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Cancer incidence in Northern Uganda (2013–2016)

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Gulu Cancer Registry was established in 2014 to assess the incidence and survival of cancer in 4 districts of the Acholi Sub-region of northern Uganda. Here we report the results of the first 4 years of registration (2013–2016) in this largely rural population of 771,514. In total there were 1627 cases of cancers registered; 644 among men (corresponding to an ASR of 106.7 per 100,000 population) and 983 cancer cases among women (ASR 118.5 per 100,000). The most common cancers were cancers of the cervix and non-Hodgkin Lymphoma in females, and non-Hodgkin Lymphoma, Kaposi Sarcoma, prostate and liver cancers in men. Incidence rates of Burkitt lymphoma in children were high in comparison to elsewhere in Africa, whilst the incidence of breast cancer in women was rather low. The figures suggest a rather different pattern from that observed in the metropolitan population of Kampala, where there has been a cancer registry since 1951. This helps to provide a more complete picture of the national cancer profile, permitting more targeted interventions in prevention, early detection and treatment services.

Introduction

The global burden of cancer is on the increase both in developed and developing countries. Nearly 14 million new cases of cancer and 8 million deaths were recorded in the year 2012 accounting for 1 in 6 deaths worldwide. Up to 70% of these deaths occur in developing countries.[1] About 25% of these cancers in developing countries are caused by infections such as HPV, Hepatitis and HSV among others.[2] Sub-Saharan Africa is one of the region hit by the cancer burden yet only 30 population based cancer registries representing about 19% coverage are currently providing quality cancer data for the entire continent to inform policy on cancer control programs in the various member states.[3] In Uganda, estimates of the cancer profile have been entirely dependent on the findings from the Kampala cancer registry.[1] To bridge this gap new registries have been established, one of which is the Gulu Cancer registry, located at St. Mary's Hospital Lacor in the Northern region of Uganda. This part of the country is predominantly rural, and differs with respect to climate, ethnic composition of the population, social and healthcare factors compared to the cosmopolitan population served by Kampala cancer registry.

Gulu registry was established in 2014, and covers the population of four districts (Gulu, Omoro, Nwoya and Amuru), of the Acholi Sub-region of Uganda (Fig. 1), with a population at the national census (2014) of 771, 514.[4] We report here on the results from the first 4 years of registration, 2013–2016.

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Materials and Methods

Cancer registration

Gulu Cancer registry is physically located in the department of Cancer Registration and Palliative Care at St. Mary's Hospital Lacor, Gulu District, Northern Uganda. The cancer registrars actively collect data on new cases of cancer from all the wards in hospitals located in the region (St. Mary's Hospital Lacor, Gulu Regional Referral Hospital, Gulu Independent hospital, Gulu Military Hospital, Anaka Hospital), as well as other medical centres and pathology or clinical laboratories in the catchment area. St. Mary's Hospital has a diagnostic pathology service, and provides surgical oncology and chemotherapy for childhood cancers, HIV related cancers, uterine and ovarian cancers. Cases requiring more specialised treatment are referred to Mulago National Referral Hospital, the Uganda Cancer Institute and the Radiotherapy unit in Kampala. Such cases are identified by the Kampala registry staff, assisted by the cancer registrar from Gulu, and included in the registry database. Registry methods and data items collected follow the procedures in the standard AFCRN manual[5]; diagnosis is recorded according to the International Classification of Diseases for Oncology (ICD-O-3)[6] and converted to the codes of ICD-10[7] for presentation of results.

The registrars adhere to the strict guidelines with respect to the preservation of confidentiality in the collection, storage, use and transmission of identifiable data.

This data are entered into CanReg5 database, which checks for consistency, duplication and possible errors. The software has been used for analysis of the cancer data presented in this paper.

What's new?

Up until recently, cancer incidence estimates in Uganda have been entirely dependent on the Kampala Cancer Registry, which represents about 8% of the national population. Here, the authors report on the first 4 years of the Gulu Cancer Registry, which covers a predominantly rural region of northern Uganda. The figures suggest a rather different pattern from that observed in the metropolitan population of Kampala, with high rates of cervix and liver cancer and non-Hodgkin lymphoma (especially childhood Burkitt lymphoma). The findings help provide a more complete picture of the national cancer profile, permitting more targeted prevention, detection, and treatment interventions.

