Original Research

Distribution and Trends of Cancer Incidence in Tanzania from 2007-2021: A Hospital-Based Study

Baldwina Tita Olirk[1*], William Neslon Mwakalasya[2], Aiwerasia Vera Ngowi[2], Ezra Jonathan Mrema[2], Jovine Bachwenkizi[2], Deogratius Beda Mwanakulya[3], Mbonea Salehe Yonazi[4], Mohamed Yakub Janabi[5]

[1]Department of Occupational Health and Safety, Muhimbili National Hospital, Dar es Salaam, Tanzania

[2]Department of Environmental and Occupational Health, School of Public Health and Social Sciences, Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania

[3]Department of Medicine (Oncology Unit), Muhimbili National Hospital, Dar es Salaam, Tanzania

[4]Department of Clinical and Supportive Services, Muhimbili National Hospital, Dar es Salaam, Tanzania

[5]African Region of the World Health Organization (WHO - AFRO)

*__Corresponding author:__ Baldwina Tita Olirk; Email: baldwina.olirk@mnh.or.tz

Abstract

Background: The increasing prevalence of cancers in Tanzania poses a significant public health concern. Despite data being collected from major referral hospitals, systemic challenges such as delayed diagnosis and incomplete historical records may still affect overall cancer surveillance.

Objective: To determine the distribution and trends of cancer incidence in Tanzania.

Methods: We analysed all cancer data collected between 2007 and 2021 from available cancer registries. Cancer incidence trends were assessed using linear regression with statistical significance considered at $p < 0.05$ and the 95% confidence intervals.

Results: Data from four hospitals yielded 58,271 cancer cases for the sixteen most recorded cancer types. Retinoblastoma was the most common among children under 15 years (42.4%). Liver cancer was most prevalent in the 15–29 years age group (28.7%) and among males aged 30–59 years (21.7%). While prostate cancer dominated in those aged at least 60 years (30.4%), cervical cancer was the most common (39.8%) in females aged 30–74 years. Overall cancer incidence increased significantly from 5.91 to 12.89 per 100,000 (β=0.66; $p<0.0001$). Specific cancers such as prostate, cervical, and breast cancer increased, while Kaposi sarcoma and bladder cancer declined. Cancer cases were concentrated in Dar es Salaam, Kilimanjaro, and Mwanza regions.

Conclusion: This study shows cancer incidents that demonstrate significant trends in Tanzania and regional distribution. Findings may facilitate cancer control strategies addressing the impact of cancer cases nationwide.

Keywords: *Cancer; Distribution; Trend; Retrospective*

Introduction

Cancer has emerged as a significant public health concern and is registered worldwide as one of the major causes of mortality every year (1,2). Mortality rate due to cancer in developing countries is projected to increase from 65% in 2012 to 70% by 2030 (1,2). In sub-Saharan Africa, the burden of cancer is more pronounced, with approximately 75% of cases and deaths occurring (3).

The burden of cancer in Tanzania continues to grow rapidly, exerting high physical, emotional, and financial strain on individuals, families, communities, as well as health systems (1,3–5). It was estimated that Tanzania had 44,931 new cases and 29,743 deaths recorded by 2020 (6). A previous facility-based study showed that cancer is the seventh leading cause of mortality in the country (4). Nevertheless, a previous population-based study reported cancer as the third leading cause of mortality in individuals aged 15-59 years (5). The trend has been attributed to a fast alteration in lifestyle, behavioural patterns, and an increase in environmental and occupational exposures to carcinogens (1). Based on this report, variations in cancer incidence between regions in Tanzania have been reported (3). Cancer incidence and prevalence in Tanzania are likely to be highly underestimated due to a lack of

appropriate diagnosis and the actual distribution of these malignancies in Tanzania is partly unknown, which makes it hard to establish cancer control interventions (7).

