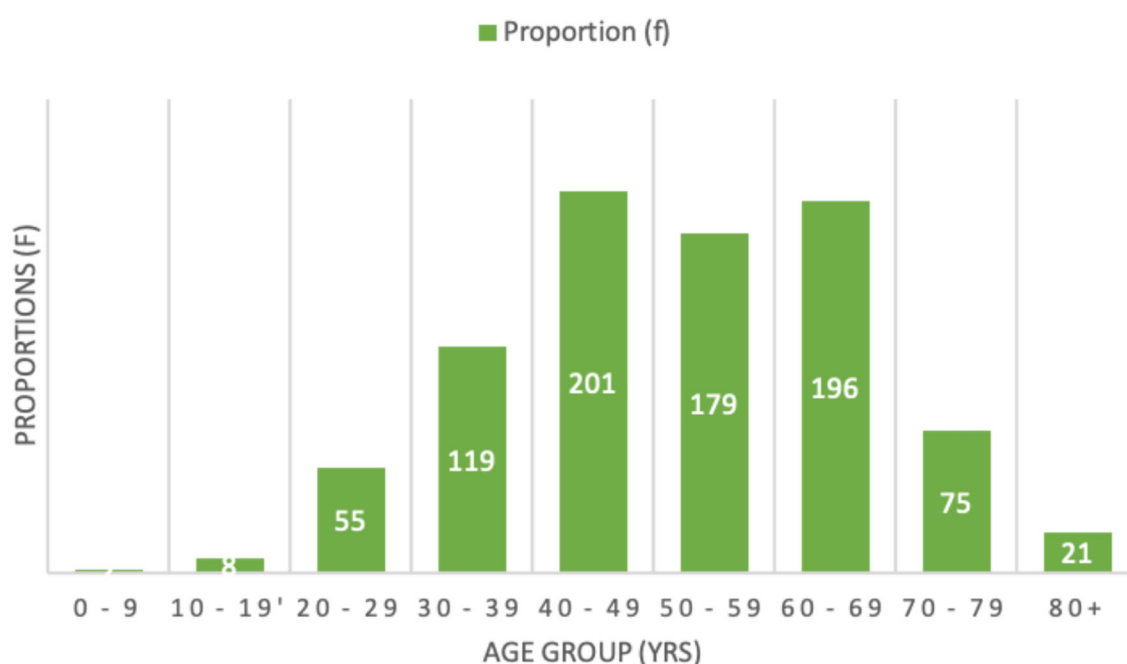

FIGURE 1
Bar charts showing the age group distribution in decades of the study population.
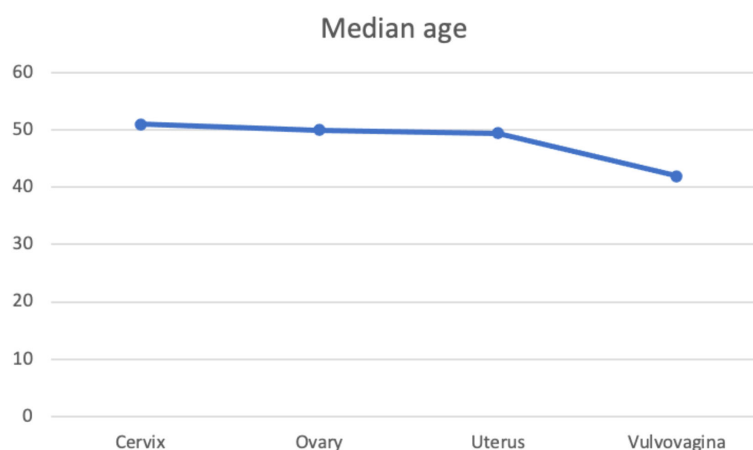
FIGURE 2
Line graph portraying the trend of median ages of patients by cancer site.

common, followed by uterine cancers. A remarkable proportion of malignancies that occurred in the cervix were conveniently described as "others", as they included not only rare tumors such as sarcomas, non-Hodgkin lymphomas, and adenoid cystic carcinoma but also because some were not outrightly classified at the time of data storage. Corpus uteri malignancies were more of endometrioid carcinoma, followed closely by choriocarcinoma. Cases of endometrial stromal sarcoma and metastatic carcinomas to the uterus were also observed. Other histological subtypes are as outlined in Table 1.

Ovarian cancers in this study ranked third among the female genital malignancies. One case of fallopian tube cancer was seen, and this was a serous carcinoma. Together with the epithelial ovarian cancers, they constituted 67.9% (87/128) of the cancers. The various histologic variants of epithelial cancers were epithelial serous carcinoma, mucinous carcinoma, clear cell carcinoma, and endometroid carcinomas. Among the non-epithelial tumors which represented 27.3% (35/128) of all the ovarian cancers, 34.3% (12/35) were germ cell tumors (GCT), made up of immature teratoma, dysgerminoma, yolk sac tumor, choriocarcinoma and a cancer within a mature teratoma, while 45% (16/35) were of sex cord-stroma tumor in origin, all comprising of granulosa cell tumor. Few (6) cases among the ovarian cancer histotypes had no histological class designation. Thus, they could not be placed in any class. and were documented as "not available (NA)".

Vulvovaginal cancers accounted for 26 (3.0%) cases and were the least with predominance of squamous cell carcinoma (17 cases; 65.4%).

Gynecologic cancer presenting symptoms

The recorded history of presenting complaints was varied as there were sites with overlap in many cases. By organ sites, 87.5% and 91.7% of uterine and cervical cancer patients respectively complained of bleeding through the vagina, with coexisting foul-smelling vaginal discharge among the latter. Feeling of abdominal mass and swelling was seen among the ovarian cancer patients in

about 68% of cases, 10% of these had associated vaginal bleeding. Other symptoms included weight loss, body weakness, hemoptysis, chronic pelvic pain, leakage of fecal matter, miscarriage, protrusion par vagina, vaginal nodules, bleeding vulval mass and anorexia.

Discussion

This study has shown a remarkable burden of gynecologic malignancies that is predominantly driven by hrHPV infections (19). Our finding of more cervical cancer is similar to the study by Okunade et al. in southwest Nigeria but contrasts with a report of higher ovarian cancers in the southeast of Nigeria by Nzeribe et al. (14, 20) However, these two studies reported single tertiary institution data each, whilst the present study was multi-institutional and could represent a truer picture of the disease in the population studied. There was also a notable variation in the age of occurrence of cases among these study environments. Whereas the overall median age at diagnosis was 50 years in the present study with a peak at the 5th decade, Okunade et al. in contrast, found a mean age of 52 years with a peak at the 6th decade (20). These reports and that from the present study suggest that women in this population are likely to be diagnosed with gynecological cancer irrespective of subtype at a young age. Given the attendant impact of this on the economy and households, there is a need for interventions that will promote a demographic shift in the disease occurrence.

Besides low overall median age, variations were also observed among different cancer subtypes in this study. It was noted that while cervical cancer was diagnosed at a median age of 51 years, vulvovaginal cancers were diagnosed at a median age of 42 years. By histological subtype, the majority of these cancers were squamous cell carcinomas that are usually driven by a common aetiologic agent, the hrHPV (21–23). Other risk factors commonly associated with the development of these cancers, and which were likely present in this population going by the most recent census data, include high parity, early age at sexual debut, and multiple sexual

TABLE 1 The four broad groups of gynecologic cancers and their histological subtypes.

Organ site	Histologic subtypes	Frequency (N)	Percentage (%)
Uterine cervix	Squamous cell carcinoma	379	66
	Adenocarcinoma	58	10
	Others	138	24
Sub-Total		575	100
Uterine corpus	Choriocarcinoma	45	33.5
	Endometrioid carcinoma	48	35.8
	Squamous cell carcinoma	10	7.5
	Leiomyosarcoma	6	4.5
	Serous carcinoma	4	3.0
	Carcinosarcoma	4	3.0
	Others	17	12.7
Sub-Total		134	100
Ovary and fallopian tube	Epithelial cancers	87	68
	Sex cord stromal tumors	16	12.5
	Germ cell tumors	12	9.4
	Miscellaneous	7	5.5
	Subtype not available (NA)	6	4.6
Sub-Total		128	100
Vulvovaginal	Squamous cell carcinoma	17	65.4
	Adenocarcinoma	2	7.7
	Others	7	26.9
Sub-Total		26	100

partners (24–26). These cancer types also have premalignant stages that can be detected by screening and treated to forestall their transformation into a malignant disease (26). For example, vulvar intraepithelial neoplasia has two distinct subtypes, a usual type seen more in younger age groups and associated in over 80% of cases with HPV infection and a differentiated form that occurs in older women and is less HPV-dependent (27). Given the younger age of patients who had cervical, vaginal and vulval cancers in the present study, addressing issues surrounding HPV infection prevention, and early detection would help to reduce the burden of these malignancies in the region and perhaps the country at large as has been demonstrated in some Nordic countries (28). A population-specific approach may be needed in the African population as data suggests differences in hrHPV prevalence among the black population compared to White women (29).

Also, the absence of the cervix, as in women who had undergone a hysterectomy, should not preclude vaccination against hrHPV as studies have shown that they can develop lower genital tract HPV-associated cancers, such as vaginal, vulval and anal cancers in the future (30).

The finding of more epithelial cancer among ovarian cancers and at a young age in this study is in keeping with the literature (18). We suspect from the census data that the protective influence of high parity against ovarian cancers among women in this region could account for the overall low proportion of this group of malignant diseases in this study (31). Non-epithelial tumors, on the other hand, though still low in proportion, exceeded data documented in other studies (32). Whereas this may not represent an increase in incidence of cases, nevertheless, the age at diagnosis is in keeping with the age demographics reported by other studies (32).

Uterine cancer had similar incidence as ovarian cancer in this study, although it surpasses cervical and ovarian cancers in developed countries (19). Emerging evidence suggests that African American or Black women have both higher incidence and worse mortality from the disease than White women in the United States, suggesting racial disparity in disease occurrence that may be explained by differing genetic predispositions (33, 34). For example, Black women have been shown to have a much greater risk of high-grade (serous and carcinosarcoma) uterine cancers relative to White women. In the same cohort, copy-number high (serous-like) tumors had a direct correlation with percent African ancestry (35). Efforts to reduce the more readily modifiable risk factors of worse outcomes among Black women, such as low health education (including awareness of symptoms), late detection, treatment delays, and poor implementation of evidence-based treatment recommendations, should be prioritized to improve the women's health in this regard (36).