Population data

Results are presented for residents of the 4 districts (Amuru, Gulu, Omoro and Nwoya). Based on the 2014 Uganda national and housing census[8] and the population growth rates by age group and sex, the estimated average annual population (2013–2016) for the four districts was 771,514 [377,923 males and 393,591 females]. The population pyramid showing composition by a 5-year age group is shown in Figure 2. Ethnically, the predominant tribes are known as the Luo tribes (Acholi, Alur and Lango) who share a common language and culture with those of Nyanza province of Kenya. Their major economic activity is farming, cattle keeping and staple food crops being cereals, peas and vegetables.

Data analysis

Using CanReg5 software, the total cases registered, and the annual crude and age specific incidence rates were calculated according to sex and ICD-10 category for the period (2013–2016). Age adjustment was carried out by calculation of cumulative rates (0–74), and age standardised incidence rates (ASR), using the direct method and world standard population.[9]

A separate analysis was carried out for childhood cancers (ages less than 15) according to the diagnostic categories of the International Classification of Childhood Cancer (ICCC-3),[10] with incidence rates for 5-year age groups 0–4,5–9 and 10–14, together with crude and cumulative (0–14) rates per million.

Figure 1. The area covered by the Gulu Cancer Registry (Amuru, Nwoya, Omoro and Gulu Districts), and of the Kampala Cancer Registry (Kyadondo County). [Color figure can be viewed at wileyonlinelibrary.com]

Results

One thousand six hundred and twenty-seven cases of cancer were registered in the four-year period 2013–2016, 644 among males equivalent to overall ASR of 106.7 per 100,000 and 983 cancer cases among females corresponding to an ASR of 118.5 cases per 100,000 (Table 1). Most cases were in the 30–49 age group (43% in females and 30% in males). Children under 15 years of age comprised 13% of cases in males and 5% in females.

In males, non-Hodgkin lymphomas (including unspecified lymphomas) were the most commonly diagnosed cancer (119 cases (18.9% of the total), with an ASR of 10.9 per 100,000), followed by Kaposi sarcoma (112 cases (17.4%), ASR 11.0 per 100,000) although because many cases of these two cancers occur at young ages, the ASR (and cumulative rates) of prostate cancer (20.4 per 100,000) and liver cancer (12.8 per 100,000) were higher (Table 1). Cancer of the oesophagus was 5th in frequency, and also in terms of standardised rates. Of note also is the high frequency of cancers of the eye (ICD code C69)—of the 43 cases registered, all but one of the cases in adults (a melanoma) were squamous cell carcinomas, or conjunctival cancers of undertermined histology.

In females, the most common malignancy is cancer of the cervix uteri with 486 cases representing 49.4% of all female cancers (ASR = 57.0 per 100,000). This was followed in terms of numbers by non-Hodgkin lymphomas with 113 cases (10.7%, ASR = 10.1). There were 105 cases of breast cancer accounting for 10.7% of cancers (ASR = 12.7) and 55 cases of liver cancer representing 5.6% of female cancers (ASR = 6.9).

Figure 3 shows the age specific incidence rates for the most common cancers in men (*a*) and women (*b*). At young ages, NHL is the predominant cancer. The incidence of Kaposi sarcoma, after a small peak in infancy, rises to a peak at ages 30–34 in men (25–29 in women—data not shown), and then again in elderly males (70–74). Prostate cancer is essentially a disease of men aged over 50 (98/99 cases). In women, the incidence of cancer of the cervix rises rapidly after age 15–19 and

