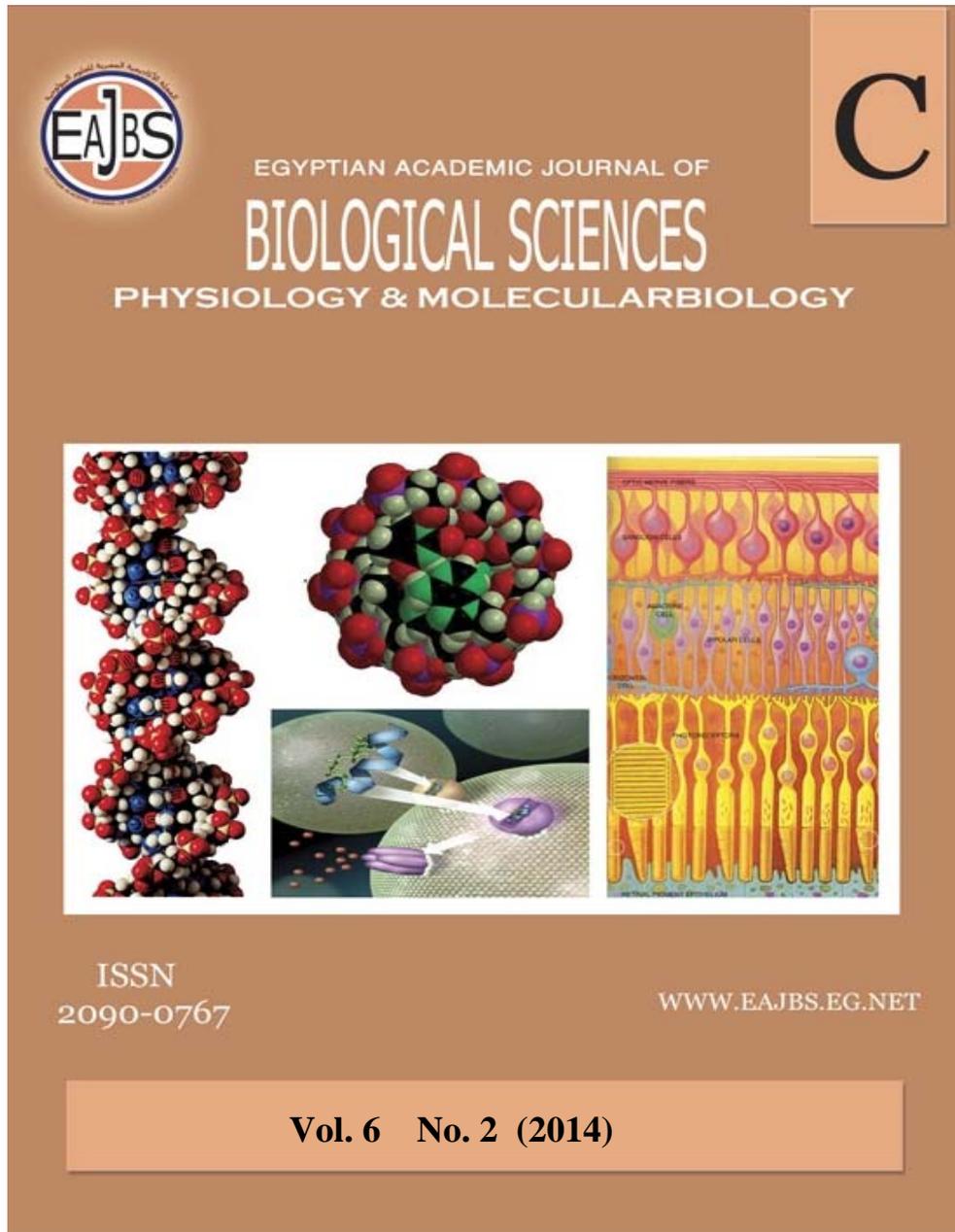


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Egyptian Academic Journal of Biological Sciences is the official English language journal of the Egyptian Society for Biological Sciences ,Department of Entomology ,Faculty of Sciences Ain Shams University .

Physiology & molecular biology journal is one of the series issued twice by the Egyptian Academic Journal of Biological Sciences, and is devoted to publication of original papers that elucidate important biological, chemical, or physical mechanisms of broad physiological significance.