The high proportion of cases of gestational choriocarcinoma in this study raises significant concerns regarding the needs of the local population who develop these aggressive yet chemotherapy-sensitive pregnancy-related cancers, which could threaten their lives during their reproductive years. An explanation for this finding in this study is unclear. However, a review of literature on gestational choriocarcinoma across different regions globally showed that older maternal age, long-term oral contraceptive use and socioeconomic status were strong risk factors for this cancer subtype (37). While these risk factors have not been investigated presently, we recommend a high index of alertness by gynecologists to be able to salvage all such patients. Campaigns to encourage ante- and postnatal care services utilization are also expedient so that more women can be brought into the "safe net" of gynecologic care within which such adverse pregnancy outcomes can be detected and treated early.

The absence of data on tumor staging, treatment received and survival limits further analysis of the impact of the disease on the population. Recent studies from northern Nigeria revealed that about 67%-92% of women with GC present at a very advanced stage (38, 39). The region also suffers from a lack of skilled specialists for oncology care. Northeastern Nigeria has the lowest number of

obstetricians and gynecologists in the country (40). This has implications on whether the patients are diagnosed at all or on time. Indeed, it has been shown that about 80% of patients experience a delay in diagnosis within a hospital setting, which could be due to prolonged waiting time on account of high physician workload (38). Another area of concern is the availability of care and its accessibility. The predominant form of treatment fo GC in this region are surgery and chemotherapy, which the majority are not able to afford out-of-pocket (38, 39, 41). Radiation oncology services are rarer and have a very long waiting time (42). These care gaps warrant policy guidelines to address. Training of more manpower is urgently needed to detect cases early while strengthening GC care through infrastructural provision and universal health insurance coverage.

Other limitations to this study include the non-population level data reporting and incomplete classification of some cases according to sites of origin. Likewise, the non-inclusion of clinically diagnosed cases and non-documentation of the Human Immunodeficiency Virus infection status of the patients with cervical, vaginal and vulvar cancers, all affect accurate estimation of the burden and risk factors of the disease in the population. Future studies should be designed in such a way to capture these and determine the financial, social and psychological impact of the disease on the women and their families. This will help to determine how to support them along their care journey (43).

Conclusion

The spectrum of gynecologic cancers in this study reveals a need for HPV infection prevention through advocacy, vaccination, screening and treatment of premalignant lesions. While these will reduce the cases of cervical, vulva and vaginal cancers, health education to the women regarding possible symptoms and signs of endometrial and ovarian cancers will enable them to present early to hospital for care. Future research is required to determine the risk factors for endometrial and ovarian cancers in this population, alongside investigating the impact of GC on the women. Lastly, population-specific policy direction that takes into account required manpower and infrastructural need to curb GC morbidity and mortality is highly advocated.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material. Further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Research Ethics and Review Committee, Federal Medical Center Azare. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements.

Author contributions

DK: Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing. UE: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. SA: Conceptualization, Data curation, Methodology, Writing – review & editing. AL: Conceptualization, Data curation, Methodology, Writing – original draft. DS: Conceptualization, Data curation, Methodology, Writing – original draft. MUK: Conceptualization, Methodology, Writing – review & editing. AK: Conceptualization, Data curation, Methodology, Writing – review & editing. AA: Conceptualization, Data curation, Methodology, Writing – review & editing. AKM: Conceptualization, Data curation, Methodology, Writing – review & editing. HU: Conceptualization, Data curation, Methodology, Writing – review & editing. SG: Conceptualization, Methodology, Supervision, Writing – review & editing. MS: Conceptualization, Methodology, Supervision, Writing – review & editing. BA: Conceptualization, Methodology, Supervision, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fonc.2025.1420113/full#supplementary-material

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Common haematological malignancies in Northeastern Nigeria: a multi-centre study of their pattern, distribution and treatment challenges

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Background: Haematological malignancies (HMs) are primary cancers of the blood and blood-forming organs. They are heterogeneous and of diverse clinical features, treatment protocols and prognoses. They constitute a significant source of cancer-related morbidity and mortality. Northeastern Nigeria, being the region in the country with the worst literacy rate and poverty indices, is also battling with the burden of these diseases with the limited health facilities to adequately diagnose and treat these ailments. There is paucity of a comprehensive data on HMs in the region, so this study aims to report on the multi-centre burden of the common HMs in the region and to discuss their patterns of distribution and management challenges.

Materials and methods: This was a 5-year retrospective study where records of cases of HMs diagnosed in the four health facilities [viz., Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi; Federal Teaching Hospital (FTH), Gombe; Modibbo Adama University Teaching Hospital (MAUTH), Yola; and Federal Medical Centre (FMC), Azare] were collected from 1 January 2018 to 31 December 2022. Data on the age, gender, diagnosis and subtypes of some malignancies were also obtained and analysed using the SPSS Version 23.0 statistical software.

Results: A total of 493 cases of HMs, which constituted 8.2% of all cancers, were diagnosed during the period under review. Paediatric HMs constituted 42.0% (207/493) of the HMs. Non-Hodgkin lymphoma (NHL) constituted the majority of the HMs at 115/490 (23.5%), while multiple myeloma (MM) was the least at 38/493 (7.7%). An average cost of 5,000 to 10,000 United States dollars is required to manage an HM in Nigeria. Late presentation of patients, non-availability and

inadequate number of personnel, inability to pay for investigations and/or treatments due to financial constraints, and limited facilities for tests such as flow cytometry, immunohistochemistry, cytogenetic and molecular genetic analyses were the challenges identified in the institutions in Northeastern Nigeria that manage cancer patients.

Conclusion: Haematological malignancies are common in our environment, and there are limited facilities and expertise to accurately diagnose and treat them in the region and Nigeria in general.

Introduction

Haematological malignancies (HMs) are primary clonal disorders of the blood and blood-forming organs that are characterized by abnormal proliferation and accumulation of malignant cells in various body tissues and organs (1). They are a group of heterogeneous and diverse diseases composed of infiltrates of mature or immature haemopoietic cells at various stages of differentiation, along the lymphoid and myeloid lineages. Significant variations exist in their incidences, biological behaviours, clinical presentations, treatment options and prognosis (2). The clinical presentations of HMs vary between diseases, and these include features of bone marrow failure (such as anaemia, neutropaenia and thrombocytopenia) and organ infiltrations, presenting with organomegaly, i.e., lymphadenopathy, splenomegaly and hepatomegaly. They can sometimes infiltrate other organs like the central nervous system, testes and eyes, presenting with features related to these organs (3). These diseases include leukaemias [which can be acute myeloid leukaemia (AML), acute lymphoblastic leukaemia (ALL), chronic myeloid leukaemia (CML) or chronic lymphocytic leukaemia (CLL)], lymphomas (Hodgkin and non-Hodgkin types), multiple myeloma (MM), myelodysplastic syndrome (MDS) and myeloproliferative neoplasms (which include polycythaemia rubra vera, essential thrombocythaemia and myelofibrosis) (3).

Haematological malignancies, like most other cancers, largely have unknown aetiologies. However, strong relationships have been established between the role of genetic defects such as cytogenetic abnormalities, gene mutations and abnormal gene expression as well as environmental exposure to some carcinogens (chemicals such as petro- and agro-chemicals and some radiological substances) in the pathogenesis of these malignancies (4). HMs constitute serious public health challenges in both developed and developing countries due to their associations with increased morbidity and mortality, with the burden being more pronounced in low- and middle-income countries (LMICs) like Nigeria owing to the high frequency of late presentation of cases as well as the inadequacy of diagnostic and therapeutic facilities in addition to a serious financial burden where patients pay out of pocket for all health-related needs (5).

Population-based incidence and survival outcomes of HMs in many sub-Saharan African countries have been difficult to estimate for many years. Lack of functional cancer registries and/or rudimentary or non-existent medical records are partly responsible for the partial information about cancer incidence, treatment and follow-up in Africa (6). However, the global picture reveals that HMs represent approximately 6.5% of all cancers worldwide, and they are the fourth most frequently diagnosed cancers in both men and women in developed countries of the world (7). The breakdown of this figure shows that NHL accounts for 2.7%, while leukaemias, multiple myeloma and HL represent 2.5%, 1.0% and 0.8%, respectively (8). It is of note that the incidences are on the rise globally, owing to improved understanding of the biology of the tumours and improved diagnostic facilities where hitherto inaccessible diagnostic modalities such as cytogenetic analyses and molecular diagnostics are now conducted frequently in many parts of the world, including in developing countries. According to the World Health Organization (WHO) 5th Edition of Classification of Haematolymphoid Tumours, they are classified broadly into myeloid, lymphoid, histiocytic/dendritic cell and stroma-derived neoplasms of lymphoid tissues.

A systematic review by Ugwu et al. revealed that challenges in diagnosing and managing haematological malignancies encompass late patient presentation at advanced disease stages, diagnostic difficulties or misdiagnosis stemming from reliance solely on morphology for histological diagnosis without ancillary immunohistochemistry, financial barriers preventing access to investigations and treatment due to the high cost of cytotoxic drugs and poverty-related constraints, and the absence of adequately equipped facilities for the management of HMs (7).

As a consequence of the challenges highlighted in the study above, the health outcomes of the management of HMs in Nigeria were observed generally to be poor and characterized by needless

mortality, incomplete treatment and follow-up, and discharges against medical advice largely due to socio-economic challenges (7).

There is paucity of a comprehensive data and information about patterns of haematological malignancies in Northeastern Nigeria. However, there are few centre-based reports from Yola, Bauchi and Maiduguri, where varying proportions of HMs were reported (8–10). This study aims to report the pattern and distribution of the common haematological malignancies in multiple centres from Northeastern Nigeria where specialist haematological and histopathological services exist with expertise to diagnose haematological malignancies via bone marrow aspiration cytology, trephine biopsies and histopathological examination of solid haematological tumours such as lymphomas.