The provision of cancer services is more complicated. None of the primary and secondary levels has the capacity to diagnose and treat cancers (8). Cancer services in the country are provided at four tertiary-level hospitals: Ocean Road Cancer Institute (ORCI), Muhimbili National Hospital (MNH), Bugando Medical Centre (BMC) and Kilimanjaro Christian Medical Centre (KCMC). This centralized service delivery model contributes to delays in cancer diagnosis and treatment, forcing many patients to move around the health system extensively, mainly through self-referral as symptoms worsen (9).

ORCI alone manages a high volume of cancer patients annually despite having few clinical oncologists (10). Similar capacity constraints are observed at other regional centres (11,12). Efforts to address these challenges include the Tanzania Comprehensive Cancer Project (TCCP), which supports training and infrastructure development, and partnerships aimed at expanding the oncology workforce.

Recognizing that low national income and the inability to spend due to the high expense of chemotherapy and radiation (13), the Tanzanian government has exempted cancer patients from paying for their treatment when cost-sharing was introduced in the public health sector in 1993. However, cancer patients still have to pay for diagnostic tests, additional medications, and other inpatient treatments, including surgery and transfusions. Evidence from a prospective cohort study at ORCI estimated the total cost of managing a cervical cancer patient to range between TZS 2 million and 6 million (about USD 1,300–2,900), depending on disease stage and required services (14). This highlights the substantial financial burden of cancer care in Tanzania, particularly for patients without health insurance or financial support.

However, the current understanding of cancer trends and their geographic distribution across Tanzania remains limited. Although national referral hospitals contribute significantly to cancer data, challenges such as delayed diagnosis, incomplete documentation, and fragmented record systems affect the completeness and timeliness of hospital-based data. These limitations hinder comprehensive

epidemiological insight and complicate timely and targeted cancer control interventions. This study aimed to determine the distribution and trends of cancer incidence in Tanzania using data from selected hospital-based cancer registries. The analysis provides information beyond Global Cancer statistics database (GLOBOCAN) as it utilizes real-world, hospital-based data collected directly from patient records, offering more detailed and context-specific insights. This is particularly important in low-resource settings, where reliable cancer data is limited.

Materials and methods

Study design and settings

We employed a cross-sectional hospital-based study using data collected between 2007 to 2021 in Tanzania. We included four hospitals (Ocean Road Cancer Institute (ORCI), Muhimbili National Hospital (MNH), both from the Dar es Salaam region, Bugando Medical Centre (BMC) in the Mwanza region and Kilimanjaro Christian Medical Centre (KCMC) from the Kilimanjaro region. These sites were selected because they are the main hospitals attending cancer patients in Tanzania. While initial diagnoses begin at other healthcare facilities, suspected cancer cases are typically referred to any of these four centres for definitive diagnosis and management. Therefore, cancer data from these centres provide a comprehensive and representative overview of cancer cases nationwide.

In cancer management, MNH receives patients who need further investigation and treatment from all parts of the country. It offers comprehensive cancer services such as diagnosis, surgery, pathological services and chemotherapy treatment before and after surgery. Patients in need of radiation treatment are referred to ORCI. BMC provides tertiary speciality care referral services to a catchment population of over 14 million people in northwest Tanzania (15). The KCMC serves as the referral hospital mostly for people in Northern Tanzania (16).

Data abstraction

Data were extracted using a pre-tested data abstraction form (Excel sheet), developed with competent registry personnel from all sites. Cancer cases were confirmed as per International Classification of Diseases (ICD) codes.

Measures

The main variables for this study included cancer type and its ICD-10 code, year of

first diagnosis, patient's age and sex and patient's residence and birth place.

Data collection process

Data was extracted from both electronic and paper-based data sources for about eight months.However, in the electronic data source, the number of cancer cases were regrouped in descending order to determine the top ten prevalent cancer types using the ICD-10 classification. To avoid duplication, cleaning was done by checking hospital registration numbers to remove recurring patients across years and visits. Cases from MNH and ORCI were merged due to frequent patient overlap between these two sites. Consistency checks were applied to variables (e.g., standardizing variable names), and patient residence was verified using referral letters and patient history to avoid misclassification. For the paper-based source, files were grouped by year and ICD-10 cancer type to identify the top ten cancers. Data abstraction focused only on these top cancers using a pre-designed form. Throughout the data collection and validation process, the research team collaborated closely with each hospital's cancer registry staff to guarantee data accuracy. To reduce classification errors, cancer cases were verified after abstraction using ICD-10 codes.