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Burden of Cancer in North Sudan: A community-based Survey

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ARTICLE INFO

Article History

Received: 21/5/2014

Accepted: 6/7/2014

Keywords:

Cancer

Sudan

Relatives

Breast

Leukemia

ABSTRACT

Objective: The aim of this study was to verify the approximate epidemiology of cancer burden in the adults' population of North Sudan.

Methodology: A cross-sectional survey among 1200 individuals was performed. A purposeful form was used to collect cancer-related data.

Results: About 865 participants had responded. Out of 865 respondents, 346(41.1%) had relatives with cancer. The most frequent mentioned cancers were breast, leukemia, colon, prostate, oral, lung, cervix and stomach, representing, 24.8%, 17%, 15%, 14.6%, 14.3%, 13.9%, 10.6% and 9.6%, respectively.

Conclusion: The prevalence of cancer was higher among adults population in North Sudan. The full burden of cancer in Sudan remains mysterious, since there no effective cancer registry in the country.

INTRODUCTION

Cancer is a leading cause of death worldwide and accounted for 7.6 million deaths (around 13% of all deaths) in 2008. Lung, female breast, colorectal, stomach and cervical cancers were the most commonly diagnosed cancers, accounting for more than 40% of all cases. About 70% of all cancer deaths occurred in low- and middle-income countries (IARC, 2008). Cancer can be reduced and controlled by implementing evidence-based strategies for cancer prevention, early detection of cancer and management of patients with cancer. Many cancers have a high chance of cure if detected early and treated adequately.

The awareness of early signs and symptoms for cancer types such as, cervical, breast colorectal and oral in order to get them diagnosed and treated early before the disease becomes advanced is important step toward reducing cancer mortality. Early diagnosis programmes are particularly relevant in low-resource settings where the majority of patients are diagnosed in very late stages and where there is no screening (WHO, 2013).

The prevalence of cancer cases has dramatically increased in Sudan in recent years and cancer is ranked as the major cause of death in most instances (Elebead, *et al.* 2012). Despite the increased prevalence of cancer in Sudan, few effective programs are accessible. The majority of patients attend at advanced stage of the disease. The only available treatment is surgery or radiation therapy or palliative care. In reality the effect of cancer catastrophe in the Sudan is not known yet, inadequate diagnostic facilities and trained health workers and infrastructure, all contribute to lack of cancer reporting. But increasing numbers and death from cancer has drawn the attention of both the health professional and the public (Saeed, *et al.* 2013). The first National Cancer Registry (NCR) in Sudan started in 1967 with a grant from the International Union against Cancer (IUAC). However, the cancer registry was short lived and its activity was discontinued in early 1980s due to lack of funds (Awadelkarim, *et al.* 2012). However, cancer registration in Sudan is exclusively dependent on hospital-based cancer recoding system without knowledge of population background. Most of these systems are within the general health information system of the health institution. Few studies from these hospital-based cancer registries reported that cancer was the third leading cause of death in Sudan hospitals (Hamad, 2006). Up to date, most of the published cancer studies focused in examining one type of cancer. An exception is a study from western Sudan – Elobeid, concluded that number of cancer cases increasing and the

pattern of cancer is different from that reported in other areas of Sudan (Doumi, *et al.* 2009). However, the authors emphasized that the burden of cancer in the different regions of the country is unknown. Another hospital based study from the same area, raised up the flag that the cases admitted to hospital only reflect the tip of the iceberg (Doumi, *et al.* 2009). Therefore, the objective of this study was to verify the approximate epidemiology of cancer burden in the Sudan.

MATERIALS AND METHODS

This is a community-based, cross-sectional study was conducted in North Sudan including North states and Khartoum State. Data was collected as a part of cancer awareness program that conducted during one year activity. People were gathered in certain centers (Clubs, Health centers, Educational centre), for the delivery of the program, they were then asked to fill a form about cancers, which approximately affected one of their first, second or third degree relatives (Cancer confirmation was based on treatment at Radiation and Isotope Centre Khartoum (RICK)). A first-degree relative is defined as a close blood relative who includes the individual's parents, full siblings, or children. A second-degree relative is defined as a blood relative who includes the individual's grandparents, grandchildren, aunts, uncles, nephews, nieces or half-siblings. A third-degree relative is defined as a blood relative who includes the individual's first-cousins, great-grandparents or great grandchildren.

Statistical analysis

Statistical analysis was performed by proportion. The Microsoft Excel Office 2007 and the SPSS software (version 16) were used for statistical analysis.