Materials and methods

This was a 5-year retrospective study where records of cases of haematological malignancies diagnosed in the Haematology and Histopathology Departments of Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi; Federal Teaching Hospital (FTH), Gombe; Modibbo Adama University Teaching Hospital (MAUTH), Yola; and Federal Medical Centre (FMC), Azare, were obtained from the Bone Marrow Aspiration cytology register as well as the cancer registers of the various pathology departments from 1 January 2018 to 31 December 2022. Data on the age, gender, diagnosis and subtypes of some malignancies diagnosed were also collected. The collated data were analysed using SPSS Version 23.0 (IBM SPSS Statistics). Continuous variables with z-scores within ±2.58 for skewness and kurtosis were considered to be normally distributed. Normally distributed data were reported as means ± standard deviations (SDs), while non-normally distributed data were reported as median (interquartile ranges). Categorical data were reported as percentages. A p-value of ≤0.05 was considered significant.

Results

A total of 493 cases of HMs were diagnosed during the period under review. They constitute 8.2% of all cancers diagnosed during the period. The ages of the participants range from 6 months to 80 years. A total of 207 paediatric haematological malignancies occurring in patients ≤15 years were recorded, representing 42.0% of the HMs observed during the period under review. The mean ages ± SD and gender distributions of the participants are shown in Table 1. For the paediatric haematological malignancies, non-Hodgkin lymphoma constituted the majority at 86/207 (41.5%), while AML was the least in prevalence, accounting for 21/207 (10.1%) as shown in Figure 1. For the generality of the HMs comprising both paediatrics and adult groups, non-Hodgkin lymphoma (NHL) constituted the majority of the HMs at 115/490 (23.5%), while MM was the least at 38/493 (7.7%) as shown in Figure 2. The distribution of the various HMs per health facility is

TABLE 1 Distribution of participants' age, gender and male–female ratio.

Haematological malignancy	Mean age ± SD (years)	Age range	Male–female ratio
AML	27.1 ± 9.2	12–58	2:1
ALL	16.8 ± 10.4	0.5–53	2.5:1
CML	55.0 ± 11.2	37–70	1:1
CLL	57.6 ± 18.2	50–80	1.5:1
MM	48.4 ± 9.5	45–60	1:1
NHL	22.8 ± 7.5	5–60	1.8:1
HL	21.0 ± 4.8	10–60	1.7:1

Key: AML, acute myeloid leukaemia; ALL, acute lymphoblastic leukaemia; CML, chronic myeloid leukaemia; CLL, chronic lymphocytic leukaemia; NHL, non-Hodgkin lymphoma; HL: Hodgkin lymphoma.
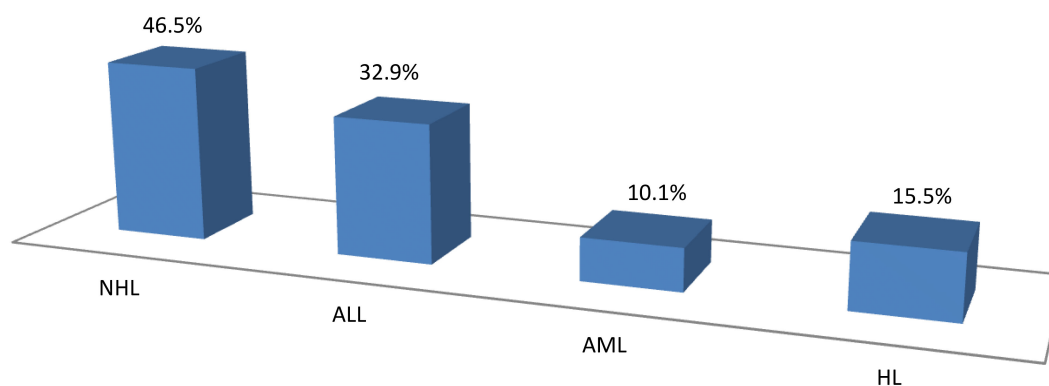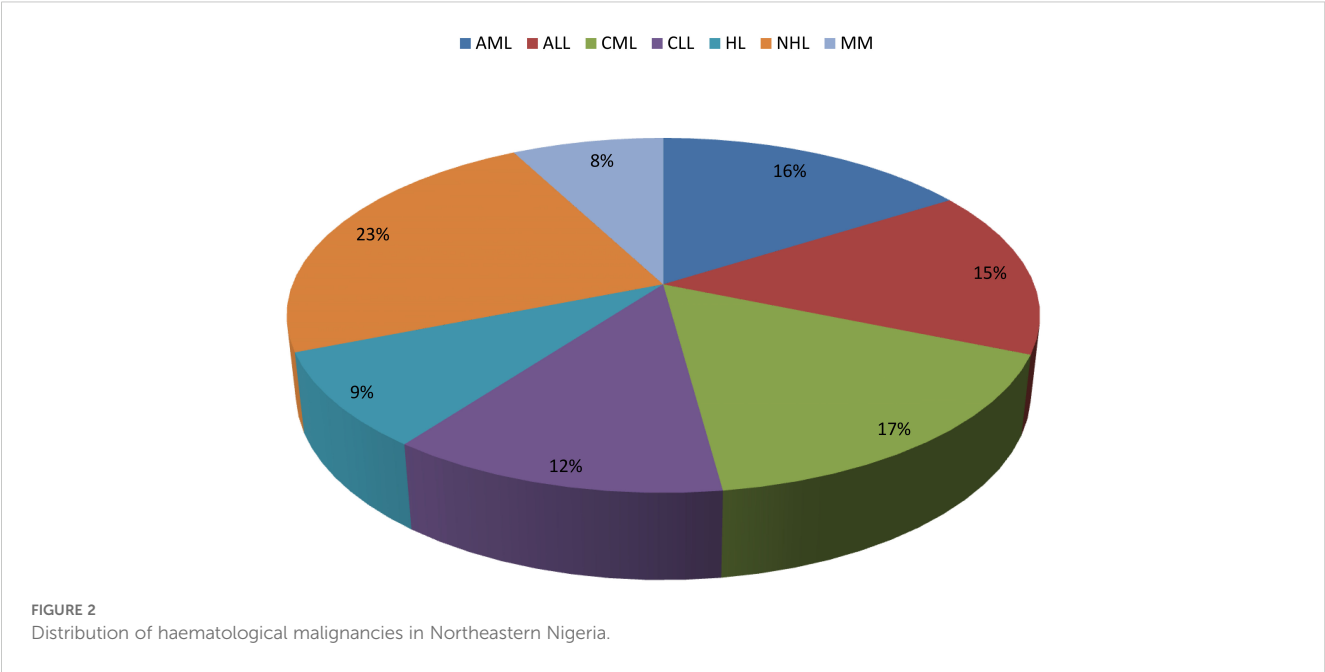

Pattern of Paediatric HMs

46.5% NHL
32.9% ALL
10.1% AML
15.5% HL

FIGURE 1
Distribution of the paediatric haematological malignancies.

FIGURE 2
Distribution of haematological malignances in Northeastern Nigeria.

presented in Table 2. An average cost of 5,000 to 10,000 United States dollars is required to manage an HM in Nigeria. Late presentation of patients to the health facilities to access care, non-availability and inadequate number of personnel to appropriately manage HMs, inability to pay for investigations and/or treatments due to financial constraints, as payment is mostly out of pocket and only a few of them have insurance coverage, and delay in arriving at a diagnosis due to limited facilities for further tests (such as flow cytometry, immunohistochemistry, cytogenetic and molecular genetic analysis) as well as poorly equipped health facilities to appropriately manage the conditions are the challenges identified across health institutions in Northeastern Nigeria.

Discussion

Northeastern Nigeria comprises six states, viz., Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe states, and is home to

TABLE 2 Distribution of the various haematological malignancies per health facility.

Health facility	AML	ALL	CML	CLL	HL	NHL	MM
ATBUTH	22	27	23	29	13	36	11
FTHG	31	22	24	14	18	38	14
MAUTH	23	18	29	16	8	34	13
FMCA	3	8	6	2	4	7	0
Total	79	75	82	61	43	115	38

Key: AML, acute myeloid leukaemia; ALL, acute lymphoblastic leukaemia; CML, chronic myeloid leukaemia; CLL, chronic lymphocytic leukaemia; NHL, non-Hodgkin lymphoma; HL, Hodgkin lymphoma; ATBUTH, Abubakar Tafawa Balewa University Teaching Hospital; FTHG, Federal Teaching Hospital, Gombe; MAUTH, Modibbo Adama University Teaching Hospital; FMCA, Federal Medical Centre, Azare.

approximately 26 million people, representing 12% of Nigeria's population (11). The zone has nine tertiary health facilities, but only five have functional specialist haematological services that have the capacity to diagnose and treat HMs. These include ATBUTH, Bauchi; FMC, Azare; MAUTH, Yola; FTH, Gombe; and University of Maiduguri Teaching Hospital (UMTH) Maiduguri, so the data here were from these centres as presented in the Results section. This study recorded 493 cases of haematological malignancies during the period of study, which represent 8.2% of all cancers diagnosed. This is similar to what was reported by Babatunde et al. and Errahhali et al., who respectively reported 8.1% and 9.3% cases of HMs in Ilorin, North Central Nigeria and Eastern Morocco (12, 13).

The age range of the study participants was between 6 months and 80 years. This indicates that HMs just like other malignancies can be found among all age groups. The result is similar to what was reported by Babatunde et al., who reported an age range of 7 months to 80 years (12). A contrasting finding was reported by Akaba et al. in Calabar, south–south Nigeria, where an age range of 20–89 years was observed (14).