Statistical analysis

The data were analyzed by using IBM Statistical Package for Social Sciences (SPSS) for Windows version 23 (IBM Corp., Armonk, New York, USA), applying both descriptive and inferential statistical approaches. Cancer incidence rates per 100,000 population were calculated for each year using the number of new cases and population estimates as per the 2002 (17) and 2012 census (18). Incidence rates for gender specific cancer like prostate, cervical and breast were computed by including only the population for that specific gender.

Trends in cancer incidence over the study period were assessed by linear regression analysis. The regression coefficients (β), including their respective 95% confidence intervals (CI) were used to assess the linear trends and their strength. Statistical significance was considered at a p-value<0.05.

Ethical considerations

All methods were carried out in accordance with the Declaration of Helsinki guidelines and regulations. The study was approved by the Institutional Review Board of Muhimbili University of Health and Allied Sciences

(MUHAS) through a reference, MUHAS-REC-10-2021-866. The permission to conduct the study at all centres was obtained from the respective Executive Directors (ED). None of the individual consent was required as this was a secondary data analysis. All the data were fully anonymized before analysis, and no identifiable personal information (such as medical ID or patients' names) were accessed.

Results

After a thorough scrutiny of the records from all four hospitals, a total of 58,271 records were collected from MNH, ORCI and KCMC, which reflected the ten most occurring cancer types for the last 15 years and the last 10 years from BMC. The majority of the cases 41,085 (70.5%) were retrieved from MNH/ORCI, 10,066 (17.3%) from KCMC and 7,120 (12.2%) from BMC. The mean age for the patients at registration was 52.7 (SD=19.6) years, ranging from 0 to 112 years. Cases were almost equally distributed by sex (female, 54.2%).

Distribution of cancer cases by year of registration, 2007-2021

In all cancer cases studied, cervical cancer was the most prevalent (22%), followed by prostate (16.8%) and breast (14.2%). The detailed distribution of cancer types is shown in Figure 1.

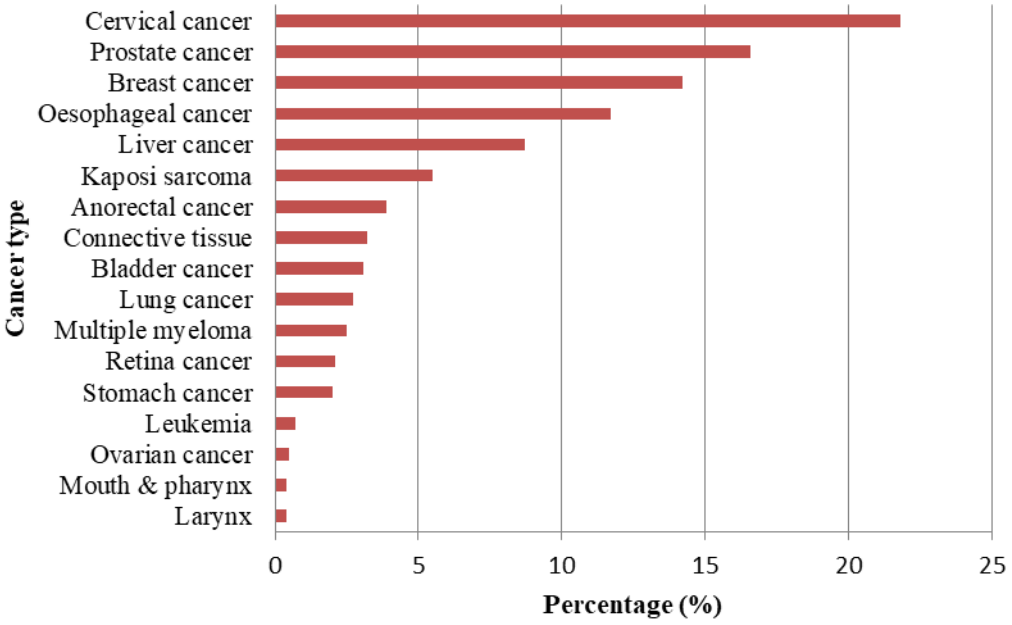

Figure 1: Distribution of cancer patients for 15 years (2007-2021)