Ethical Consent

Written informed consent was obtained from each respondent, ensuring strict anonymity. The Ethical Committee of the Department of Histopathology and Cytology,

FMLS, University of Khartoum has approved the study.

RESULTS

This survey involved 1200 individuals of whom 865/1200 (72.1%) have responded to participate. Of the 865 participants, 346 (41.1%), have claimed that they have relatives with cancer. The most frequently mentioned cancers were breast, leukemia,

colon, prostate, oral, lung, cervix, stomach and other scattered cancers, constituting, 205, 141, 125, 120, 118, 115, 88, 79 and 159 respectively. Out of the total respondents, these numbers representing, 24.8%, 17%, 15%, 14.6%, 14.3%, 13.9%, 10.6% and 9.6% of breast, leukemia, colon, prostate, oral, lung, cervix, stomach, respectively, as indicated in Fig 1.

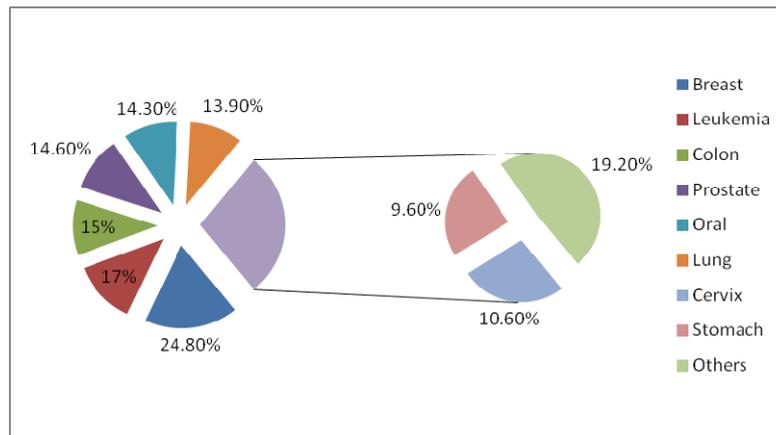


Fig. 1: The frequency of cancers in study population

DISCUSSION

The burden of cancer in Sudan is still unknown due to the absence of effective national registry. This leads to the fact that, data was only obtained from the centers that offer oncology services. Therefore, in this study we tried to determine approximately the burden of cancer, during community-based activities aiming at raising public awareness towards cancer. The overall percentage of those with relatives having cancer is alarmingly showing huge burden of cancer in Sudan. Cancer prevalence differs for the different countries, according to the presence of a particular risk factors group, such as environmental exposure to carcinogens and the life style adopted. It is well established that, more than 30% of cancer deaths could be prevented by modifying or avoiding key risk factors, including; tobacco use, being overweight or obese, unhealthy diet with low fruit and vegetable intake, lack of physical activity, alcohol use, sexually transmitted HPV-

infection, urban air pollution, and indoor smoke from household use of solid fuels (Hussain, 2012; Hussain, 2013; Hussain and Twihida, 2013). For that reason, and due to the absence of such study that evaluated the burden of cancer similarly, we can only say that the prevalence of cancer is expected to be very high according to our overall assessment. The entire discussion may be more effective for the individual investigated cancers, since they were reasonably studied.

Breast cancer is a major cause of morbidity and mortality in women worldwide. In this study, the highest percentage was registered for the breast cancer (24.8%), which was previously reported in several studies as a female leading cancer and as the most commonly diagnosed cancer in Sudan (Elnour, *et al.* 2012). According to a statistical report from the Radiation and Isotopes center in Khartoum, approximately 836 women developed breast cancer in 2007 and 895 in 2008. This accounts for more than 30% of all

cancers in women in Sudan and is estimated as 17.2% of all types of cancers in 2007 and 17.9% in 2008 (Elnour, *et al.* 2012; Awadelkarim, *et al.* 2007). In a survey of 2370 Sudanese students, 67 cases (47 with family history and 20 controls) were analyzed for BRCA1 and BRCA2 mutations with a single-stranded conformation polymorphism (SSCP) mutation detection method applied to peripheral blood. Eighteen subjects knew of first degree female relatives with breast cancer, 23 with second degree female family members affected and 6 with related male sufferers. Twenty randomly selected girls from the remainder of the survey population with no known family history were also tested. The breast cancer susceptibility genes BRCA1 and BRCA2 accounted, respectively, for 1.21% of responders or 51% of those claiming a family history. Mutations were found in 20% of the group selected with no family history. Only 2 BRCA 2 mutations were found, both in girls with no known afflicted relatives. Six girls knew of male relatives with breast cancer; five of these girls carried mutant BRCA 1. Most of the BRCA1- mutations located to exon 11 fragments 11.9 and 11.1 (Awadelkarim, *et al.* 2007).

