

ORIGINAL ARTICLE

**SEX DISPARITY IN CANCER OCCURRENCE AND TREATMENT AMONG
CANCER PATIENTS: A 2-YEAR RETROSPECTIVE STUDY OF THE
ONCOLOGY UNIT, FEDERAL TEACHING HOSPITAL, GOMBE**

**Khadijat A. Bobbo¹, Amina U. Babuga, Zubairu S. Rayyanu¹, Abdulrahman Adamu²,
Danladi A. Bojude²**

1. Department of Human Anatomy, Faculty of Medicine and Allied Sciences, College of Medical Sciences, Gombe State University, Gombe State, Nigeria.
2. Department of Oncology, Faculty of Medicine, Gombe State University/ Federal Teaching Hospital 760253 GSU, Gombe State-Nigeria.

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ABSTRACT

Background: Sexual disparity in cancer prevalence and treatment approaches is a crucial factor in achieving effective cancer treatment and management globally. This study aimed to investigate gender-specific patterns of cancer types and treatments among patients in Nigeria.

Objective: To determine the prevalence of different cancer types and associated treatment modalities, highlighting any sexual dimorphism among patients attending the Oncology Unit of the Federal Teaching Hospital, Gombe, Nigeria, between 2022 and 2024.

Methods: This was a two-year (2022-2024) retrospective study. Data on patient demographics, cancer types, and treatment modalities were systematically collected from oncology ward records at the Federal Teaching Hospital, Gombe.

Results: A higher overall prevalence of cancer was observed in females. Gynecological cancers (cervical and ovarian) and breast cancer are the most common among females, while prostate and gastrointestinal (GIT) cancers are predominant in males. Cancers are treated either as a standalone therapy or in combination. No significant gender difference was found in the use of standalone chemotherapy. However, combination therapy involving chemotherapy and surgery was more common in male patients, while other multi-modal treatments incorporating radiotherapy, surgery, and brachytherapy were less frequent across both genders.

Conclusion: Significant gender disparities in cancer types and treatment patterns exist among patients at the Oncology Unit of the Federal Teaching Hospital, Gombe. Females showed higher overall cancer incidence, primarily with breast and gynecological cancers, while males exhibited higher rates of prostate and GIT cancers. Gender differences were observed in treatment modalities, likely influenced by the anatomical locations of organs, such as the deep ovary versus the more superficial prostate.

Keywords: Sex disparity, cancer, treatment, chemotherapy

INTRODUCTION

Sex disparity in humans refers to the physical differences between males and females beyond their primary sex organs. It is a multifaceted phenomenon that extends beyond basic reproductive biology, encompassing physical and psychological traits. These differences influence reproductive capabilities, mate choice, and how individuals are perceived and behave in social contexts. They also contribute to social structures and stereotypes that exist in societies. Understanding sex disparity is crucial in human biology, psychology, and behaviour.^{1,2} In biomedical research, sex disparity influences the risk assessments, disease manifestation, and therapeutic/ drug interactions.^{1,3}

For instance, men are generally at a higher risk of developing infectious diseases due to hormonal and chromosomal influences on the immune system.³ Women, on the other hand, have a higher risk of mental disorders influenced by various factors such as social, lifestyle, genetic, and biological factors.⁴ During the COVID-19 pandemic, viral entry and vaccine response demonstrated sex-specific patterns, with men experiencing higher sensitivity, mortality, risk of reinfection, and long COVID.⁵ Similarly, men and women demonstrate different risks and manifestations in cardiovascular diseases, with men having a younger age of manifestation risk than women.⁶

Anatomical and physiological differences between sexes are essential for forensic sex estimation^[7] and impact surgical techniques and outcomes.⁸ The disparity in pharmacokinetics and pharmacodynamics emphasizes the importance of including both sexes in clinical trials and optimizing drug dosages, efficacy, and minimizing adverse

effects.⁹ Furthermore, the application of sex disparity is crucial for the development of sex-specific precision therapeutic targets.^{1,10} In terms of some disease conditions, such as cancers, sex-specific screening guidelines have been established for female reproductive cancers. A similar application could refine preventive strategies for a broader range of conditions in both sexes.¹¹

