

Chapter 16

General Oncology Care in Sudan



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16.1 Sudan Demographics

Sudan, officially the Republic of the Sudan, was the largest country in Africa and the Arab world by area before the secession of South Sudan in 2011. The geographical location on the global map is a country in North-East Africa. It occupies 1,886,068 km² (728,215 square miles), making it Africa's third largest country and also the third largest in the Arab world [1].

The population of Sudan is estimated to be about 42 million, after the secession of South Sudan in July 2011. The last census was in 1993, no one carried out since that time due to the political Sudanese civil war. The rapidly increasing population in the capital of Sudan Khartoum (including Khartoum, Omdurman, and Khartoum North) is mainly due to the displaced persons from the war areas and better public services rather than the rural states [2]. According to United Nations High Commissioner for Refugees (UNHCR) statistics, more than 1.1 million refugees lived in Sudan in August 2019 [3].

The identity of any community is the collection of cultural aspects, including mainly ethnicity and languages of communication. There are many ethnic types; 70% of the population is Arab (the largest ethnic group in Sudan). Others include North Sudan Nubians, Zurga (South and West Sudan), and Copts [4]. There is limited cultural integration between the Arab tribes and Arabized and indigenous tribes in west areas of Sudan, due to linguistic and genealogical variations [5].

The most generally spoken language in the country is Sudanese Arabic. There are more than 50 native languages in Sudan. Other languages such as Bedawi along

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the Red Sea, several Nilo-Saharan languages, and the Niger–Congo type are represented by many of the Kordofanian languages [6]. There are many local tribal languages and Sudanese sign languages but not commonly used [7]. Arabic was the official language before 2005 [8]. The political constitution approved English and Arabic languages as the official languages of the country in 2005 [9].

The huge difference in the Sudanese community in the ethnicity, languages, and religion shape the different behaviors and practices in the society. The main identifies in the country are Arab and African [10].

16.2 Cancer Statistics in Sudan

Cancer now is a more known health problem not as in the last decay, while the communicable condition (infectious and tropical diseases) had more attention and efforts [11]. Cancer was the third leading cause of death in Sudan hospitals, about 5% of all deaths (Table 16.1) [12].

The first National Cancer Registry (NCR) in Sudan started in 1967, unfortunately it is no longer acting now due to the lack of financial and technical support. The lack of proper cancer registration systems was reflected in the type of published data as it was mainly hospital-based, descriptive, and retrospective studies [13].

Most data for cancer registries comes from hospital-based registries mainly: Radiation Isotopes Center at Khartoum (RICK), National Health Laboratories (NHL), and the National Cancer Institute at Gezira University (NCI-GU). From 2010, other centers in the public and private sectors started to be in-service effectively and developed additional data sources while expanding the network of services.

Malignant epithelial tumors in the Sudanese were the first report about cancer in Sudan, published by Hickey in 1959. At that time, the most common tumor sites

Table 16.1 Ten leading causes of death in Sudan hospitals in 2000 [12]

Disease	Number of deaths	% of total deaths
Malaria	2162	19.1
Viral pneumonia	691	6.1
Malignant neoplasms	530	4.7
Iron deficiency anemias	504	4.4
Streptococcal septicemia	434	3.8
Heart failure	403	3.6
Tuberculosis	387	3.4
Severe malnutrition	382	3.4
Meningococcal infection	362	3.2
Coronary heart disease	351	3.1
Total	6206	54.7

Data is from the Sudan Federal Ministry of Health

Table 16.2 Cancer frequencies in Sudan 1967–2010 [19]

Year	Number of cancer incidents	Cancer rate/1000 population	Year	Number of cancer incidents	Cancer rate/1000 population
1967	303	0.0234	1989	1357	0.0558
1968	448	0.0339	1990	1572	0.0629
1969	540	0.0400	1991	1494	0.0582
1970	512	0.0371	1992	2157	0.0817
1971	538	0.0382	1993	1847	0.0722
1972	500	0.0348	1994	1645	0.0625
1973	562	0.0398	1995	1733	0.0640
1974	692	0.0472	1996	1810	0.0649
1975	470	0.0308	1997	2119	0.0739
1976	565	0.0357	1998	2145	0.0727
1977	738	0.0449	1999	2102	0.0692
1978	545	0.0319	2000	2541	0.0813
1979	568	0.0320	2001	2963	0.0922
1980	704	0.0381	2002	3070	0.0928
1981	672	0.0350	2003	3185	0.0936
1982	773	0.0388	2004	3450	0.0986
1983	870	0.0422	2005	3705	0.1029
1984	913	0.0431	2006	3505	0.0946
1985	903	0.0415	2007	4813	0.1262
1986	1112	0.0497	2008	5156	0.1317
1987	927	0.0403	2009	5739	0.1425
1988	1308	0.0553	2010	6303	0.1522