This study showed that HMs occurred more frequently in male than female individuals in this region. This is similar to reports of HMs by Babatunde et al., Errahhali et al. and Akaba et al. in Ilorin Nigeria, Eastern Morocco and Calabar, south–south Nigeria, respectively (12–14). A contrasting result of female preponderance was reported by Perez et al. in Chile (15). The high male preponderance in our study is similar to most publications on HMs both nationally and internationally. This could be attributed to increased exposure to potentially carcinogenic occupational and environmental agents (14). There are different types of HM, and this study showed that the majority of the patients had NHL. This is similar to reports by Akaba et al., Perez et al. and Hungria et al. in Nigeria, Chile and Latin America (14–16). Multiple myeloma was reported to be the least of all the HMs in this study, and it is similar to what was reported by Perez

et al.; however, Hungria et al. reported contrasting results, where they found CLL as the least of the HMs (15, 16).

The challenges of diagnosis and management of HMs are common to almost all the centres in Nigeria, as previously reported by Dachi et al. and Ugwu et al., where issues such as late presentation of the patients in the advanced stage of the disease, inability to pay for investigations and/or treatment due to financial constraint, and wrong or delayed diagnosis due to inadequate diagnostic facilities, as most centres mainly rely only on morphologic appearance for histological diagnosis without immunohistochemistry. Poorly equipped health facilities for the management of haematological malignancies equally contribute to poor outcomes in these patients (4, 7). Delayed presentation, which can be due to ignorance about the disease among patients due to low literacy rates, has also been a source of worry. Financial constraints in settling the bills of investigations and treatment of cancers, in general, and haematological malignancies, in particular, is also a big challenge in many African countries (17–19).

The challenges can be tackled by awareness creation and education on the importance of early presentation to health facilities; health systems should be strengthened by including HMs in the coverage of the National Health Insurance and adequately equipping health facilities for proper diagnosis and management of HMs.

There are unexplored areas in relation to HMs in Northeastern Nigeria that can be further explored for future research. These include the following:

i. Are there differences in tumour biology and clinical differences between the different HMs in Northeastern Nigeria and other parts of the world?
ii. What are the barriers and facilitators to accessing standard-of-care treatments in patients with HMs in Northeastern Nigeria?
iii. What is the effect of HMs on the quality of life of patients in Northeastern Nigeria?

Conclusion

Haematological malignancies are common in our environment, and there are limited facilities and expertise for the comprehensive management of these patients, not only in the northeast region but in Nigeria in general. There are also some research areas that need to be looked into to fully characterize and adequately manage HMs in the region. This can be conducted by building the capacity of staff and establishing robust centres that can provide holistic care to oncology patients.

Recommendations

Collaborative work with experts in the management of haematological malignancies here in Nigeria and other parts will surely add value to both the diagnosis and treatments of these diseases and avert the observed challenges, so these are strongly recommended.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for this study that did not involve direct use of human participants in accordance with the local legislation and institutional requirements. Written informed consent from the patients/patients legal guardian/next of kin was also not required for this study in accordance with the national legislation and the institutional requirements.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Key stakeholders' experiences, knowledge and perspectives regarding care quality for breast cancer in South-West Nigeria

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The landscape of breast cancer care in Nigeria is complex, with various structural and individual barriers impacting patient care. Breast cancer (BC) is the most common cancer and a leading cause of cancer deaths among women worldwide. In Africa, the cancer burden is expected to rise significantly, with projections estimating an increase of 50% by 2050. Rising incidence rates and barriers to care contribute to a healthcare crisis, leading to late-stage presentation and high mortality rates for women with breast cancer in Nigeria. Quality healthcare must be patient-centered, involving stakeholders - patients, clinical and community partners, and other healthcare stakeholders to achieve a desired outcome. Understanding the cancer journey from different perspectives allows for targeted approaches for increasing access to quality healthcare as well as reducing morbidity and mortality rates. To address this, healthcare provider perspectives about breast cancer care were compared with the lived experiences of breast cancer patients to emphasize the need to increase access and quality of care. A mixed method study was conducted in 2 phases: Phase I: 3 Focus group discussions (FGDs) with breast cancer patients and their care givers were conducted at the NSIA-LUTH Cancer Centre in Lagos, Nigeria. Phase II: A pre and post-survey of a continuing medical education course focused on breast cancer was delivered to healthcare providers in southwest Nigeria. Survey responses regarding causes for delays and barriers to care indicated financial strain, fear, and alternative treatments as the largest hurdles, coinciding with patient testimony from the FGD. Fear of mastectomy was a perceived barrier to care for 90% of healthcare providers while 87% and 86% of providers perceived seeking spiritual and herbal treatments as the largest delays of care. Despite this, a significant number of focus group participants (39%) presented within the first month of noticing a breast symptom to a proper healthcare provider. Data from

our study reports that 70% of patients receive help from family to fund treatment highlighting why cancer can be a poverty trap for families and the need for universal health insurance. Half of the focus group participants had a positive interaction with their doctors, with the rest reporting neutral (19%) or even negative (31%) interactions. Our study also reports 42% of healthcare providers feeling only "somewhat" qualified to deal with breast cancer, highlighting the significant need for more education, with a further 14% feeling neutral or negative about their qualification, a potential contributing factor in negative interactions recalled by patients. Knowledge increase was consistent for best practice diagnostic modalities among healthcare providers (p < 0.05). At the same time, items related to symptoms and risks of breast cancer had inconsistent knowledge increases, indicating why further courses like these should be pursued. With the success of the course and the inspiration of breast cancer survivors, a proposed expansion into community awareness is discussed along with enlisting local practitioners in the fight against breast cancer in hopes of lowering the barriers to and delays of care in Nigeria.

1 Introduction

The landscape of breast cancer (BC) care in Nigeria is complex, with various structural and individual barriers impacting patient care. Worldwide, Breast cancer is the most common cancer and the most frequent cause of cancer death among women (1). The cancer burden in Africa is expected to increase significantly. According to the 2020 GLOBOCAN data, 186,598 breast cancer cases were reported in Africa with 85,787 related deaths (2). By 2050, these numbers are projected to rise to an estimated 50% (3). Rising incidence rates, combined with barriers to care, create a healthcare crisis.

Structural barriers include provider knowledge, education and training, provider perception of breast cancer, center location, and availability of infrastructure. Individual barriers include a lack of patient knowledge, financial constraints, and lack of an adequate support system. These barriers to care are contributing factors behind late-stage presentation and the consequent high mortality rates of women with breast cancer in Nigeria (4–6). While reported cancer incidence rates in low and middle-income countries (LMICs) are lower than those of high-income countries (HICs), overall mortality rates are much higher in countries in Sub-Saharan Africa owing to inadequate screening and detection methods, as well as limited treatment and palliative care options (7).

Quality healthcare is a goal that every practice, hospital, and institution aims for whether it is in everyday health maintenance, or the difficulties of cancer care. This healthcare must be patient-centered involving stakeholder involvement - patients, clinical and community partners, and other healthcare stakeholders to achieve a desired outcome (8). "Stakeholder" in this context is an individual

or group who is responsible for or affected by health- and healthcare-related decisions (8). This individual or group play specific roles that contribute immensely to ensuring quality care which will impact patient survival. Understanding the cancer journey from different perspectives allows for targeted approaches for increasing access to quality healthcare as well as reducing morbidity and mortality rates. The identified deficiencies served as a background to develop a CME course to better equip providers to address these issues when caring for breast cancer patients. These comparisons highlight the interconnectedness of barriers to care and provider knowledge weakness that in turn can inform potential curricula for continuing medical education (CME) courses.

Our study employs a mixed-method design to examine healthcare providers' (HCP) perspectives on breast cancer care. It will also compare these insights with the lived experiences of breast cancer patients and their caregivers. The goal is to provide continuing medical education (CME) to health care professionals by key stakeholders including breast surgeons, breast radiologists and clinical oncologists, while also providing recommendations and strategies that will help reduce barriers associated with breast cancer treatment to relevant authorities.

2 Materials and methods

2.1 Study design

A mixed-method study design was used. The study was in 2 phases, this approach was adopted to aid in the collection of

different but complimentary data at the study sites to enrich the interpretation of the results.

2.2 Study location

This study was conducted in the southwestern part of Nigeria (Lagos State). Although ideally assumed to be a Yoruba community, the ethnic diversity in the region is rich and well-distributed. English Language is an official language in Nigeria, and researchers confirmed to see if all participants understood the language. Lagos State is the commercial center of Nigeria. The focus group discussion was conducted at the NSIA-Lagos University Teaching Hospital (LUTH) Cancer Centre (NLCC), Lagos a foremost cancer center in the region that receives referrals from within and outside of the region. The center is a state-of-the-art Oncology center equipped with modern infrastructures including the 3 latest Varian LINAC machines for radiotherapy services. The chemotherapy clinic runs 5days a week within the NLCC-LUTH cancer center of the Lagos University Teaching Hospital with an average of 10 breast cancer patients receiving chemotherapy treatment per clinic. The hospital also has a One Stop Breast Clinic, a multidisciplinary clinic where all breast services are offered every Wednesday with an average of 10 new cases per clinic. The Continuing Medical Education was done at the quarterly meeting of the Association of General and Private Medical Practitioners of Nigeria (AGPMPN) in Lagos. Ethical approval was obtained from institutional HREC.

2.3 Study population

2.3.1 Phase I
2.3.1.1 Patient focus group

Sampling method used was a purposive sampling technique. All consenting new breast cancer patients presenting for the first time to the clinic on the day of the focus group discussion were included in the study. The FGD patients were recruited one day in each month (August, September and November 2022) at the NSIA-LUTH Cancer Centre.

Three focus groups had a total of 23 participants with 9, 8 and 6 in each group respectively of women who consented on the allocated date. Study participants filled out demographic information including name, age, gender, family type, occupation, level of education, average monthly income, and marital status. Interviews were modeled around qualitative methods, which were able to capture information that contextualized answers to interview questions. Psychological and socioeconomic factors were investigated during the FGDs, including emotional, financial, and physical well-being within and outside of the clinical setting as it pertained to barriers faced during their breast cancer journeys.

The in-depth interviews (IDIs) were conducted face-to-face using an IDI guide to interview a total of twenty three (23) breast cancer patients in 3 FGDs. The interviews were conducted in the research room of the cancer center within the hospital, which was private. The interviews lasted an average of 45–60 minutes and were recorded on audiotapes. Before the interviews, the researcher explained the objectives of the study, assured the participants of confidentiality, and obtained permission to use a digital voice recorder which was later transcribed. The interviews were facilitated by a moderator and a note taker.