Distribution of cancer cases by age and sex

Figures 2 and 3 show the distribution of cancer cases by age and sex, respectively. Among children below fifteen years, Eye (Retinoblastoma) was the most diagnosed cancer, accounting for 42.4%, followed by anorectal cancer (10.4%) and connective tissue (8.7%). Among males, liver (21.7%) and oesophageal (21.6%) cancers were the most common in the 30–59-year age group. In the 15–29-year age group, liver (28.7%) and oesophageal (15.2%) cancers were also the most prevalent. For men aged 60 years and above, prostate cancer was the most common, accounting for 30.4% of cases. In females, cancer of the cervix (39.8%) is the highest in all the 30-74-year age groups, followed by breast (26.6%) and oesophageal (7.9%).

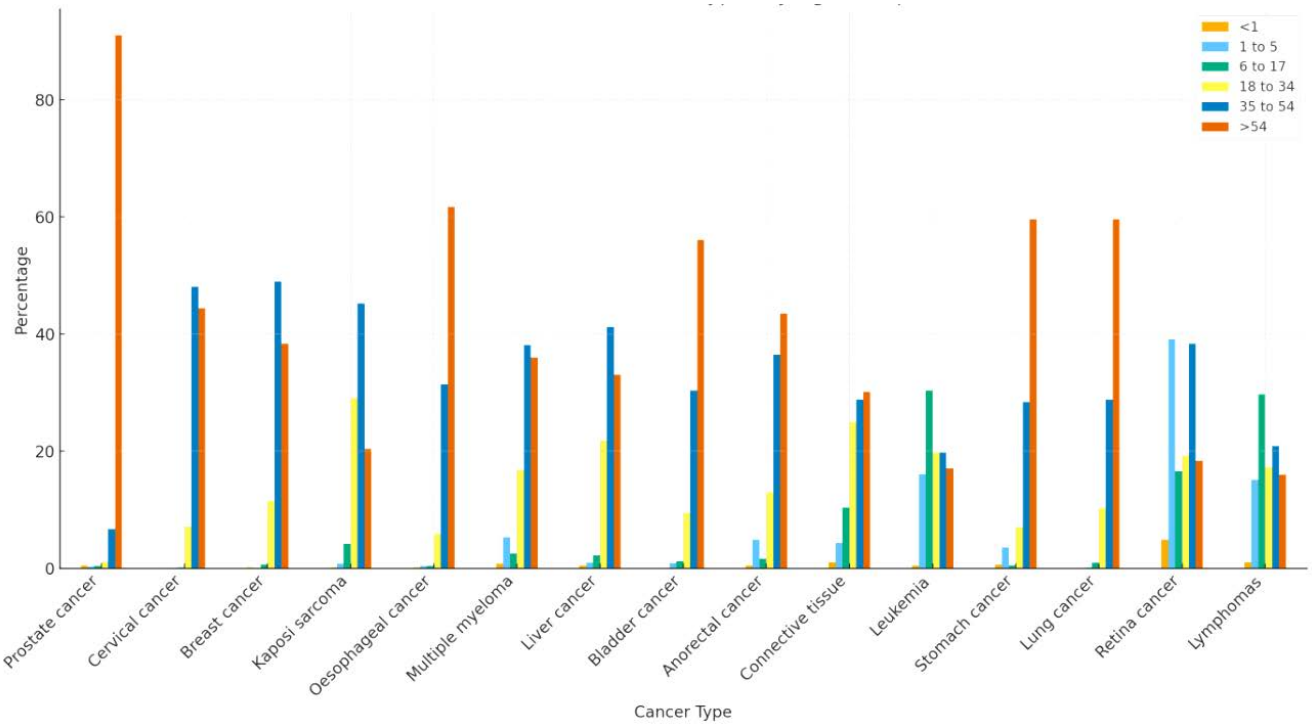

Figure 2: Distribution of cancer cases by age (2007 – 2021)