In terms of cancers, factors such as genetic, hormonal, immunological, and environmental factors contribute to the sex disparity. These influence the prevalence of sex-specific and non-sex-specific cancers, diagnosis, management, and prevention. Despite its significance, sex may not be given adequate relevance in cancer research and clinical practice.¹²

Cancer poses a significant global public health challenge, burdening healthcare systems and populations with its increasing incidence and mortality rate.^{13,14} The global incidence, reported by GLOBOCAN from 185 countries in 2022, has reached about 20 million,¹⁵ a notable increase from 2018 of about 18.1 million (new cases) and 9.6 million cancer deaths.¹⁶ In Africa, there were about 1.1 million new cases and 711,429 deaths in 2018, with higher incidence rates in females (633,456 new cases and 387,546 deaths) compared to males (475,753 new cases and 323,883 deaths).¹⁷ However, the global trend of new cancer cases was higher in males.^{15,17} Breast cancer remains the most common malignancy in females globally and in Africa, while prostate cancer is the most common in males.¹⁷

In Nigeria, cancer incidence and mortality rates are alarmingly high, with breast and prostate cancer being the most prevalent

among females (22.7%) and males (11.3%), respectively.^{17,18} Other common cancers in Nigeria include cervical (12.9%), colorectal (5.8%), and non-Hodgkin lymphoma (4.6%). The incidence of breast and cervical cancers is particularly high among Nigerian women. The trend of cancer incidence in Nigeria is increasing, with a projected 85% rise in incidence and mortality over the next 15 years.¹⁹

This study aims to investigate the sex disparity in types and treatment regimens in cancer patients. This preliminary study might offer a promising starting point for understanding any sexual disparities among cancer patients in the Oncology Unit of the Federal Teaching Hospital, Gombe. The study's outcome might enhance the therapeutic strategies and outcomes for cancer patients in Nigeria.

MATERIALS AND METHODS

This retrospective study analysed data from 149 cancer patients who received care at the Oncology Unit of Teaching Hospital Gombe between January 2022 and December 2024. Ethical clearance (NHREC/25/10/2013) was obtained from the Health Research and Ethics Committee of Federal Teaching Hospital, Gombe, before data extraction commenced.

Study Population and Design

The sample population included all 149 patients who met the inclusion criteria during the specific period. Data on sex, age, cancer types, and treatment were collected using a structured data extraction method following that of an Hungarian tertiary care center.²⁰ One patient was excluded due to age criteria. The study aimed to check the distribution of cancer types and treatment by gender. Chi-square (X^2) analysis was used to test the association

between cancer types, treatments, and gender. The following data was collected:

1. **Demographics:** sex and age
2. **Cancer Diagnosis:** Type of cancer.
1. **Treatment History:** Type of treatment received (e.g., surgery, chemotherapy, radiotherapy).

The data extraction process was adapted from a methodology used in a Hungarian tertiary care center²⁰ with slight modifications in the tables to ensure relevance to the study population.

Inclusion Criteria

1. Cancer patients with a histological or cytological diagnosis of cancer
2. Patient 18 years and above (for a more homogeneous study population)
3. Patient attending Federal Teaching Hospital, Gombe

Study Location

Data was collected from the Oncology Unit of the Federal Teaching Hospital in Gombe State, Nigeria. This is a referral center and tertiary healthcare facility for specialized medical care, including cancer diagnosis, treatment, and management, located in the North-East region of Nigeria, serving several states, including Borno, Yobe, Adamawa, Taraba, and Bauchi states.

Data Analysis

Data was summarized and figures were created using Microsoft Excel version 2019 (16.69). The Chi-square test was used to determine if there is a significant association between the categorical variables. A p-value of 0.05 or less was considered significant.

RESULTS

Descriptive Statistics

This 149-patient cohort was extracted from the Oncology Unit of the Federal Teaching Hospital (FTH) in Gombe, predominantly comprising females (117 patients) at 79%, and

32 (21%) males (Figure 1). The age distribution of males ranged from 21 to 78 years, with a mean age of 51 years, while the female patients had a slightly broader age range from 19 to 86 years, with a mean age of 55 years (Table 1).