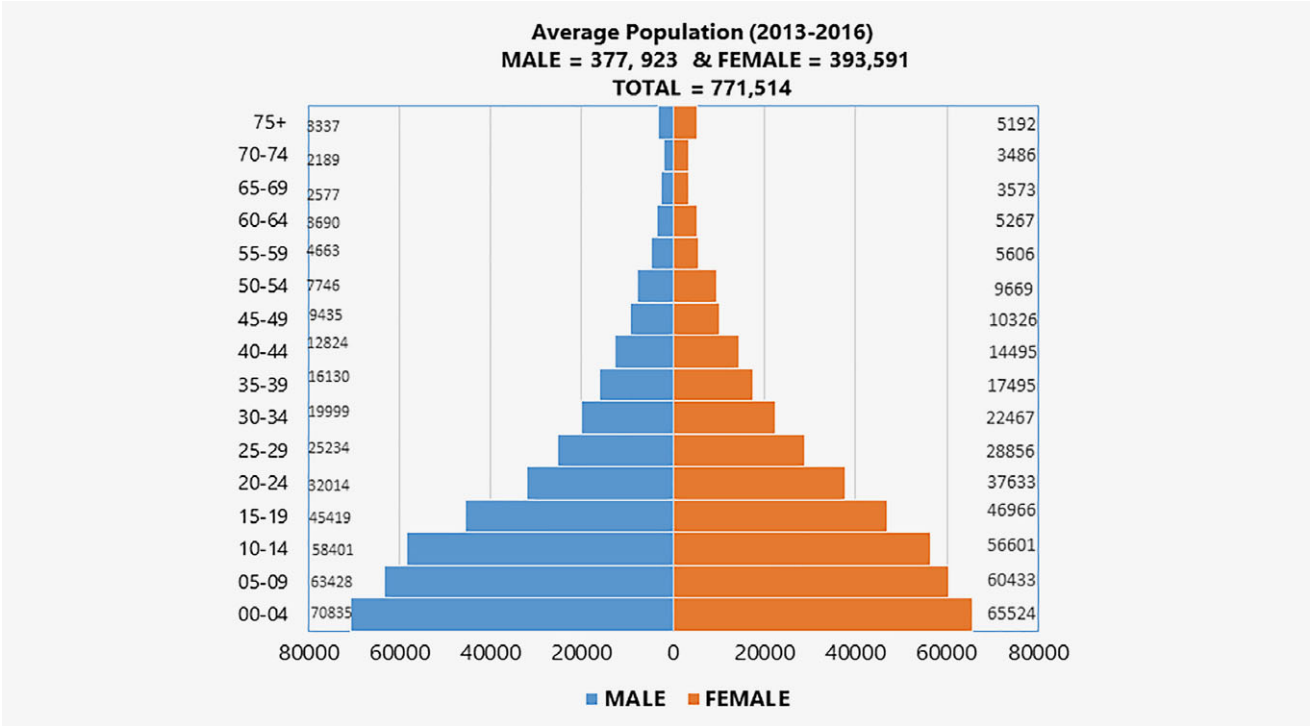

Figure 2. The estimated average annual population (2013–2016) for the registry area (UBOS, 2014). [Color figure can be viewed at wileyonlinelibrary.com]

Table 1. Numbers of cases registered in 2013–2016, by sex and site, with crude, cumulative and age standardised incidence rates