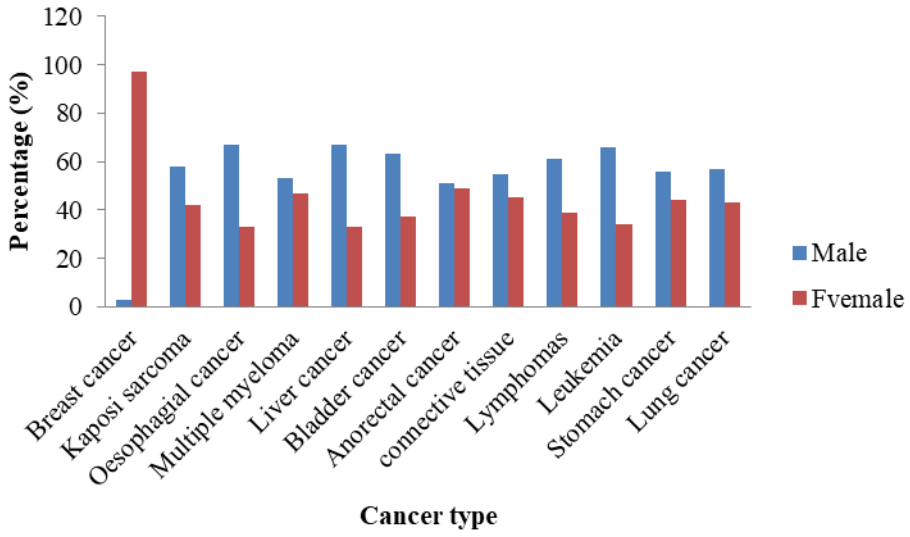

Figure 3: Distribution of cancer cases by sex (2007 – 2021)

Trends of registered cancer cases

Table 1 shows overall cancer incidence rates per 100,000 population across the registration periods (2007-2021). A linear regression analysis revealed a statistically significant positive trend in the overall cancer incidence rate from 2007 to 2021 (β=0.66, 95% CI: 0.36-0.97, p<0.0001). The incidence rate increased by approximately 0.66 cases per 100,000 population per year.

Table 1: Overall cancer incidence rates per 100,000 population across the years 2007-2021

Year	Number of Cancer cases	Incidence rate per 100,000 population (95%CI)
2007	2044	5.91 (5.66-6.17)
2008	2031	5.88 (5.62-6.13)
2009	2153	6.23 (5.97-6.49)
2010	2468	7.14 (6.86-7.42)
2011	2592	7.50 (7.21-7.79)
2012	2499	5.56 (5.34-5.78)
2013	2888	6.43 (6.16-6.66)
2014	2814	6.26 (6.03-6.49)
2015	3308	7.36 (7.11-7.61)
2016	4780	10.64 (10.34-10.94)
2017	7892	17.57 (17.18-17.95)
2018	5219	11.62 (11.30-11.95)
2019	6241	13.90 (13.54-14.24)
2020	5549	12.35 (12.03-12.68)
2021	5793	12.89 (12.56-13.23)

Cancer-specific trends

Generally, cancer-specific trends show an average annual increase in cases since 2007. A linear regression analysis revealed a statistically significant positive trend in cancer incidence rates from 2007 to 2021, including prostate, cervical, breast, oesophageal cancer, multiple myeloma, anorectal cancer, cancer of the connective tissue, lung cancer and retina cancer. However, we observed a slight decrease in incidence rates of Kaposi sarcoma and bladder cancer over the years. (Table 2).