were the skin (32.8%) followed by the breast (22.9%) [14]. From 1954 to 1961, a study from National Health Laboratories (NHL) and the Department of Pathology, University of Khartoum showed that the number of cancer cases clearly increased twice to 2234 malignant neoplasms [15]. In Khartoum hospital (which mainly serves the Khartoum population and population referred from other parts of Sudan at that time) from 1957 to 1956, about 1578 cancer cases were reported [16]. There were 8212 cases reported in a published article about gastrointestinal tract cancers in 1976 [17]. After 1984, breast cancer was at the top of the list and most of the data came up from single centers efforts [18].

There is a clear increase in the incidence of cancer cases among the Sudanese population (Table 16.2, [19]). According to GLOBOCAN estimates, the most common cancers in both sexes are breast, non-Hodgkin lymphoma, leukemia, esophagus, and colorectal cancers [20]. Officially now the authority for estimating cancer incidence in Sudan is under the umbrella of the Federal Ministry of Health depending on the different hospitals and centers statistical reports.

The record showed that breast cancer is the most common tumor in females, while in males the prostate cancer is on top of the incidence. This data is from the population in Khartoum state (Figs. 16.1 and 16.2 [21]).

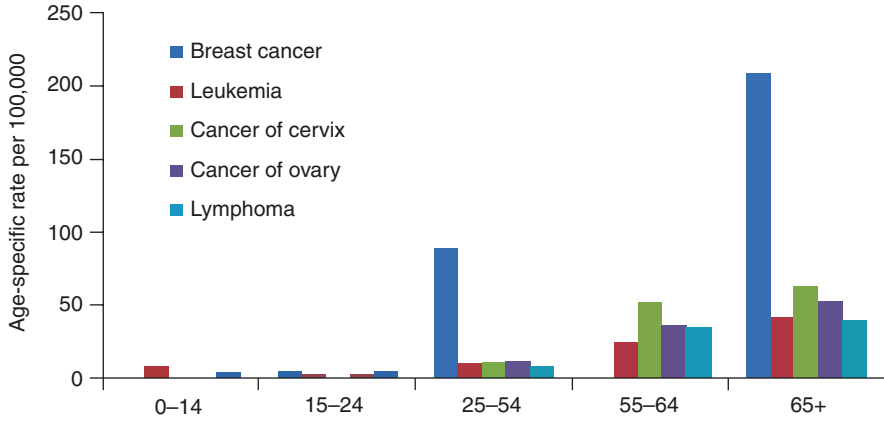


Fig. 16.1 The most common primary cancer sites among females by age group, Khartoum, Sudan (2009–2010), $N = 3619$ [21]

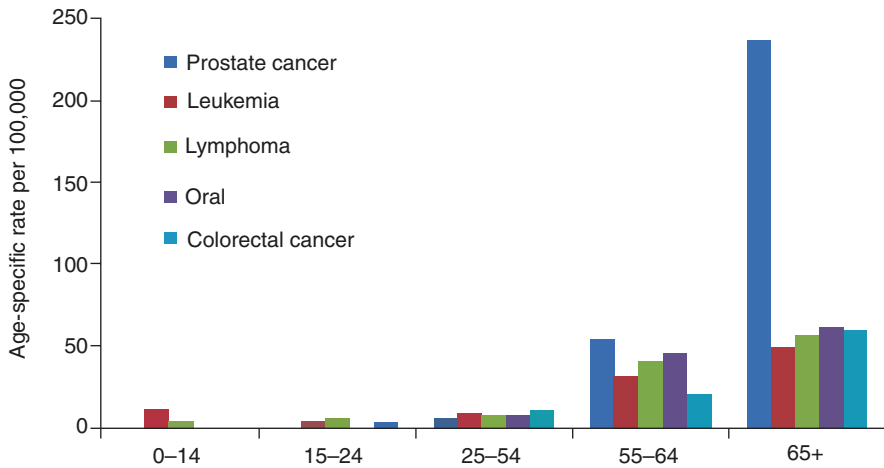


Fig. 16.2 The most common primary cancer sites among males by age group, Khartoum, Sudan (2009–2010), $N = 3619$ [21]

16.2.1 Breast Cancer

Breast cancer is the most frequent occurring cancer among females in Sudan, followed by gynecological tumors. In 2008, a recent study between central Sudan breast cancer records and north Italian data showed more advanced stages and negativity in the receptors in the Sudanese group [22].