Table 1. Descriptive statistics of cancer incidence in Gombe State University Teaching Hospital between January 2022 and December 2024

Descriptive Stat	Male	Female
Sample	32	117
% Sample	21.5	78.5
Average age (years)	50.7	53.6
Mean Age (years)	51	55
Maximum age (years)	78	86
Minimum age (years)	21	19

The cancer types of analysis demonstrated a non-even distribution within this study population, with breast (BRT) at 35% and gynaecological cancers, cervical (CEV) at 24%, and ovarian (OVR), being the most frequently occurring. The gastrointestinal tract (GIT) cancers were the third most common, accounting for 13% of all cases (Figure 2), as the most common in males in this study. Other cancer types, head and neck (H&N) at 4%, prostate (PROS) at 3%, lymphoma (LYM) and bone (BON) at 2% each, were observed in smaller proportions. Lacrimal duct, muscle, lung, skin, pancreatic, Kaposi, and

fibrosarcoma cancer types were also identified in the cohort, but at a low frequency (~1% each).

Sex disparity in Cancer prevalence

The table below (Table 2) represents the distribution of different cancer types among male (Figure 3) and female (Figure 4) patients, demonstrating sex disparity in cancer occurrence and types. The table categorizes various cancers and provides the number of cases for each sex and their respective percentages. Chi-square (χ^2) test and p-value were used to assess the statistical significance of the differences between males and females.

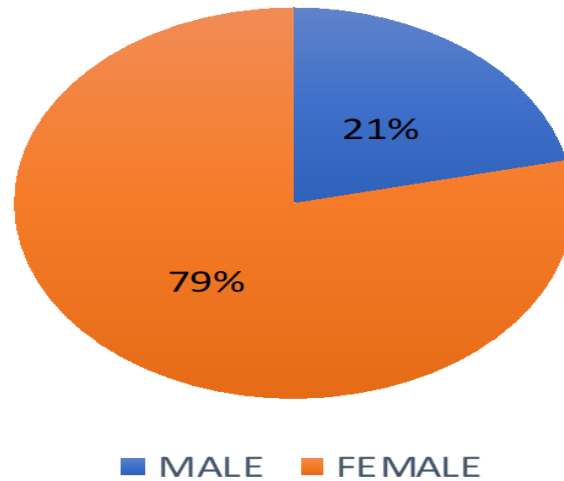


Figure 1. Cancer incidence between January 2022 and December 2024 in the Oncology Unit of Gombe State University Teaching Hospital.

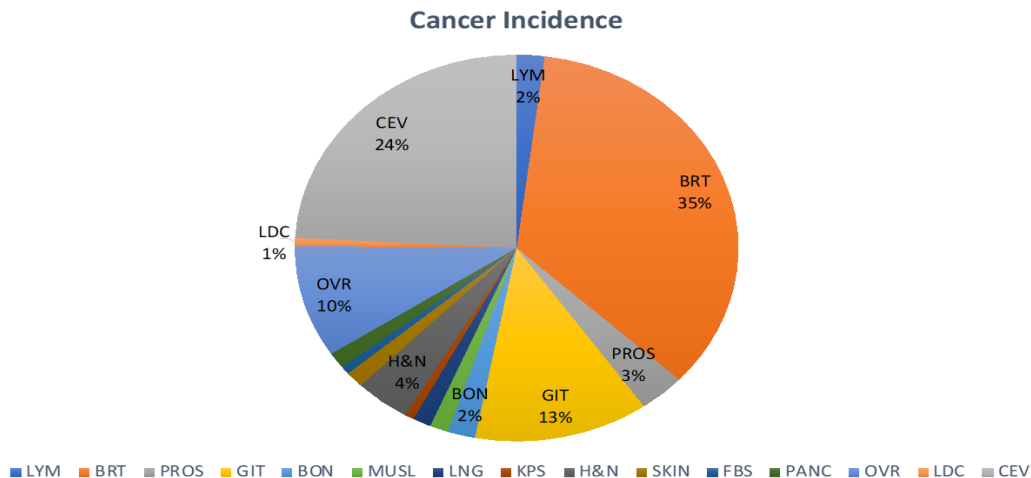


Figure 2. Distribution of Cancer types from January 2022 to December 2024 in the Oncology Unit of Gombe State University Teaching Hospital.