Questions asked related to the timeline between symptom onset and presentation to a proper HCP, satisfaction with provider response, and problems or issues faced in pursuing diagnosis and treatment. Interview items also included questions on who made up their support system (i.e. who did they first tell?) and funding questions (i.e. how did you finance your treatment)?.

2.3.1.2 Data analysis

Each interview recording was transcribed verbatim into Word documents by 2 researchers J.C. and V.A. to identify patterns and themes common across participants' experiences. The researchers read the transcripts to develop the coding guide, which aligned with the questions/sections in the quantitative instrument, and all the researchers discussed the data to ensure correctness. NVIVO version 12 was used to analyze the data.

2.3.2 Phase II
2.3.2.1 Methods for continuing medical education course on breast cancer

A one-day CME for HCPs was held jointly with the Association of General and Private Medical Practitioners of Nigeria (AGPMPN) in Lagos during one of their quarterly meetings. This study involved a purposeful sample of key stakeholders, comprising 71 medical doctors with experience in providing primary care for breast cancer patients. Topics for the in-person CME course titled "Advances in Multidisciplinary Management of Breast Cancer" included breast cancer risks and symptoms, diagnostic methods including various imaging modalities and testing options, breast cancer facts and treatment modalities. The CME presentation content was taken by the Breast radiologist, Breast surgeon and Clinical oncologists This course was advertised via social media platforms and posters made by the sponsoring associations. Advertisements targeted health care professionals within the AGPMPN who form the first point of contact for patients before referral to specialists. Questionnaires to assess HCP knowledge before and after the course were composed in-house using various publications concerning breast cancer diagnosis, treatment and delay of care as seen across the African continent, in Sub-Saharan Africa, and in Nigeria specifically with contextualization of the patient experience informed by FGDs as they related to finances, awareness and emotional responses with providers (4, 9–13). Key stakeholders including breast radiologists, breast surgeons, and clinical oncologists gave 45mins lecture on cancer care and answered relevant questions asked by participants. Additionally, a post course evaluation was collected.

2.3.2.2 Data collection and analysis

The pre- and post-course self-administered questionnaire collected demographic data, provider knowledge and comfort with diagnosing and treating patients with breast cancer, where

they go for healthcare, perceived barriers to care and additional items related to their practice. The patterns and themes identified during the FGDs with patients were then compared with the HCP assumptions on barriers to care and comfort level when dealing with breast cancer.

Questions pertaining to specific diagnostic tests, treatment modalities, and various facts about breast cancer and its symptoms, causes, and risks were asked in both pre- and post-course evaluations. While most questions asked were true/false or yes/no/don't know, some included short-answer responses related to symptoms and referral activity. Answers from both evaluations were tabulated in excel and sent to a secondary researcher to analyze. The quantitative data were entered into the Statistical Package for the Social Sciences (SPSS version 21) statistical software. Statistical significance of nominal data was assessed using Pearson's Chi Square test with p value threshold of <0.05.

3 Results

3.1 Focal group discussions - patient perspective

3.1.1 Socio - demographics

The three focus groups had up to six participants each, ranging in age from 26 to 76 years for a total of 23 female participants with 9, 8 and 6 individuals in each group respectively. Majority of participants were in the age groups 41–50 and 51–60 years, with 9 (39%) and 6 (26%) respectively. Of these participants, 30.4% (n=7) worked in business or trade,74% (n=17) were married, 52% (n=12) had tertiary education, and 30% (n=7) had a monthly income between ₦50,000 ($30) and ₦100,000($60) {*Xe.Com converter accessed 04/11/2024*} while 26% (n=6) had no livable income (Table 1).

3.1.2 Symptoms and presentations

Thirty-nine percent of patients (n=9) saw their HCP within one month of noticing symptoms and commenced care shortly after (Figure 1). Twenty-six percent and 22% of patients saw their healthcare provider within 2 and 3 months, respectively, while 4% saw a healthcare provider after 2 years. Those that had longer timelines discussed not recognizing their symptoms as breast cancer, pursuing local treatment providers, getting misdiagnosed and prescribed inappropriate treatment as the reasons for the longer timelines. In one case, the lack of appropriate diagnosis from an HCP resulted in a delay close to four years before getting accurately diagnosed and starting treatment.

Participants in the focus groups frequently expressed their fear of death related to a breast cancer diagnosis, as well as the fear of abandonment by family or the community. Emotional responses varied among them: 45% reported feeling unhappy or sad, 18% felt afraid or scared, and 9% expressed feelings of shock, relief, or even a sense of being good. Many patients remarked that cancer felt like a death sentence. One patient even recalled being so frightened that she remained silent for several months (Figure 2).

TABLE 1 Demographic information for focus group participants.

| Sex	Total	Percent
Male	0	0
Female	23	100%
Age	Total	Percent
21-30	1	4%
31-40	2	9%
41-50	9	39%
51-60	6	26%
61-70	4	17%
71-80	1	4%
Marital Status	Total	Percent
Single	2	9%
Married	17	74%
Widowed	3	13%
Divorced	1	4%
Education	Total	Percent
Primary	2	9%
Secondary	6	26%
Tertiary	12	52%
Post-Tertiary	3	13%
Monthly Income	Total	Percent
₦20000-₦50000	4	17%
₦50000-₦100000	7	30%
₦100000-₦150000	3	13%
₦150000-₦200000	1	4%
₦200000-₦250000	1	4%
₦200000-₦300000	1	4%
Nil	6	26%
Occupation	Total	Percent
Academic (Current or Retired)	3	13.0%
Business and Trade	7	30.4%
Catering	1	4.3%
Civil Service (Current or Retired)	6	26.1%
Entrepreneurship	1	4.3%
Fashion	1	4.3%
Hair Dressing	2	8.7%
Homemaking	1	4.3%
Student	1	4.3%

n% < 100% due to rounding.
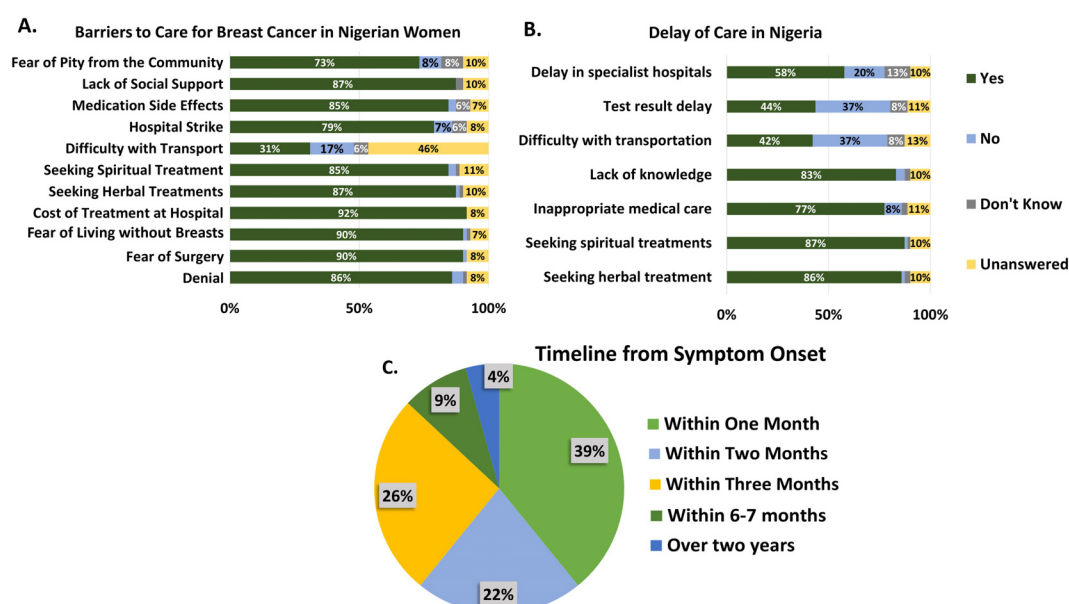
FIGURE 1
Provider responses about barriers to care **(A)** and delays of care **(B)** in Nigeria contrasted with the reported patient timeline **(C)** between symptom onset and seeing a proper healthcare professional.

3.1.3 Interaction with providers

Of the sixteen FGD participants who discussed how they felt with their providers, 50% (n=8) reported positive interactions with 19% (n=3) and 31% (n=5) reporting neutral and negative interactions respectively (Figure 2). One patient recalled getting so frustrated with the number of tests and lack of explanation from her doctor that she stopped attending the clinic, further delaying her diagnosis before finally returning to a different provider. The contrast between the impact had by positive and negative interactions can be seen explicitly from the patient' s testimonies. Patient A had a positive interaction, recalling "*The doctor shout. Madame, this is cancer … He said Madame I am telling you this is cancer. It is not killing people at least they need to remove my breast I can still survive (sic). This is what the doctor told me.*" Patient B, however, had a negative interaction, recalling: "*I left because the doctor did not give me hope for living. You know, when you have cancer, it is like a death sentence. When I heard it, I was so scared. For one month I did not speak. In the night I would just sit down, and I would be crying.*"

Patient C recalled: "*…I gave [the doctor] the initial report. He said he would look for a second opinion. I went and he was like no this cannot be for you. He said to please do another test. It will be expensive for you to manage to do it. So, I went for the third opinion and waited for the results….*"

3.1.4 Family support

Most funding was from family members 70% (n=16), Church 30% (n=7) and Friends 22% (n=5). Additional funding sources included patient contributions at 9% (n=2), community support at 9% (n=2), and clinical trials at 4% (n=1), along with non-governmental organizations (NGOs) or combinations of these sources (Table 2). Despite the preponderance of family support a

few patients recollected being abandoned by their family, one patient gave the context that her family thought she would die, so they abandoned her, while another patient, who had already lost her husband, was abandoned by her relatives, leaving her to provide for both her children and her treatment alone.