		Male						Female					
					Incidence (per 100,000)						Incidence (per 100,000)		
SITE	ICD 10	cases	%	MV%	Crude rate	*CUM* (%)	ASR	cases	%	MV%	Crude rate	*CUM* (%)	ASR
Lip, oral cavity and pharynx	C00-14	25	3.9	63.6	**1.7**	**0.58**	**4.7**	21	2.1	60	**1.3**	**0.24**	**2.3**
Oesophagus	C15	42	6.5	50.9	**2.8**	**0.85**	**7.7**	9	0.9	12.5	**0.6**	**0.13**	**1.1**
Stomach	C16	8	1.2	40	**0.5**	**0.19**	**1.3**	9	0.9	41.7	**0.6**	**0.14**	**1.3**
Colon and rectum	C18-20	15	2.3	34.8	**1**	**0.26**	**2.3**	9	0.9	50	**0.6**	**0.16**	**1.3**
Liver	C22	97	15.1	73.6	**6.4**	**1.41**	**12.8**	55	5.6	40.3	**3.5**	**0.77**	**6.9**
Pancreas	C25	11	1.7	30.8	**0.7**	**0.19**	**1.6**	9	0.9	41.7	**0.6**	**0.2**	**1.4**
Lung	C33-34	15	2.3	33.3	**1**	**0.32**	**2.7**	13	1.3	28.6	**0.8**	**0.17**	**1.4**
Skin	C44	13	2	66	**0.9**	**0.19**	**2**	13	1.3	60	**0.8**	**0.21**	**1.7**
Kaposi sarcoma	C46	112	17.4	52	**7.4**	**1.01**	**11**	46	4.7	50	**2.9**	**0.31**	**3.8**
Breast	C50							105	10.7	52.7	**6.7**	**1.45**	**12.7**
Cervix uteri	C53							486	49.4	33.2	**30.9**	**5.8**	**57**
Corpus uteri	C54-55							7	0.7	37.5	**0.4**	**0.05**	**0.7**
Ovary	C56							19	1.9	33.3	**1.2**	**0.22**	**2.3**
Prostate	C61	99	15.4	46.7	**6.5**	**2.7**	**20.4**						
Kidney etc	C64-66	13	2	88.2	**0.9**	**0.04**	**0.6**	8	0.8	84.6	**0.5**	**0.03**	**0.5**
Bladder	C67	4	0.6	60	**0.3**	**0.07**	**0.6**	1	0.1	50	**0.1**	**0**	**0.1**
Eye	C69	30	4.7	51	**2**	**0.18**	**2.4**	13	1.3	50	**0.8**	**0.13**	**1.2**
Brain and nervous system	C70-72	4	0.6	50	**0.3**	**0.03**	**0.6**	0	0	0	**0**	**0**	**0**
Thyroid	C73	4	0.6	50	**0.3**	**0.13**	**0.6**	11	1.1	60	**0.7**	**0.13**	**1.3**
Non Hodgkin lymphoma	C82-86	119	18.5	56.9	**7.9**	**1.05**	**10.9**	113	10.7	61	**7.2**	**1.03**	**10.1**
Leukaemia	C91-95	23	3.6	68.4	**1.5**	**0.27**	**2.3**	23	2.3	66.7	**1.5**	**0.13**	**2.2**
Other and Unspecified		10	1.6		10.3	2.12	**22.2**	13	2.4		5.6	0.96	**9.2**
Total		**644**	**100**	**58.4**	**52.4**	**11.59**	**106.7**	**983**	**100**	**48.1**	**67.3**	**12.26**	**118.5**

The bolds are the incidence rates (ASR, CUM, CRUDE rates).