Comparing data in Sudan and other African countries, the age of incidence of the disease is younger than the global data. On the other hand, Sudan is similar to

African countries in the late presentation of patients and the lack of hormonal receptor expression [23].

16.2.2 Gynecological Cancers

Cervical carcinoma is considered as the second most common malignant condition in Sudanese women seeking medical care at Khartoum Oncology Hospital and National Cancer Institute in Gezira Province over a 6-year period (2000–2006) [24]. Human Papillomavirus (HPV) is a major risk factor reported to predispose to the disease mainly type 16 or 18 [25].

16.2.3 Prostate Cancer

The most common cancer in Sudanese men is prostate cancer [26]. It is considered the second malignant condition in both sexes after the breast cancer in 2012 [20]. In the central part of Sudan (NCI), data showed that the incidence is the same among all patients regardless of their ethnic background and the presentation is usually in older ages 72 years or more with advanced clinical stages [27].

16.3 Healthcare System in Sudan

The Sudanese healthcare system is built to implement the approved strategic plans and policies. There is a need to increase the financial budget for healthcare and proper administrative efforts to achieve the goals both currently and in the future. Besides that, there is a great need for improving the health technical information systems, collaboration with international agents working in supporting medical services in the developing countries and more training for professionals [28].

16.4 Oncology Care in Sudan

In Table 16.3, there are limited radiation therapy and nuclear medicine services in the centers if compared with medical oncology services. There are good efforts in the National Cancer Department in the Federal Ministry of Health regarding supporting the governmental centers in the form of total free medications in chemotherapy and radiotherapy, including some expensive drugs according to the approved protocol in each center.

Some services are not available inside a few of these centers, such as diagnostic—interventional radiology and molecular—histopathological services.

Table 16.3 Treatment facilities in Sudan in the governmental and private sectors

No.	Name of the facility	Established	Location	Sector	Services
1	Khartoum Oncology Hospital (RICK)	1964	Khartoum state Capital of Sudan	Governmental	Radiation Nuclear medicine medical oncology services
2	National Cancer Institute	1992	Gezira state Second city of Sudan Middle Sudan	Governmental	Radiation Nuclear medicine medical oncology services
3	Tumor Therapy and Cancer Research—Shendi	2008	Nile Valley state North Sudan	Governmental	Radiation Nuclear medicine medical oncology services
4	Khartoum Oncology Specialized Center	2010	Khartoum state Capital of Sudan	Private	Medical oncology services
5	Khartoum Breast Care Center	2010	Khartoum state Capital of Sudan	Private	Medical oncology services
6	Dongla Cancer Center	2012	North state North Sudan	Governmental	Medical oncology services
7	Taiba Cancer Center	2013	Khartoum state Capital of Sudan	Private	Medical oncology services
8	Shafi Specialized Oncology Center	2015	Khartoum state Capital of Sudan	Private	Medical oncology services
9	East Oncology Center	2015	Gadarif state East Sudan	Governmental	Medical oncology services
10	Port Sudan Oncology Center	2015	Red Sea state East Sudan	Governmental	Medical oncology services
11	Kordfan Cancer Center	2015	North Kordofan state West Sudan	Governmental	Medical oncology services
12	Merowe Oncology Center	2017	North state North Sudan	Governmental with Private	Radiation Nuclear medicine medical oncology services
13	Nyala Cancer Center	2019	South Darfur state West Sudan	Governmental	Medical oncology services
14	AlFashir Cancer Center	2020	North Darfur state West Sudan	Governmental	Medical oncology services

Data is from the Sudan Federal Ministry of Health and Khartoum State Ministry of Health

16.5 Cancer Risk Factors

In general, the risk factors for cancer in Sudan are not different from the well-known globally on this issue. In Gezira state, where the Gezira agriculture scheme is located, more fertilizers and pesticides were extensively used and proposed to be associated with cancer incidence in this area [29].

The appearance of malignant conditions in young ages in both males and females in recent years has been mostly associated with risk factors such as smoking, chemical cosmetics, and environmental pollution.