Most patients confided in family members about their diagnosis first, most commonly their husbands before anyone else. This formed their primary support with one patient emphasizing the importance of having a strong support system through her diagnosis and treatment journey, as her daughter recalled "We (*Her children*) *found out first before [her]. We were allowed to talk to ourselves and embrace before we broke the news to her. She received it better. [She was] the one encouraging us. We have been together as a team.*"

3.1.5 Barriers

Some patients emphasized the impact hospital strikes had on their ability to start treatment. Finance was another major barrier, As patient D recalled, "*I had 50,000 Naira ($50), when I found out. I was crying because I had no money to start the treatment. But fortunately, I told a family member, and he gave me some money, so I started the treatment…*" Patient D also sought means to support herself, recalling that "*Fortunately I applied for a job they called me to come work. I said to them, I would rather make this money and keep for my children. If I survive [the cancer]…*".

3.2 Providers perspective

3.2.1 Pre-course survey
3.2.1.1 Provider sociodemographic data

Seventy-one HCPs participated in the continuing medical education course ranging from 18 to 65+ years. Males constituted
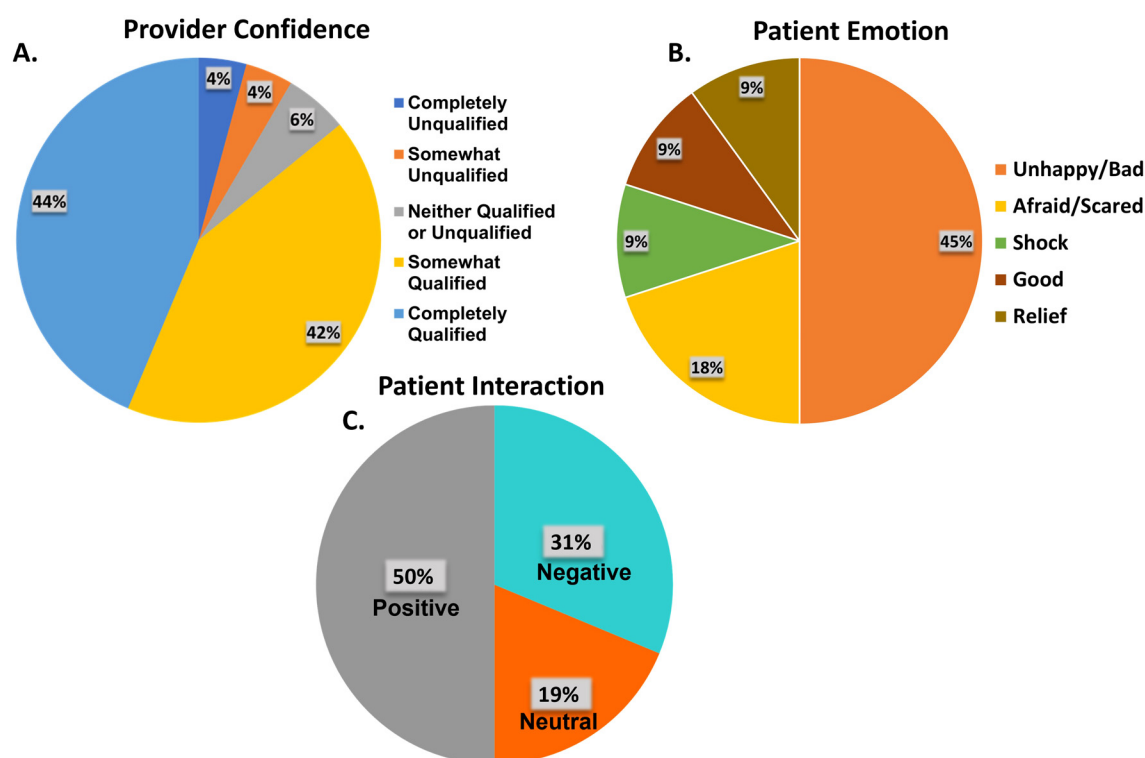
FIGURE 2
(A) Health care provider self-evaluated confidence with treating breast cancer. (B) Patient emotional state when diagnosed. (C) Patient-reported evaluation of interaction with their provider.

TABLE 2 Funding sources as reported by focus group participants.

Funding Source	n	n%
Family	16	70%
Church	7	30%
Friends	5	22%
Self	2	9%
Community	2	9%
NGO fund	2	9%
Clinical Trial	1	4%

Participants included multiple funding sources leading to > 100% sum.

62% (n=62), while females represented 13% (n=9). The predominant age group was 54% (n=66), aged 56–65 years. Additionally, the majority were of the Yoruba ethnicity at 47% (n=66). They included a variety of occupations within the healthcare field with a wide range of experience (70% had practiced for over 10years). Occupations included general medical doctors 45% (n=32), while others were primary care doctors at both public and private practices, family or pediatric doctors, nurses, residents, and medical students.

When asked about their own health care, providers indicated that although they primarily bring themselves and their families to larger hospitals and clinics, many still seek alternative treatments to supplement their care. Provider demographic data is presented in Table 3. The sociodemographic and personal healthcare questions were only present in the pre-course survey. The full questionnaire can be found in the associated Supplementary Material.

3.2.1.2 Knowledge regarding signs and symptoms

Provider comfort with treating breast problems was self-assessed before the course on a scale from completely unqualified (4%, n=3) to completely qualified (44%, n=31), 42% felt somewhat qualified (Figure 2). Most providers (42%, n=30) reported seeing between one and five patients with breast complaints in the past six months. Seventeen percent (n=12) attended to six to ten patients, while 15 providers did not see any women with breast complaints during this time (Table 4). The array of breast problems presented at their clinics included benign breast lumps (45%, n=32), breast abscess (21%, n=15), mastitis (17%, n=12), galactorrhea (11% n=8) and fibrocystic breast disease (8%, n= 6). Other mentioned conditions included pain, breast ulcers, hotness, fungal infections, retracted nipples, skin sinuses, lipomas, boils, nipple discharge, swollen breasts, and puerperal mastitis (Table 5).

3.2.1.3 Knowledge regarding imaging

Providers' understanding of the typical diagnostic tests used for breast problems to detect potential breast cancer reveals patients presenting with breast symptoms primarily involve referrals for mammography (73%, n=52). Additional tests include CT imaging

TABLE 3 Demographic data reflecting the attendance of the continuing medical education course on breast cancer.

Sex	n	n%
Male	62	87%
Female	9	13%
Age		
18-25	6	8%
26-35	8	11%
36-45	3	4%
46-55	7	10%
56-65	38	54%
65+	9	13%
Ethnic Background		
Yoruba	47	66%
Ibo	14	20%
Edo	1	1%
Ogu	1	1%
Urhobo	3	4%
Afemai	2	3%
Efik	3	4%
Other	1	1%
Education	**Total**	**Percent**
Secondary Schooling	1	1%
Some Tertiary	6	8%
Tertiary	14	20%
Post-Tertiary	50	70%
Occupation		
Medical Student	5	7%
Resident Doctor	6	8%
Nurse	2	3%
General Medical Doctor	32	45%
Family Doctor/Pediatrician	2	3%
Private Practice Doctor	12	17%
Medical Officer	2	3%
Misc. Undisclosed Position	10	14%
Years in Healthcare		
<1 year or Undisclosed	5	7%
1-5 Years	5	7%
6-10 Years	5	7%
>10 Years	56	79%

n%<100% due to rounding.

(46%, n=33), biopsy/histology (45%, n=32), and ultrasound scans (34%, n=24). Other diagnostic tools include CT scans, biopsies, and ultrasounds (Table 6).

3.2.2 Post-course survey
3.2.2.1 Knowledge regarding breast cancer symptoms, causes and risk factors

Thirty-one HCPs participated in the post-course survey. Providers were asked to indicate common symptoms of breast cancer along with causes and risk factors (Figure 3). Most symptoms of breast cancer were correctly identified both pre- and post- course except painful breast lump and breast pain without lump both of which increased from 20% answering correctly to 61% and 58% respectively, both of whose responses indicated statistically significant knowledge increase (p= 0.00045 and 0.0012) (Figure 3).

Many providers were aware that breast cancer could be inherited from both maternal and paternal lines, both before and after CME. There is however a slight decrease in correct answers relating to paternal inheritance, but this change is slight and not deemed statistically significant (p=0.58). Other causes of breast cancer, including breast infection and beliefs in 'evil spirits, witches, and spiritual attacks,' clearly show a trend where participants decisively responded "no" to these.

Regarding increased breast cancer risk, most items showed either stagnating correct answers or slight increase in correct answers. There was a surprising decrease in correct answers related to age and alcohol use after the post-CME session, however, the change related to age was deemed insignificant. Alcohol use, however, did show statistical significance of knowledge decrease (p=0.022). In the opposite question of factors that decrease the risk of breast cancer, all items showed some knowledge improvement, but none were deemed statistically significant.

3.2.2.2 Knowledge regarding imaging and treatment

Providers indicated a statistically significant change in how they would approach a patient presenting with a breast lump, indicating an increased use of diagnostic imaging modality options including mammography with subsequent biopsy, fine needle aspiration cytology (FNAC), and breast ultrasound followed by lumpectomy. These values were evaluated via the chi squares method and resulted in p values of 0.0013, 1.87…E-07 and 0.034 respectively, indicating both heightened awareness of these modalities and willingness to use them. Providers were split on whether or not they would order a lumpectomy with subsequent biopsy both before and after the CME, providing no significant change (p>0.05). (Figure 4) With chi square p values all significantly less than the threshold of 0.05, knowledge of what immunohistochemistry markers to check for had the largest increase in knowledge across providers. Before the course, most providers did not know what markers would be able to indicate breast cancer, and while after the course some participants did not answer, there was a significant increase in knowing these markers could be used. This change is displayed in Figure 4, with all immunohistochemistry markers asterisked to indicate statistical

TABLE 4 Average number of patients presenting with a breast problem over the past six months to providers taking the CME.

Number of Women Presenting with a Breast Problem in the 6 Months Prior to CME	n	n%
Don't know/Unanswered	3	4%
0	15	21%
1-5	30	42%
6-10	12	17%
10-20	3	4%
>20	8	11%

TABLE 5 Typical breast problems seen by healthcare providers participating in the CME within the past 6 months.