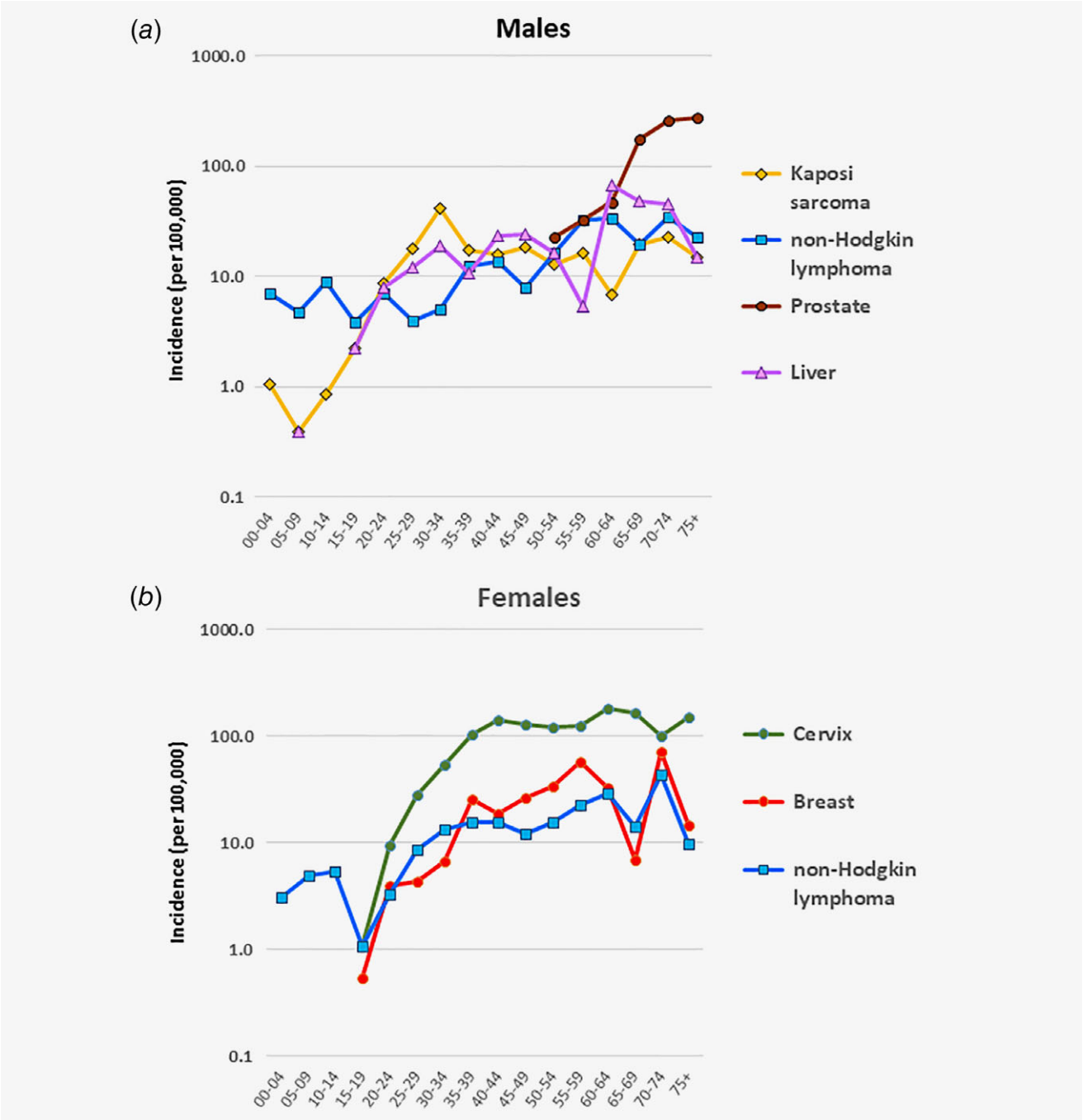

Figure 3. Age specific incidence rates of common cancers in males (*a*) and females (*b*). [Color figure can be viewed at wileyonlinelibrary.com]

then plateaus after ages 40–44, while for breast cancer, although numbers are small, the peak incidence appears to be rather later.

Hundred and sixty two cancers were registered in children aged 0–14 (107 boys and 55 girls), with the most common being Burkitt lymphoma (25.3% of cancers), and lymphomas of unspecified type (23.5%), followed by Wilms' tumours (9.3%) (Table 2). There were 17 cases (all but one with no histology) in the group "Other and unspecified malignant tumours" (ICCC code 12b).

Discussion

Accurate determination of cancer incidence in Uganda started back in 1951 when the first cancer registry, Kampala Cancer Registry, was established in the metropolitan area of Kampala city. This registry covers only Kyadondo County (Kampala

Table 2. Childhood Cancer Incidence in Gulu (2013–2016) by age group and type of cancer (according to the International Classification of Childhood Cancer (ICCC-3))