Key: LYM = lymphoma, BRT = breast, OVR = ovary, PROS = prostate, GIT = gastrointestinal, BON = bone, LDC = lacrimal duct cancer, CEV = cervical, MUSL = muscle, LNG = lung, KPS = Kaposi, PANC = pancreas, H&N = head & neck, SKIN = skin, FBS = fibrosarcoma.

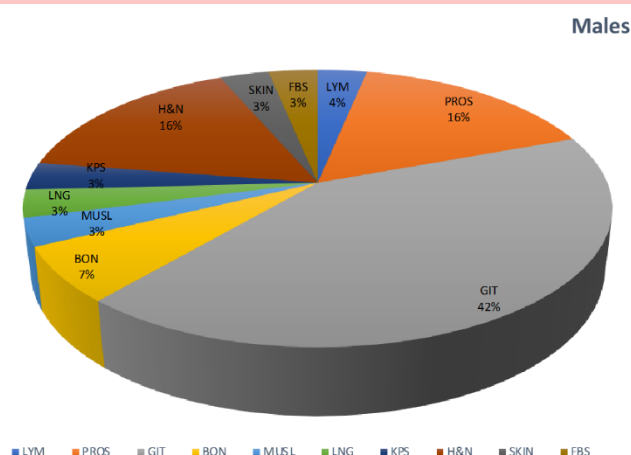


Figure 3. Distribution of Cancer types in male patients from January 2022 to December 2024 in the Oncology Unit of Gombe State University Teaching Hospital.

Key: LYM = lymphoma, BRT = breast, OVR = ovary, PROS = prostate, GIT = gastrointestinal, BON = bone, LDC = lacrimal duct cancer, CEV = cervical, MUSL = muscle, LNG = lung, KPS = Kaposi, PANC = pancreas, H&N = head & neck, SKIN = skin, FBC = fibrosarcoma.

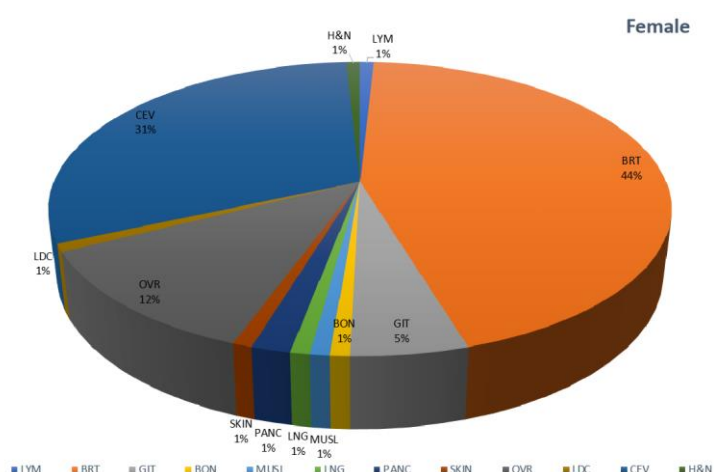


Figure 4. Distribution of Cancer types in female patients from January 2022 to December 2024 in the Oncology Unit of Gombe State University Teaching Hospital.

Key: LYM = lymphoma, BRT = breast, OVR = ovary, PROS = prostate, GIT = gastrointestinal, BON = bone, LDC = lacrimal duct cancer, CEV = cervical, MUSL = muscle, LNG = lung, KPS = Kaposi, PANC = pancreas, H&N = head & neck, SKIN = skin, FBC = fibrosarcoma.

The chi-square (χ^2) test was used to investigate the relationship between sex and cancer occurrence within this cohort, and the resulting statistic was $\chi^2 = 2.1561$ at p-value = 0.1420. This showed the difference between the observed and expected cancer frequencies in males and females, leading to the acceptance of the null hypothesis, which states that there is no statistically significant association between sex and cancer types.