Breast Problems	n	n%
Benign Breast Lump/Fibroadenoma	32	45%
Breast Abscess	15	21%
Mastalgia/Mastitis	12	17%
Galactorrhea	8	11%
Fibroadenosis/Fibrocystic breast disease	6	8%
Nipple Discharge	4	6%
Pain	3	4%
Swollen Breast	3	4%
Boil	2	3%
Breast Cysts	2	3%
Lactational Mastitis	2	3%
Breast Hotness	1	1%
Breast Ulcer	1	1%
Fungal Infection Under Breast	1	1%
Lipoma	1	1%
Puerperal Mastitis	1	1%
Retracted Nipple	1	1%
Skin Sinus	1	1%
Others (Dysmenorrhea, Abdominal swelling, Post coital bleeding)	3	4%

Participants allowed to have multiple answers.

significance with p values of 1.9E-14, 1.9E-14, 1.5E-13, 3.4E-15 respectively. When asked about various factoids related to cancer, participants showed some improvement. When asked about mammography being able to detect breast cancer before a lump can be felt (fact 7), providers showed improvement, going from 69% answering correctly to 81%. Along with this, knowledge of treating metastasis (fact 11) went from 31% correctly answering to 48%, and mortality of breast cancer (fact 12) increased from 59% answering correctly to 65% (Table 7).

TABLE 6 Pre-CME: Typical diagnostic tests given for breast problems to detect breast cancer.

Test	n	n%
Mammogram	52	73%
CT Imaging	33	46%
Biopsy/Histology	32	45%
Ultrasound Scan	24	34%
Bloodwork	19	27%
Cytology	17	24%
Physical Exam	9	13%
Others	7	10%

Participants allowed to choose multiple answers.

3.2.2.3 Factors responsible for barriers and delays in care

HCP-reported opinions on barriers and delays to care are shown in Figure 1. Several barriers were identified and grouped into two categories: individual (or patient-related) barriers and structural barriers. Individual barriers include fear of surgery (90%), denial (86%), fear of pity from the community (73%), lack of social support (87%), medication side effects (85%), difficulty with transportation (31%), and the cost of treatment (92%) which was the largest barrier. An example of a structural barrier is hospital strikes (79%). Factors responsible for delays included seeking spiritual (87%) and herbal treatments (86%), inappropriate medical care (77%), and lack of knowledge (83%). Other factors were delays at the specialist hospital, test result delays, difficulty with transportation, and lack of knowledge.

3.2.2.4 Participation in future CMEs

A significant 74% of participants showed interest in additional educational programs. Among them, 16% were willing to dedicate 1 to 2 hours, while 6% preferred a week-long experience. Notably, 16% chose not to respond (Figure 5).

4 Discussion

Our study showed that diverse stakeholders, including patients, care givers, primary care providers (PCPs), radiologists, surgeons, and clinical oncologists, have a role in reducing the burden encountered in a breast cancer patient's healthcare journey. Structural and individual barriers exist and play a large role but knowing what they are and how they affect the patient is imperative to addressing them. Patient experiences are best informed via FGDs focused on breast cancer diagnosis, treatment and the impact of psychological and socioeconomic factors in hopes of bringing heightened awareness of the impact on patients in LMICs (14).

Findings from our study highlight that 39% (9 patients) were mostly age 41-50years of age. The reported mean age at diagnosis of breast cancer in Nigeria was 42.7 years (SD 12.2, range 18–85 years) (15), likewise, that reported by Zaza et al. patients had a median age of 47 (IQR: 40,58) years (16). All the patients in the study were
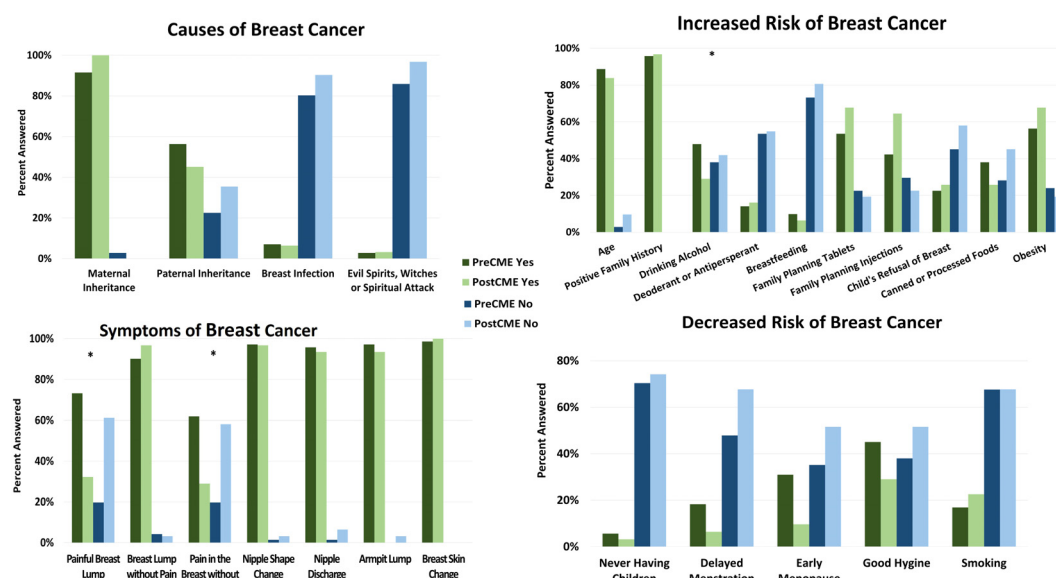
FIGURE 3

Provider knowledge increase pre- and post- CME course on breast cancer. Starting from top left going clockwise, the graphs show causes of breast cancer, causes of increased risk, causes of decreased risk and symptoms of breast cancer. Green represents "yes" while blue indicates "no". Dark colors indicate pre-CME answers while lighter colors indicate post-CME answers. Asterisks indicate statistical significant change in answers.

females, with 12 of them (52%) reporting a tertiary education level. Most participants were married, comprising 74% of the sample (17 individuals). A similar demographic was noted by Zaza et al, which revealed majority of participants were also female (n=349, 99.13%) (16). Among those for whom education level was known (n=182, 52%), many had attained a tertiary level of education (16). Additionally, 261 participants (74%) were married (16), suggesting a potentially higher level of social support for breast cancer patients, as corroborated by our study where funding source was mostly from family members 16 (70%). This finding aligns with reports of family support (57.6%) in another study (17). Monthly income was between N50,000 to N100,000 for 7(30%) while 6(26%) had no livable income, this is similar to that reported that the

majority of BC patients in Nigeria present late and have very low income, thus leading to inability to finance treatment (16).

The experiential responses from FGDs contextualize how barriers to care can compound and impact their care while HCP assumptions and knowledge base highlight the need for robust continuing education on specialty topics. Many patients (39%) saw a healthcare professional (HCP) within one month of beginning treatment. However, a significant number experienced delays in receiving care. Many participants discussed seeing different types of providers before finally seeing a physician with the knowledge and ability to diagnose breast cancer, which in one case ultimately caused a delay of close to four years before the patient received an appropriate diagnosis and began treatment. Frustratingly, this

FIGURE 4

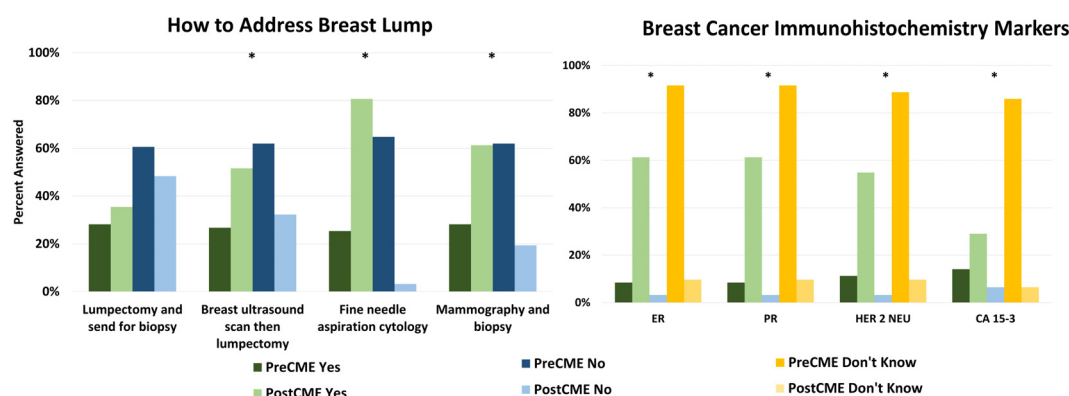Knowledge change in providers pre- and post- CME on breast cancer. How to address a breast lump (left) and what immunohistochemistry markers to order for breast cancer. Green indicates "yes", blue indicates "no" and yellow indicates "don't know" with darker colors indicating pre-CME answers and lighter colors indicating post-CME answers. Asterisks indicate statistically significant change in answers.

TABLE 7 Common facts and misconceptions about breast cancer with True/False responses as answered before (left) and after (right) CME course on breast cancer.