		Numbers						Rates (per million)				
Cancer type (ICCC-3)	ICCC Code	0–4	5–9	10–14	0–14	M/F	FREQ (%)	0–4	5–9	10–14	0–14	*CUM*
Leukaemia	**1**	2	7	4	13	0.9	8.0	**3.7**	**8.7**	**8.7**	**8.7**	**105.3**
Hodgkin lymphoma	**2a**	0	0	2	2	1.0	1.2	**0.0**	**0.0**	**4.3**	**1.3**	**21.7**
NHL	**2b**	3	1	2	6	2.0	3.7	**5.5**	**2.0**	**4.3**	**4.0**	**59.3**
Burkitt	**2c**	8	18	15	41	2.4	25.3	**14.7**	**36.3**	**32.6**	**27.3**	**418.0**
Lymphoma NOS	**2e**	17	5	16	38	1.1	23.5	**31.2**	**10.1**	**34.8**	**25.3**	**380.2**
Brain tumours	**3**	1	0	0	1	0	0.6	**1.8**	**0.0**	**0.0**	**0.7**	**9.2**
Retinoblastoma	**5**	9	0	0	9	3.5	5.6	**16.5**	**0.0**	**0.0**	**6.0**	**82.5**
Wilms tumour	**6a.1**	12	3	0	15	1.5	9.3	**22.0**	**6.1**	**0.0**	**10.0**	**140.3**
Liver tumours	**7**	1	1	0	2	1.0	0.6	**1.8**	**2.0**	**0.0**	**1.3**	**19.3**
Osteosarcoma	**8a**	0	0	2	2	1.0	1.2	**0.0**	**0.0**	**4.3**	**1.3**	**21.7**
Rhabdomyosarcoma	**9a**	1	1	0	2	0	1.2	**1.8**	**2.0**	**0.0**	**1.3**	**19.3**
Kaposi sarcoma	**9c**	5	1	2	8	3.0	4.9	**9.2**	**2.0**	**4.3**	**5.3**	**77.7**
Other and unspecified		6	5	12	23	6.7	10.5	**11.0**	**10.1**	**26.1**	**15.3**	**235.9**
Total		**65**	**42**	**55**	**162**	**1.9**	**100.0%**	**119.2**	**84.8**	**119.6**	**107.9**	**1,617.5**

The bolds are the incidence rates (ASR, CUM, CRUDE rates).

city with a peri-urban area in Wakiso district) with a population of 2.6million people, which represents about 8% of the 34 million people in Uganda.[4] This gap in cancer registration is a familiar feature of the lack of a clear national framework for cancer surveillance through comprehensive cancer registration programs for most countries in Sub-Saharan Africa. To improve coverage of population based cancer registry and estimation of cancer incidences and burden, Gulu Cancer Registry was founded in 2014, with support from the International Network for cancer Treatment and Research (INCTR) through the African Cancer Registry Network. It covers a predominantly rural region of northern Uganda, comprising 4 districts, containing one urban area—Gulu municipality (population 150,300 in 2014[4]).

Cancer registration in rural populations of Africa is not straightforward. Although all treatment and diagnostic services in the registry area are searched for cases, it is possible that cancer patients distant from Gulu town go outside the area for treatment. As we describe in the Methods, the registry personnel identify cases diagnosed or treated in the major hospital in the capital city of Kampala. In the 4-year period studied, 71 cancer cases (33 males and 38 females) were registered from Uganda Cancer institute and 37 (M = 23, F = 14) from Mulago Hospital (Oncology wards and Radiotherapy unit). Information from these patients—8% of the total registered - was not accessible from the registry catchment area. In addition, the records of 52 patients registered from hospitals in Gulu could be updated with information (e.g. on treatment) from these facilities.. In the absence of civil registration of deaths, it is impossible to know whether some cancer sufferers die without ever seeking medical attention. Nevertheless, the registry was judged to surpass the 70% completeness of registration threshold required for membership of AFCRN.[3] The modest level of morphological verification of diagnosis (49.5%), while raising questions concerning the validity of some diagnoses, is reassuring concerning the use of non-pathology data sources.[11]

Plummer *et al.* (2016) estimated that 31.3% of cancers in Sub-Saharan Africa are related to infectious agents, and indeed, the most striking feature of the cancer profile in Gulu is the frequency of infection-related malignancies: lymphomas, cancer of the cervix, Kaposi sarcoma and liver cancer.