Table 2. Summarizes the occurrence of cancer among males and females

Cancer Type	Males	Percent	Females	Percent
LYM	2	6	1	1
BRT	0	0	52	44
OVR	0	0	14	12
PROS	5	15	0	0
GIT	13	39	6	5
BON	2	6	1	1
LDC	0	0	1	1
CEV	0	0	36	31
MUSL	1	3	1	1
LNG	1	3	1	1
KPS	1	3	0	0
PANC	0	0	2	2
H&N	5	15	1	1
SKIN	1	3	1	1
FBS	1	3	0	0
TOTAL	33	100	117	100

Key: LYM = lymphoma, BRT = breast, OVR = ovary, PROS = prostate, GIT = gastrointestinal, BON = bone, LDC = lacrimal duct cancer, CEV = cervical, MUSL = muscle, LNG = lung, KPS = Kaposi, PANC = pancreas, H&N = head & neck, SKIN = skin, FBC = fibrosarcoma.

Previous studies have shown significant differences in the prevalence, type, progression, and treatment response across various cancers in the different sexes. The analysis revealed a non-uniform distribution within the study population, with the most frequently occurring cancers (BRT, CEV, and OVR) being female-associated cancers, likely reflecting the larger proportion of female patients in the sample. In this cohort, breast cancer constitutes 44% of all female cancers. While the male-associated cancers are less frequent than those of females, prostate cancer incidence is at 16% of all male cancers. Other cancers commonly affecting males include those of the gastrointestinal tract and the head and neck, accounting for 42% and 15% of all cancers occurring in males, respectively.

Distribution of Cancer Treatment among Male and Female Patients

The contingency table 3 below summarizes treatments administered to male and female patients, the chi-square (χ^2) test, and the p-value for chemotherapy treatment. As highlighted, chemotherapy is the most common treatment for males and females, accounting for roughly half of the treatments administered in each group.

Chi-square (χ^2) test and p-value to check for the relationship between chemotherapy treatment and gender specific yielded a statistic of 2.381 with a corresponding p-value of 0.8815. No statistically significant difference in the proportion of males and females who received chemotherapy. Therefore, the null hypothesis, which states no

association between gender and chemotherapy treatments, was accepted. Although the percentage showed a slightly higher proportion of females receiving chemotherapy (50%) than males (48%), this was not enough to be considered statistically significant. This difference is likely due to random variation within this specific sample.

The percentages for other treatments reveal interesting descriptive differences that recommend further investigation in a larger dataset. In surgery-based treatment regimens, males appear to have a slightly higher (6% + 30% + 3% = 39%) proportion than females (3%

+ 21% + 31% = 31%). The surgery was standalone, and in combination with other treatments like chemotherapy and radiotherapy. This suggests male patients within the sample have a higher inclination towards surgical interventions, although the statistical difference was not tested. Females have a notably higher CHM-SURG-RA (7%) and a slightly higher CHM-RAD-BRAC (4%) combination regime than males (4% and 3%, respectively). In the case of CHM-RAD and BRAC-CHM treatment regimes, both genders had the same percentage, suggesting a similar utilization.

Table 3: Treatment modalities among males and females

Treatment	Males	Percentage	Females	Percentage	X ²	P-Value
CHM	16	48	58	50	2.381	0.8815
SURG	2	6	3	3		
CHM-RAD	2	6	3	3		
BRAC-CHM	1	3	4	3		
CHM-SURG	10	30	25	21		
CHM-SURG-RAD	1	3	8	7		
CH-RAD-B	1	3	5	4		
TOTAL	33	100	117	100		

Key: CHM = chemotherapy, SURG = surgery, CHM-RAD = chemotherapy-radiotherapy, BRAC-CHM = brachytherapy-chemotherapy, CHM-SURG = chemotherapy-surgery, CHM-SURG-RAD = chemotherapy-surgery-radiology, CHM-RAD-B = chemotherapy-radiotherapy-brachytherapy.