Table 2: Trends in Cancer Incidence Rates for various Cancer Types (2007–2021)

Cancer Type	β (95% CI)	p-value
Prostate cancer	0.22 (0.11 to 0.33)	0.001
Cervical cancer	0.21 (0.02 to 0.41)	0.031
Breast cancer	0.23 (0.13 to 0.32)	<0.001
Kaposi sarcoma	-0.02 (-0.03 to -0.01)	0.008
Oesophageal cancer	0.11 (0.04 to 0.23)	<0.001
Multiple myeloma	0.04 (0.02 to 0.06)	<0.001
Liver cancer	0.04 (0.01 to 0.05)	0.032
Bladder cancer	-0.03 (-0.06 to – 0.02)	0.005
Anorectal cancer	0.04 (0.01 to 0.06)	0.002
Connective tissue	0.03 (0.02 to 0.05)	<0.001
Lung cancer	0.05 (0.03 to 0.06)	<0.001
Retina cancer	0.03 (0.02 to 0.04)	<0.001
Non-Hodgkin lymphoma	-	0.151
Stomach	-	0.107
Leukaemia	-	0.095

Spatial distribution of cancer cases

A high concentration of cancer cases was observed in Dar es Salaam, Mwanza, and Kilimanjaro regions, where the cancer referral hospitals are located, which may not reflect the true geographic distribution of cancer due to referral bias (Figure 4).

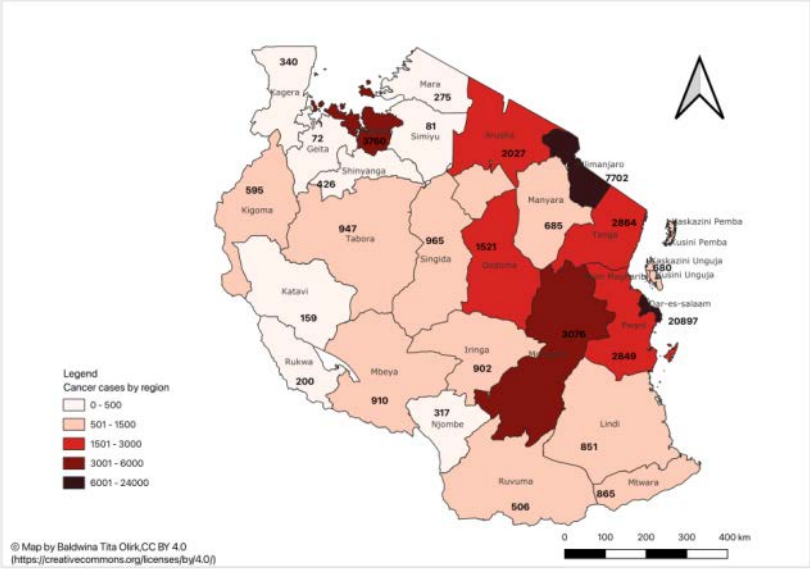

Figure 4: A map showing the overall distribution of registered cancer cases in Tanzania (2007-2021). Obtained from Natural Earth, available at the following website (https://www.naturalearthdata.com/)

Cancer-specific distributions

Generally, cases for all cancer types are localized in regions where the referral hospitals are located. We observed a special distribution for non-Hodgkin lymphoma, which had fewer cases in Kilimanjaro, where KCMC is located.

Discussion

In this study, we analyzed the trends using 58,271 of the top ten cancers registered in the four referral hospitals from 2007 – 2021. The observed high incidence of cervical cancer (20%), followed by prostate (16.8%) and breast (14.2%) has been earlier reported in Uganda (17). Furthermore, retinoblastoma emerged as the most common cancer among children under 15 years. In males, liver cancer was most prevalent in the 15–59 age group, while prostate cancer was the leading malignancy among those aged 60 and above. Among females aged 30–74 years, cervical cancer remained the most frequently diagnosed cancer in Uganda (19).