16.6 Cancer Screening Programs

Sudan first started a National Cancer Control Programme (NCCP) in 1982. The plan includes three main components: preventive initiatives, early detection and screening initiatives, improved diagnosis, and treatment with special attention to the palliative care services [30].

There are many excellent efforts regarding breast cancer screening at all levels, whether government, private, or voluntary throughout the year and many campaigns in October as it is an annual month of breast cancer. On the other hand, there is a clear shortage in the screening of cervical carcinoma and not much attention to the screening programs has been given. Only two centers are working on this issue. It needs effort, especially from the gynecologists to take over this mission. The same issue is for other malignant conditions like oral cancer or prostate cancer.

16.7 Cancer Prevention Programs

The cancer prevention programs and activities in Sudan mainly include early detection campaigns, awareness activities, health education sessions, and professional training of the healthcare teams. It is a mission of collaboration with governmental strategies, private sector, voluntary organizations, and media with community activists. Although there is a lack of prevention programs, there is still a great change in the community about the cancer stigma and related issues compared with the last 10 years. In Figs. 16.3 and 16.4, are the educational materials used in awareness activities in prevention programs and health education for the community.



Fig. 16.3 Page from a brochure on breast self-examination that was part of a breast cancer public awareness campaign [12]



Fig. 16.4 Toombak, a moist oral tobacco extensively used in Sudan, was the subject of a public awareness campaign (in poster). Inset: Toombak ingestion causes severe leukoplakia on the gingiva and lower lip, as well as tooth weakening and loosening. Malignant changes are mostly seen when the toombak is placed into the mouth [12]

16.8 Cancer Diagnosis

The services for cancer diagnosis at the basic level are excellent. There are many departments for endoscopies, imaging such as U/S, mammographic image, Computed Tomography [CT scan], bone scan, and Magnetic Resonance Imaging [MRI], biopsies (surgical or imaging guided), and histopathological with immunohistochemical services are widely available in the country.

There is a lack of molecular biology services which leads to personalized treatment approaches such as BRCA tests or tests that detect the sensitivity of chemotherapy. There is only one lab in the private sector that provides flow-cytometer tests for hematological malignancies.

16.9 Treatment

16.9.1 Medical Oncology

Medical oncology services are widely available in all centers across the country. It almost covers all the needs for the patients. There are excellent stores and supply chains in the country that cover tons of needs for the public sector as well as the private sector. Regarding advanced medical oncology services, there is an unavailability of services such as Bone Marrow Transplant (BMT).

16.9.2 Radiation Therapy

Radiation therapy services are distributed among four centers along with covering the external beam therapy and brachytherapy. Most of the techniques used are two-dimensional (2D) skills rather than the three-dimensional (3D) or other high etch radiation approaches.

16.9.3 Surgery

There are many surgical departments in different hospitals with excellent practice in breast surgeries and gastrointestinal tract operations. However, there are no robotic surgeries for cancer or Hyperthermic Intraperitoneal Chemotherapy (HIPEC) procedures available.

16.9.4 Pediatric Oncology

There is a lack of services for pediatric cancer treatment facilities with limited epidemiological data in Sudan. There are only two centers providing comprehensive pediatric cancer treatment, Khartoum Oncology Hospital and the National Cancer Institute. Hematological malignancies (Leukemia and Lymphomas) more than 50% of the pediatric cancer cases with limited Central Nervous System (CNS) tumors [31].

16.9.5 Survivorship Track

This picture is, to some extent, like the pattern of cancer treatment outcome and survivorship in the developing countries rather than the developed countries. With careful attention to the estimation of the outcome, unfortunately it can be counted as a poor survivorship track. This is justified by the diagnosis of the cases in the late stages, among other factors about the challenges of cancer treatment in Sudan (mentioned under Challenges and Advantages).

Factors that affect cancer patients' survivorship in Sudan include:

1. Financial difficulties and lack of insurance coverage
2. Lack of drugs through the approved system
3. Interruption of treatment and follow-up protocol post-treatment
4. No survival care plan approved either institutional or Federal at the Ministry of Health.

16.9.6 Palliative Care Track

The palliative care services in Sudan started in 2010 in the Radiation Isotopes Center at Khartoum (RICK). Now the palliative care services are distributed in many centers and hospitals such as the National Cancer Institute at Gezira University (NCI-GU) and Soba University Hospital (SUH).