DISCUSSION

Sex disparity has a significant impact on the diagnosis, incidence, therapeutic management, and possible prevention of sex-specific and non-specific cancers. This critical factor is, however, not stressed enough in cancer research and clinical practice.¹² Several factors have been identified to influence sex disparity in cancer. For example, the protective and promoting effects of estrogen on different cancers. Apart from hormonal factors, other

factors, including immunological and environmental factors, contribute to sex dimorphism in cancer.²² Sex disparity in the immune system, activity, and gene expression interferes with cancer development and progression.²² Similarly, differences in disease incidence, treatment response, and outcomes suggest further investigation to understand the best treatment regimen for each sex.²³ For instance, men have been shown to have higher age-standardized incidence and mortality

rates. While certain cancers, such as breast and cervical cancers, are prevalent in women.^{11,24} Understanding these sex-specific patterns is essential in cancer risk assessment and treatment planning.²⁴

A study in Nigeria of two cancer registries, the Ibadan Population-Based Cancer Registry (IBCR) and the Abuja Population-Based Cancer Registry (APBCR), found a higher incidence of cancer in females, particularly female-associated cancers, like breast and cervical cancer.²⁵ These findings are consistent with findings in other African countries, including the current study; therefore, this highlights the importance of addressing the specific healthcare needs of women in cancer prevention and treatment.²⁶

The mean ages observed in this study align with the typical age of cancer diagnosis for many common cancers. Higher prevalence of post-menopausal cancers like breast and ovarian cancers, which tend to increase with age, might be behind the slightly older ages of females. Although more common in younger women, cervical cancer can also be diagnosed in older age groups. Studies on cancer diagnosis age in Nigeria show a wide age range depending on the cancer type and region, with a general trend of younger age at diagnosis compared to developed countries for some cancers. The mean ages in this cohort align with the global trend, with a broader age range in females reflecting the diverse spectrum of gynaecological cancers manifesting at different life stages.^{27,28}

In Nigeria and globally, breast cancer is the most common cancer among women.²⁶ Cervical cancer, often diagnosed at later stages due to limited screening programmes in many developing countries, including Nigeria,

remains a significant public health concern.²⁹ A 24% incidence of cervical cancer in this cohort emphasizes this health burden. Though less common than breast and cervical cancer, ovarian cancer also shows a high prevalence of 10% in this study.

The high prevalence (13%) of the combined gastrointestinal (GIT) cancers among male patients in this cohort is obvious, highlighting it as a significant burden of these cancers in the region. Further investigation is therefore needed to understand the specific types of GIT cancers and their risk factors in this population. Some GIT cancers, such as colorectal and gastric cancer, have a higher incidence in males in certain populations,^{30,31} emphasizing the importance of investigating their prevalence and risk factors in the Gombe population. The smaller male representation in this cohort might be attributed to the low frequency of prostate cancer (3%). The other cancers (H&N, lymphoma, bone, etc.) revealed a lower frequency in the cohort; however, this was expected.

Common male cancers within this cohort, including prostate, GIT, and head and neck, reflect global trends in cancer epidemiology.²⁴ While GIT and head and neck cancers can affect both sexes, they are often prevalent in males. This could be due to lifestyle factors such as smoking, alcohol consumption, and occupational exposure.^{31,32} In Africa, prostate cancer is the most frequently diagnosed cancer in males, with 93,173 new cases and 47,249 deaths reported.¹⁷ According to the Nigerian National Cancer Control Plan (2018-2022), breast and prostate cancers are the most common malignancies in Nigerian females (22.7%) and males (11.3%), respectively. Other prevalent cancers in Nigeria include cervical (12.9%), colorectal (5.8%), and non-

Hodgkin lymphoma (4.6%). The combined incidence of breast and cervical cancers in Nigeria is alarmingly high, indicating a higher prevalence among women in Nigerian studies.¹⁸

Breast cancer in males, although rare, and its absence in this study, may be attributed to the small sample size of males. A larger study is needed to determine the prevalence of male breast cancer in this population. On a global scale, male breast cancer accounts for less than 1% of all breast cancer cases, often presenting as high-grade tumors with a poorer survival rate. Further research is recommended to investigate the biology and histology of male breast cancer.³³