The overall trend in cancer incidence rate significantly increased linearly from 2007 to 2021. The incidence rate increased by approximately 0.66 cases per 100,000 population per year. In addition, our results revealed a positive trend for specific cancer incidence rates from 2007 to 2021. They

include prostate, cervical, breast, oesophageal, multiple myeloma, anorectal, connective tissue, lung and retina. However, a decreasing rate was observed in Kaposi sarcoma and bladder cancer over the years. However, the increasing trend of cervical, breast, and prostate cancers emphasizes their persistent and concerning impact on public health in Tanzania. These findings are consistent with global and sub-Saharan Africa patterns, where these cancers are among the most frequently diagnosed and are major contributors to cancer-related mortality (20). The higher prevalence of cervical cancer is reported in one previous study from one of the regions in Tanzania (3). The observed increasing trend of cervical cancer may partly reflect increased screening activities that began in 2016. Nevertheless, other confounding factors should also be considered (21). This is supported by previous studies in Tanzania, which have reported both higher incidence and mortality of cervical cancer (1).

These findings reinforce the priorities outlined in Tanzania's National Cancer Control Strategy (NCCS) 2013–2022, which emphasizes prevention, early detection, and treatment of cancers, particularly cervical, breast, and prostate cancers (22). The government has strengthened its cervical cancer control efforts through integrating the HPV vaccination in the national routine immunization program for 14-year-old girls in 2018 and the nationwide HPV vaccination campaigns, most notably the 2024 multi-age cohort campaign that targeted to vaccinate over 5 million girls aged 9–14 years (23). Moreover, the National Health Sector Strategic Plans (2021-2026) plan to integrate non-communicable disease services, including cancer screening, into existing HIV care platforms (24). These integrated services aim to improve access to early diagnosis and treatment, especially for high-risk groups, and align with global calls for people-cantered, chronic care delivery models. Results from this study support the urgency and relevance of these initiatives and can help guide cancer care in Tanzania. In Tanzania, cervical cancer is the most common cancer among women, with around 9,772 new cases annually and incidence rates of 59.1 per 100,000 in comparison to a global disease incidence of 13.1 per 100,000 (20). Cervical cancer leads to 6,695 women's deaths each year (25).

The higher rate of breast cancer (14.2%) compared to the GLOBOCAN 2020 report (9.9%) may reflect an actual increase in

incidence over time, as well as improvements in diagnostic capacity and cancer detection within referral centres (6). This may be due to low treatment uptake and late diagnosis. The higher prevalence may be due to low treatment uptake (26), with most patients diagnosed at late stages, leading to a breast cancer cure rate below 40% in Tanzania (8).

The results show prostate cancer as the second prevalent cancer. This finding aligns with the global findings that it is the second most frequently diagnosed cancer in males (27). Furthermore, the findings revealed a higher prevalence of cancers in older adults aged 54 years. Similar results were observed from previous studies conducted in Kenya, South Africa, Uganda and Nigeria (28). This trend highlights the need for increased palliative care services and health professional training to meet the rising burden among older adults.

The number of oesophageal cancer cases identified in our study is consistent with previous Tanzanian hospital-based studies (29–31). This alignment supports the reliability of our data on oesophageal cancer trends. It confirms that case burdens at the same hospitals during comparable time periods are consistently reflected in our findings.

There were fewer exceptions where the cancers were common in a younger population, like retinoblastoma, which was more prevalent in children aged 1-5 years. Leukaemia and non-Hodgkin lymphoma have similar patterns and are concentrated more between 18 and 34 years. The increase in cancer incidence for younger age in this study may be real. It could be associated with an increase in diagnoses, better case findings, and improved access to healthcare services. Some of the cancer cases for this age group may be associated with an increase in the prevalence of risk factors for cancers in their respective areas. Compared to previous studies, the same observations have been noticed in the younger age group, such as in the United States of America (32,33).