Figure 4 compares the results from Gulu Cancer Registry with those from Kampala, Nairobi, and the US black population covered by the SEER program registries (2008–2012),[9] and the estimated rates for Sub Saharan Africa in 2012 from Globocan.[1]

The elevated incidence of non-Hodgkin lymphoma, compared to other African registries, is partly the consequence of the high rates of Burkitt lymphoma of childhood (Table 2). Northern Uganda has long been recognised as an area where Burkitt lymphoma is endemic.[12] In 1997–2006, Ogwang *et al.*[13] estimated the incidence rate in the northern region in 1997–2006 to be 18 per million, with a M:F ratio of 1.8:1, although the incidence was higher in the area now served by the Gulu registry. The incidence recorded by the registry in 2013–2016 was 27.3 per million, although this is likely to be an under-estimate, given that a similar number of childhood lymphomas were simply recorded as unspecified lymphoma. Then, as now, the highest rates were in the age group 5–9.

Lymphomas are also relatively frequent among young adults (Fig. 3) as is Kaposi sarcoma and squamous cell carcinomas of conjunctiva—especially in males. These cancers are all increased in incidence in subjects with HIV-AIDS. The prevalence of infection with HIV in 2016/7 in the mid-Northern region, where the registry is located, was 7.2%, somewhat higher than the national average of 6.2%.[14]