In the non-sex-specific cancers, differences in cancer frequencies between males and females were noted in this study. However, no statistically significant association was identified between sex and types of cancer diagnosed at FTH, Gombe. This may also be due to the small sample size, particularly of the male patients, limiting the power of the chi-square test to detect associations. Although this cohort did not exhibit sex-based disparities, global trends indicate significant differences in cancer incidence, types, progression, and treatment response based on sex, which may be influenced by environmental, genetic, or lifestyle factors.^{34,35}

Chemotherapy is one of the important components of treatment for solid tumours. It is administered to about half of all treatments in this cohort. Chemotherapy alone was the most common treatment received by male (48%) and female (50%) patients. This reflects the global value in its use as neoadjuvant, adjuvant, or palliative care for different cancer types and stages.^{36,37} In this cohort, gender did

not influence the likelihood of chemotherapy treatment as the primary factors determining chemotherapy administration were. Regarding surgery-based treatment regimens, this was more common in males (39%) than in females (31%). Females, on the other hand, had a higher use of chemotherapeutic-surgery-radiation and a slightly higher chemotherapy-radiotherapy-brachytherapy combination regimen compared to males. Both genders had similar rates of chemo-radiotherapy and brachytherapy-chemotherapy combination regimens.

The higher use of combination therapies in females may be due to the standard established management of gynaecological cancers, which often require multimodal treatment approaches. For example, cervical cancer frequently involves a combination of chemotherapy, external beam radiotherapy, and brachytherapy,³⁸ while management of advanced breast cancer may include surgery followed by adjuvant chemotherapy and/or radiotherapy.³⁹ Females with prevalent cancers such as breast and cervical cancers, may present at more advanced stages, requiring complex treatment strategies compared to males.⁴⁰ In some male common cancers, such as the GIT,⁴¹ prostate,⁴² head, and neck cancers,⁴³ the cancers are often localized, leading to a greater reliance on surgical interventions as a primary or part of a multimodal treatment approach.

CONCLUSION

This study provides a pilot study into the co-relationship between sex, cancer type, and treatment in a 2-year cohort from the Oncology Unit of Federal Teaching Hospital, Gombe. While no statistically significant association was found between sex and cancer types, gender-specific patterns in cancer prevalence

were observed. The use of chemotherapy was predominant in both male and female patients, with a higher prevalence of surgery-based regimens in males. Future research with a larger sample size and detailed analysis of cancer types and stages is needed to confirm these findings and develop a gender-sensitive approach to cancer management in the region.

RECOMMENDATIONS

1. Conduct a larger cohort of cancer patients from the FTH Gombe region to enhance the statistical power for detecting significant associations between sex, cancer type, and treatment modalities.
2. Analyze the relationship between sex and the occurrence of specific cancer types, rather than broad categories like the GIT cancers, in this study. This will provide a better understanding of gender-specific risks and prevalence.
3. Conduct a detailed analysis of the treatment regimens employed for individual cancer types, stratified by sex. This will help determine if there are statistically significant differences in the use of surgery, radiotherapy, chemotherapy combinations, and other therapies based on gender for the same cancer.
4. Analyze data on the cancer stage at diagnosis for male and female patients across different cancer types. This will help determine if differences in presentation or access to early detection contribute to the observed variation in treatment approaches and potentially influence the likelihood of surgical intervention.
5. Conduct epidemiological studies to explore potential biological, environmental, lifestyle, and genetic risk factors that may contribute to the observed

gender-specific patterns in cancer incidence in Gombe.

6. Explore the referral pathways to the oncology unit to understand if any gender-specific biases might influence the types and stages of cancer they present.
7. Future research could incorporate the analysis of molecular and genetic markers in tumor samples to investigate potential sex-based differences in tumor biology and their impact on treatment response.

RECOMMENDATIONS FOR CLINICAL PRACTICE

1. Increase awareness of gender-specific cancer risk.
2. Develop and implement a gender-sensitive cancer screening and prevention program.
3. Promote equitable access to comprehensive cancer care.

DECLARATIONS

Conflict of Interest

The authors declare no conflict of interest

Authors' Contributions

All authors made significant contributions to the study and have approved the final version of the manuscript.

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