16.10 Research and Education

The Sudan Medical Specialization Board (SMSB) is the main national body for postgraduate medical training and specialization for health care professionals. It was established in 1995 and has many health specialization councils.

Clinical oncology training started in 1998 with five medical residents. Now in 2020, there are more than 60 medical residents in the program.

Many scientific activities are usually in the field and aim to maximize skills and professional development. The first cancer conference organized by Khartoum Oncology Hospital in 2010, the second edition in 2011, unfortunately discontinued due to many changes in the head directors and affected by the budget which directed to maintain the supply of the drugs, while inside the hospital's scientific activities are running regularly. In 2015, the Khartoum Integrated Oncology World Congress organized by Khartoum Oncology Specialized Center (KOSC) started and continued annually as the biggest professional oncology gathering in Sudan and outside Sudan. Another impressive scientific activity is the annual East Oncology Center (EOC) Workshop in Gadarif state. There are still limited publications and research projects mainly due to the lack of funds to run such programs. On the other hand, there are many postgraduate researches not published in the field of cancer and related branches.

16.11 Cost-Effective Cancer Care

In the public sector, the government through the Federal Ministry of Health and the National Cancer Authority supports all the centers with free drugs, even the expensive medicines and other services (such as radiation therapy) for all the patients, even foreigners (non-Sudanese). However, there are some shortages in supply from time to time due to the lack of budget. Only one disadvantage is that the huge numbers of patients compared to the facilities need medical services, which causes overcrowding and exhaustion to the medical teams.

On the other hand, the private sector has a real impact on providing the services and the cost is a little high for drugs and other services and is affected by the economic situations in the country.

There are a significant number of patients traveling abroad seeking consultations, second opinion, reevaluation especially by Positron Emission Tomography-Computed Tomography (PET-CT) scan and treatment, especially the sophisticated modalities which are not available in Sudan in the surgical and radiation therapy departments.

16.12 Challenges and Advantages

16.12.1 Challenges for Cancer Treatment in Sudan

A considerable challenge to the cancer treatment in Sudan is that most patients have late presentations in clinical stage III or IV disease. This will reflect mainly on the treatment outcome and overall survival [12].

Other challenges, such as illiteracy, the lack of health education and awareness programs, limited screening services, limited treatment facilities, lack of institutional collaboration, limited research grants on cancer, many populations living far

away in rural areas and that is mainly due to the main work for them is agriculture and grazing animals and the social stigma of cancer in the community.

16.13 The Future of Cancer Care in Sudan

Many plans have been developed by the Federal Ministry of Health to face oncology issues and their burden on the economy and community. The policy is directed towards helping the centers in the public sector to upgrade and have new radiation therapy devices to overcome the lack of radiotherapy machines, which is the main obstacle in cancer treatment services for patients in Sudan, as well as encouraging the private sector to invest in the same issue by facilitating funds from the banks and encouraging international collaboration.

Another aim is to complete additional medical services related to cancer management, such as advanced diagnostic tools and modern laboratory techniques. Moreover, establishing main protocols at least for the common malignant tumors such as breast, ovarian, prostate, lung, and colorectal cancers, to help in the improvement of anticancer therapies supply for the whole country and evaluate the responses in other emerging scientific facts in the Sudanese population.

Encouragement for researchers and professionals to do prospective studies from the local data will support the plans for tackling different scientific issues in cancer patients as well as more activation for the Sudanese National Cancer Council in the Federal Ministry of Health to implement the different approved strategies.

16.14 Conclusion

Sudan has inadequate resources for healthcare services, including cancer prevention and treatment. There is inadequate data about cancer incidence and mortality in Sudan. Cancer in Sudan occurs at a young age and with advanced late manifestations. Cancer is emerging as a public health problem with more efforts done by the Ministry of Health and cancer centers. Measures for cancer prevention at the community level are inadequate. Much attention towards improvement of palliative care services is needed. There is a need to establish National Comprehensive Strategic Plans that include therapeutic services as well as early detection and screening programs. Establishing an effective National Cancer Registry system will help in providing the data of the cases and the data to the real consumers of drugs and other services for cancer patients and how to use the different utilities in the right way. Many efforts have been made by the National Cancer Center Authority in the Federal Ministry of Health to establish rural centers to provide care for cancer patients, but still need more support to handle the different cases.

Conflict of Interest Authors have no conflict of interest to declare.

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