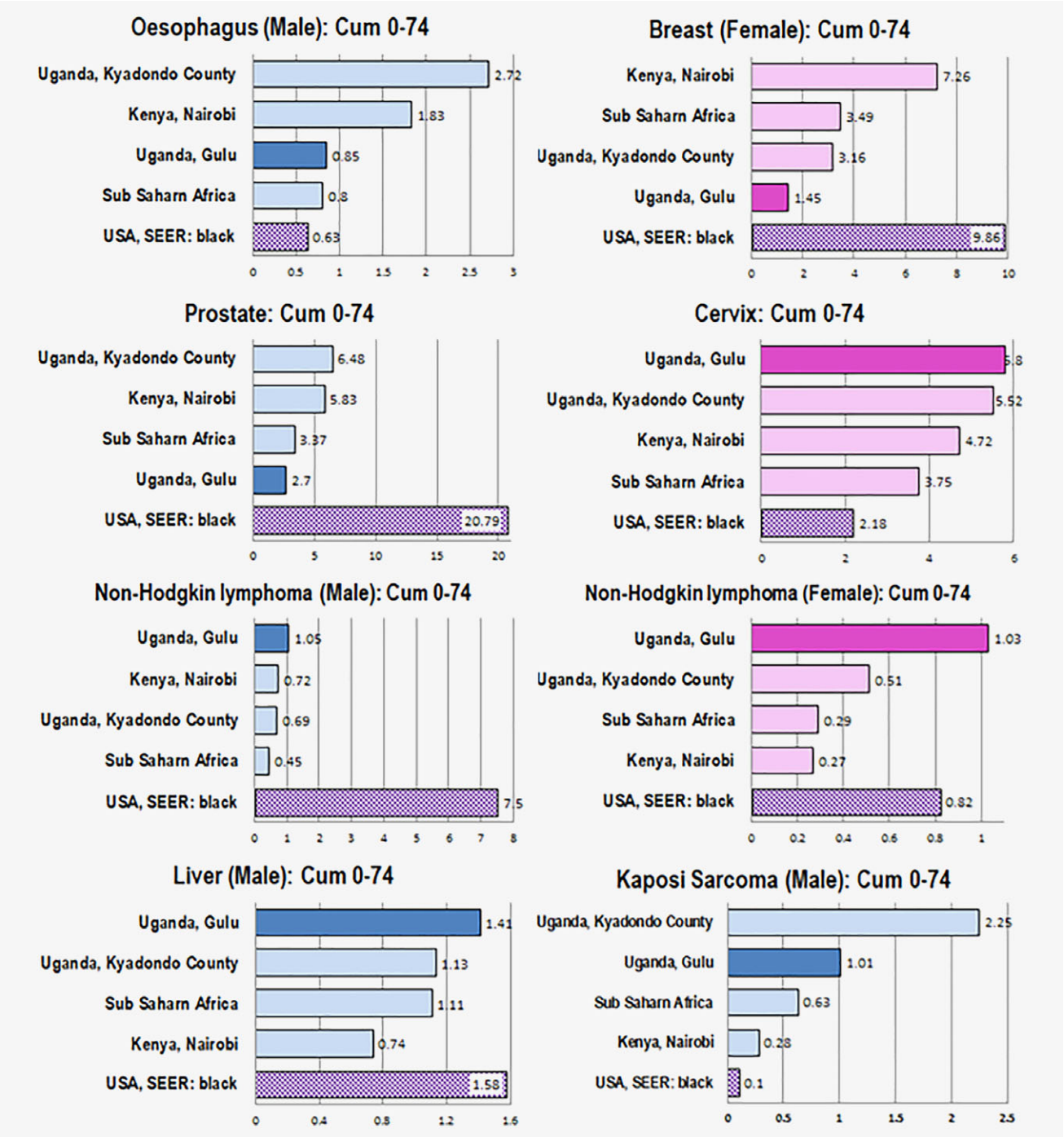

Figure 4. Comparison of incidence rates (cumulative rate (0–74) %) of the most common cancers, with rates in Nairobi, Kampala, the black population of the US SEER registries, 2008–2012 (Source Bray *et al.*, 2017) and the estimate for Sub Saharan Africa in 2012 (source Ferlay *et al.*, 2013). [Color figure can be viewed at wileyonlinelibrary.com]

Cancer of the cervix, although caused by infection with HPV viruses, is also associated with HIV infection. It is interesting that the Luo of Kenya, ethnically and culturally close to the population of the Gulu registry area, have been observed to have a high risk of cervix cancer (and Burkitt lymphoma).[15] The low prevalence of circumcision in the Luo (and in Mid Northern Uganda[14]) has been postulated to favour transmission of HIV (and HPV). There are no systematic screening programmes for cancer of the cervix in the area served by the registry.

The incidence of liver cancer is significantly higher than in Kampala and in Sub Saharan Africa as a whole (Fig. 4). Sero-prevalence of Hepatitis B surface antigen (HBsAg) in adults in

the mid Northern region is the highest in Uganda, at 4.6%, more than double that in Kampala[14] and Kenya.[16]

On the other hand, the incidence of oesophageal cancer, although relatively high by global standards, is rather lower than the elevated rates seen in many registries of East Africa,[17] although showing the marked excess of male cases, typical of this high risk region.[18]

In this predominantly rural population, it was not surprising to find that cancers associated with more urbanised/westernised lifestyles—such as large bowel cancer and breast cancer - were relatively uncommon. In northern Uganda, fertility rates were high in the generation of women at high risk of breast cancer, and, even today, the total fertility rate in the Acholi sub region is 6.7, considerably above those in Kampala (3.3), or the national average of 5.8 according to National population and housing census 2014.[19]

The incidence of prostate cancer –with by far the highest age standardised rates among men - is similar to the regional average, although rather lower than in the urban populations of Kampala and Nairobi. While this differential may in part be lifestyle related, the possibility of non-diagnosis of prostatic malignancy in elderly males in the predominantly rural population of northern Uganda should also be considered.

Conclusion

Cancer of the cervix is the most common cancers in northern Uganda accounting for nearly half of female cancers in the region. This is followed by non-Hodgkin Lymphomas in both male and females. Other cancers of significance are those of the prostate, liver and oesophagus in males, and breast cancer in females. These cancer types underscore the need for routine check-ups especially for breast and prostate malignancies and also a comprehensive screening and vaccination programs for HPV and Hepatitis B in the communities of northern Uganda and the country at large. The high rates of Burkitt lymphoma of childhood underscore the continued need to provide for the relatively inexpensive chemotherapy for this relatively curable cancer.

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Author contributions

Mr. Francis OKONGO: Responsible for the collection and analysis of data, and preparation of the first draft of the article. Dr. Martin OGWANG: Director of the Gulu Cancer Registry, overall responsibility for its operation and liaison with other health professionals. Participated in the discussion of the results and the writing of the article. Ms. Biying LIU: Responsible for contractual support of the project; preparing the study, tables and figures for publication. Dr. D Maxwell PARKIN: has helped in the discussion of the results, and the drafting of the article for publication in a scientific journal.

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