Both	Pre		Post	
	T	F	T	F
A painless lump is never breast cancer.	3%	**90%**	13%	**87%**
A benign lump becomes painful when it turns malignant.	31%	**54%**	32%	**65%**
Breast cancer is the most common cancer in women.	**87%**	7%	**87%**	13%
A woman less than 40 cannot develop breast cancer.	8%	**86%**	16%	**84%**
Tissue sample (histology) is the way to diagnose breast cancer.	**89%**	0%	**84%**	10%
Taking a tissue sample for histology or doing surgery causes the cancer to spread throughout the body.	10%	**69%**	26%	**68%**
Mammography can find breast cancer before a lump is felt.	**69%**	10%	**81%**	10%
Chemotherapy worsens outcomes in breast cancer	1%	**87%**	3%	**94%**
Radiation treatment worsens outcome in breast cancer	0%	**89%**	0%	**97%**
There are different types of breast cancer	**85%**	4%	**74%**	13%
If breast cancer has spread to other areas of the body it can still be eliminated from all parts of the body with medical treatment	**31%**	52%	**48%**	42%
Breast cancer is always deadly	32%	**59%**	29%	**65%**

Correct answers in bold.
[Totals between each true and false do not add to 100% due to answers of "do not know" being removed for brevity].
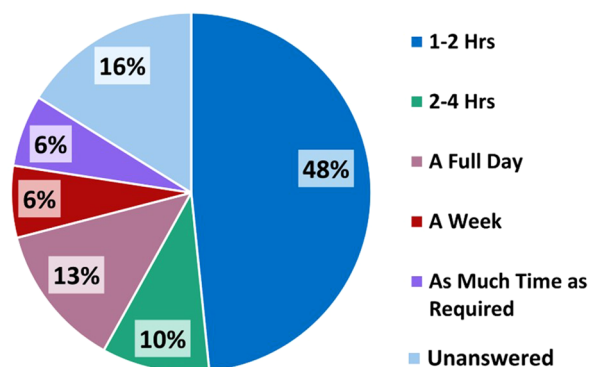

FIGURE 5
(A) Provider interest in participating in further educational programs on breast cancer. (B) Number of hours providers are willing to spend on further educational programs on Breast Cancer.

patient indicated that at least one provider she saw before taking it into her own hands promised to refer her to the proper care and never did. These delays were attributed to various factors, including not recognizing their symptoms as breast cancer, seeking treatment from local providers, being misdiagnosed, and receiving inappropriate treatment. Delays related to patients were reported and evaluated more often than those associated with healthcare providers or the health system, as noted by Nnaji et al. (18). This is a fairly common experience, as indicated in similar studies of breast cancer among 1429 women, the median length (months) of the diagnostic journey ranged from 11.3 (5.7-21.2) in Ugandan, 8.2 (3.4-16.4) in Zambian, 6.5 (2.4-15.7) in Namibian-black to 5.6 (2.3-13.1) in Nigerian (19). Many patients seek familiarity in their providers, going first to a friend or neighbor who is a nurse or chemist, a local health center staffed by non-physicians, pharmacists or church members before seeing a qualified physician (19). Further, once seen by a qualified physician, half (50%) had positive interactions with their provider, while the rest had neutral or negative interactions with their provider.

The fear of death associated with breast cancer diagnosis as well as the fear of familial or community abandonment were commonly brought up by the focus group participants in this study. Fear-based avoidance is commonly reported in similar studies, Ajekigbe et al. reported fear of mastectomy as a contributing factor to delayed presentation of BC patients (20), coinciding with the provider perception of fear of surgery in 90% of the responders, and this is also reflected in FGD responses presented here.

In this study, the fewest number of providers considered transportation difficulties to be a barrier to care. This contrasts with other publications, where approximately 34-42% of providers identified transportation as a delay or barrier. This discrepancy may be due to differences in the geographical locations where the studies were conducted. In this study, however, transportation was not a significant concern, as all participants lived within the city.

HCPs considered seeking care from spiritual leaders (85%), herbalists and traditional healers (87%) as a reason for delay of care. In sub-Saharan Africa, 85% of the population visits traditional healers for medical services (21). A major cause of delay in diagnosis of cancer at an early stage in Africa is the fact that many patients consult traditional healers first and are often treated by them until curative treatment cannot be undertaken (22). Our study highlighted, however, the fact that even HCPs believe they will consult alternative care practitioners if they have similar symptoms. Alternative sources of healthcare like herbalism, traditional healing and treatment from spiritual leaders play a large role in community health with average citizens as well as HCPs seeking them out. A significant portion of patients in another study, accounting for 35.1%, actively seek support from spiritual leaders or spiritual centers. However, it's noteworthy that the majority, 54.4%, choose to visit a healthcare facility as their first step. This suggests a valuable opportunity for integrating spiritual care within the healthcare system to better support patients' holistic needs. The World Health Organization (WHO) acknowledges the important

role of traditional medicine and recommends integrating traditional healers into the health care system (23). It can be argued that these sources of care represent an important aspect of overall health, especially in emotional well-being, as these can form an integral part of one's support system. However, it is vital to stress that these should not be the only source of care patients seek out, instead utilizing these sources as adjuvant treatments coinciding with modern medicine.

The CME course on breast cancer reported a significant increase in provider knowledge regarding the roles of mammography, fine needle aspiration cytology (FNAC), and biopsy. Additionally, the use of a breast ultrasound scan prior to a lumpectomy also yielded statistically significant results. The diagnostic test options were found to have significant (p = 0.034, 1.8E-07, 0.0012) improvement, including in the identification of specific immunohistochemistry markers. When answering true/false in regard to common breast cancer facts, there were improvements in some areas, but none with significant improvement, suggesting that future iterations of similar CME courses should focus on these facts more to improve provider confidence and reliability (Table 7). Research shows that continuing medical education (CME) improves knowledge and skills in medical education, ultimately leading to better healthcare outcomes (24). Results were limited by small sample size in the post-survey and high baseline knowledge. As knowledge about conducting biopsies after lumpectomies increases, it may not be statistically significant, but it can provide valuable information to some participants who are not aware of it. Additionally, this knowledge can enhance the comfort level of healthcare providers when dealing with patients presenting breast cancer symptoms. In turn, this can lead to more positive interactions and greater support for patients from their providers.

Many HCPs (74%) indicated willingness to take further training focused on breast cancer, which could be organized to incorporate the suggested collaborations. The majority's request for 1–2 hours may be insufficient, as some results indicate that the time spent may have been inadequate to convey all necessary information. Other factors mentioned by HCPs leading to delays include issues at the specialist hospital, delays in test results, transportation difficulties, and a lack of knowledge. These issues will be addressed in expanded meetings, where solutions will be proposed to improve the referral process and ensure that every patient receives timely care and necessary attention without delays. This suggestion of an expanded continuing education course could be further impactful by curating a breast cancer awareness outreach program targeted at the community members themselves. This could help increase awareness of breast cancer while also combating the cultural taboo of discussing it (11). In resource-constrained settings, early and streamlined care is crucial for optimal outcomes. By investing in these suggestions, patients will be more likely to receive timely and appropriate treatment, even with limited resources.

It has been documented that patients with positive relationships with their care team will have an optimistic outlook on their

treatment and that this will lead to a higher chance of completing treatment, and thus improve survival (25–27). Negative interactions, including the one patient who stopped attending the clinic, can leave patients feeling hopeless and unattended to. In the positive interactions discussed in the FGD, patient A felt that they had a chance at survival, while in the negative interaction, patient B left with her trust in her physician broken with no hope for survival. The lack of trust in any patient-provider relationship can lead to negative outcomes strongly supported by the predictions regarding both affectionate communication and affection deprivation where affectionate communication was found to positively relate to most outcome measures and vice versa (25). Luckily in the case of patient B, she was able to pursue a second opinion, however, many others with similar experiences do not have the ability, knowledge or financial means to seek out a second opinion, resulting in much poorer outcomes, reflecting a failure of the healthcare system.

The financial burden of the journey to care further impacts the patient's well-being. The process of diagnosis can be long, expensive, and frustrating on its own, but when presented with further expenses incurred for treatment, patients are caught in a poverty trap that only serves to further delay getting better. Patient C recalled being referred to a national hospital and meeting with an oncologist who requested a second opinion for her, however also brought up the expense this incurred. These tests, while important and relevant for diagnosing and staging patients properly, impose increasing financial burdens. These tests come even before discussion of treatment options, which many patients do not have the means to pay for. While the two abandoned women in the FGD were supported by a community that rallied to support them, many other women in the same position are not as fortunate and are often forced to forego treatment and ultimately pass away due to their cancer. The majority of funding was from family members 70% (n=16), church 30% (n=7) and friends 22% (n=5) indicating that in poor resource settings, healthcare spending is often out-of-pocket, which is associated often with a high rate of catastrophic healthcare expenditure (28). There is limited data concerning the specific costs associated with cancer care in Nigeria, which significantly impacts patients and their families (29). This lack of information presents challenges in developing effective health policies and creating local treatment guidelines. It is essential for stakeholders to actively participate in efforts to make cancer care accessible and affordable for everyone.

With success, providers should have increased competency in treating breast cancer and have an expanded "tool-box". The enhancement of capabilities through the collaborative efforts of stakeholders is expected to significantly improve patient outcomes and provide more comprehensive care for individuals affected by breast cancer.

5 Conclusion

FGDs highlighted the importance of support systems in patients' treatment journeys. Key elements of this support include encouragement from family and community, as well as positive interactions with healthcare providers. These factors contribute significantly to the overall experience and well-being of patients during their treatment. Providing educational tools like the CME or awareness course can enhance community knowledge of breast cancer and enable quicker referrals to healthcare providers.

To promote positive patient behaviors, key stakeholders need to participate actively in community outreach efforts and provide ongoing education programs, like the one outlined here. Future initiatives should emphasize discussions about breast cancer that incorporate a broader and more diverse range of participants. This approach will help identify and address both individual and structural barriers to accessing healthcare. This study revealed a huge lacuna in the referral system of breast cancer patients to tertiary hospitals.

The importance of Continuing Medical Education (CME) programs cannot be overstated when it comes to educating healthcare professionals (HCPs) and providing them with guidance on evidence-based medicine. This is particularly crucial in low-resource settings, where these practitioners play a vital role in promoting community health. However, this guidance can only be effective if patients are also informed. Therefore, collaboration among local providers, alternative treatment practitioners, and modern HCPs is recommended. Additionally, a post-survey will be conducted to assess any changes in healthcare professionals' attitudes toward appropriate referrals and the management of breast cancer.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Lagos University Teaching Hospital Health Research Ethics Committee Exemption Granted. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

AA: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – review & editing. VA: Formal Analysis, Visualization, Writing – original draft, Writing – review & editing, Data curation. AL: Writing – review & editing, Methodology, Project administration. DK: Writing – review & editing, Supervision. JC: Formal Analysis, Visualization, Writing – original draft, Writing – review & editing, Data curation. CW: Writing – review & editing, Funding acquisition. OO: Writing – review & editing. BA: Writing – review & editing. AS: Writing – review & editing. AO: Writing – review & editing. WS: Writing – review

& editing. AJ: Writing – review & editing. WN: Writing – review & editing, Supervision.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fonc.2025.1418649/full#supplementary-material

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