The distribution of cancer cases by sex, except those that are sex-specific, indicates that cancers are more common in males than females. These patterns are consistent with global data showing increased cancer risk with advanced age and exposures such as family history and occupational risks (27). The positive trend of cancer incidences may be due to environmental exposures, dietary habits, occupational risks, or improved diagnostic and reporting practices (34). However, we

acknowledge other potential reasons, such as improved reporting mechanisms and diagnostic capabilities during this period.

The overall distribution of cases differs from one region to another. Most cancer types are localized in regions where the referral hospitals are located. Similar studies in Mwanza and Nigeria showed higher cancer prevalence near referral hospitals, though these may not reflect the actual origin of cases (35). These findings may not reflect the places where cancer cases originate. For example, a previous study conducted in Tanzania demonstrated a higher prevalence of cases in places close to the cancer services. This may imply that many patients had moved around the nearby centres that provide cancer service mainly through self-referral as symptoms of cancer worsened (8). Furthermore, we observed fewer non-Hodgkin lymphoma cases in Kilimanjaro (KCMC) and more leukaemia cases in Dar-es-Salaam. The spatial distribution of cancer cases in this study should be interpreted with caution, as it was not adjusted for regional population size or known referral patterns.

One of the strengths of our study is that we managed to analyze 58,271 cases registered over a period of 15 years. The large sample size enhances the power of the study and provides a comprehensive analysis of the trend of cancer in the country. In addition, with this size, we have managed to establish trends and do the mapping/distribution. Second, we managed to analyze data from all large Hospitals in three different zones in Tanzania that handle cancer cases, hence, strong generalizability. Third, the special cancer mapping allows visualization of disparities in regions regarding cancer burden for intervention purposes.

This study had several potential limitations. Although data were collected from key national hospitals, delays in diagnosis or gaps in documentation may have influenced the distribution and timing of case capture. Therefore, while our data provide valuable insights into trends within tertiary care, they may not fully represent the geographic or demographic variation in cancer occurrence across the country. Second, potential underestimation or overestimation of the true burden of cancer cases in certain regions. The spatial mapping of cancer cases in this study was not adjusted for regional population size or known referral patterns. These factors may lead to underestimation or overestimation of the true burden in certain regions. Therefore, the maps reflect the distribution of cases in our hospital-

based sample and should not be interpreted as population-based incidence estimates.

Conclusions

This cross-sectional study demonstrated trends and distribution of cancer cases in Tanzania. In general, cervical cancer was the most prevalent, followed by prostate and breast cancer. Retinoblastoma was the most common cancer among children under 15 years old. Liver cancer was most prevalent in the 15–59 age group in males, while prostate cancer dominated older age. Cervical cancer was the most common in females aged 30–74 years. Overall cancer incidence showed a statistically significant upward trend from 2007 to 2021, increasing by 0.66 cases per 100,000 annually. Specific cancers like prostate, cervical, and breast also rose, while Kaposi sarcoma and bladder cancer declined. A significant distribution of cases was observed in Dar es Salaam and Kilimanjaro, and Mwanza, where cancer hospitals are located. Therefore, scale up cancer services to areas where people have to travel long distances to reach the designated hospitals. In addition, establishing centres in the southern and central zones will significantly reduce patients' burden and save lives.

Acknowledgements: The authors are grateful for the technical support provided by Benjamin Lysaniukm and Moritz Hunsmann from France.

Funding: The French Embassy in Tanzania provided funding for this study.

Authors' contributions: BTO coordinated the study, designed the questionnaire, conducted field investigations and performed the statistical analysis and writing of the paper. She is the main author of the manuscript. WNM contributed to the formulation of the study, participated in data collection and writing of the manuscript. AVN participated in data collection, writing of the manuscript and supervision. EJM participated in data collection and writing of the manuscript. JB contributed to data collection and made the maps. DBM contributed to the inception of the study and ensured the right cancer coding is done, MSY contributed to writing of the paper. MYJ contributed to the inception of the study, data analysis and writing of the paper. All authors read and approved the final manuscript.

Availability of data and materials: The author can provide the raw data upon reasonable request.

Consent for publication: Not applicable.

Competing interests: The authors declared they have no conflict of interest.

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