The second cancer found with high percentage is leukemia (17%). Leukemias are a common malignancy of blood cells emerging from different cell types (Tapio, *et al.* 2013) Although, many types of leukemias have been studied in the Sudan, no distinct study has shown the epidemiology of leukemias in general. However, many specific types have been reported from Sudan. In study investigated the association of EBV in childhood leukemia; EBV LMP1 gene transcripts were found in 29 (36.3%) of the 80 patients with leukemia but in none of the healthy controls ($P < .0001$). Of the 29 EBV(+) cases, 23 (79.3%), 5 (17.3%), and 1 (3.4%) were acute lymphoblastic leukemia, acute myeloid leukemia, and chronic myeloid leukemia, respectively (Ahmed, *et al.* 2012). Most available literature from the Sudan dealt with Burkett's lymphoma. During the period? 1962-80 thirty-five cases

of Burkett's lymphoma were seen and examined histologically in Khartoum, Sudan (Veress, *et al.* 1976; Yagi, *et al.* 1984). A retrospective study was performed dealing with clinical and histopathological aspects of Hodgkin's disease in patients presenting to the Radiation and Isotopes Centre of Khartoum (RICK) during the period from January 1984 to January 1989. A total of 105 patients were studied; this number accounted for 30.6% of all lymphoma patients and 2.0% of all cancers seen at RICK during the same period (AbuElHassan, *et al.* 1993). There is paucity of information on childhood cancer from the Sudan. Data was obtained from the hospital registry for the period May 1999 to June 2007 on all paediatric patients presenting to the Institute Nuclear Medicine and Oncology, University of Gezira, Wad Madani, Sudan. There were 322 children with cancer during this time period with a male: female ratio of 1.6:1. Lymphomas (111, 35%), leukaemia (83, 26%) and Wilms' tumor (43, 13%) were the three most common groups of tumors. Thirty percent of all lymphomas were Burkett's lymphoma; 3.4% of all childhood cancer cases were nasopharyngeal carcinomas (Abuidris, *et al.* 2008). Colorectal cancer is the third most common cancer in men (663 000 cases, 10.0% of the total) and the second in women (571 000 cases, 9.4% of the total) worldwide. Almost 60% of the cases occur in developed regions. Incidence rates are substantially higher in men than in women (overall sex ratio of the ASRs 1.4:1). About 608 000 deaths from colorectal cancer are estimated worldwide, accounting for 8% of all cancer deaths, making it the fourth most common cause of death from cancer. In Sudan, the death rates were 4.5 (701 cases) for men and 2.5 (337 cases) for women (GLOBOCAN, 2008)

Colon cancer was found to constitute 15% in the present study. The initial reports for colon cancer were started at the early seventies (Elmasri and Boulos, 1975; Elmasri and Boulos, 1976). Five hundred and forty-six primary malignant alimentary tract tumors in Sudanese patients are

analyzed for frequency. Rectal cancer is more frequent than colonic cancer per se and occurs more often in males; more cases are recorded in relatively young patients. Colonic cancer has a predilection for the caecum (Elmasri and Boulos, 1976). Interestingly, up to date there is no published histopathological study linking this predilection of right sided cancers to a possible carcinogenic pathway e.g. microsatellite instability. Certain pathological and molecular alterations associated with distinct histological patterns were proposed in the literature for this tumors' localization (Richman and Adlard, 2012; NCI, 2013). Such studies may explore possible etiological genetic factors in the Sudanese population.

Prostate cancer is the second most frequently diagnosed cancer of men (899 000 new cases, 13.6% of the total) and the fifth most common cancer overall. Nearly three-quarters of the registered cases occur in developed countries (644 000 cases). Incidence rates of prostate cancer vary by more than 25-fold worldwide, the highest rates are in Australia/New Zealand (104.2 per 100,000), Western and Northern Europe, Northern America, largely because the practice of prostate specific antigen (PSA) testing and subsequent biopsy has become widespread in those regions. Incidence rates are relatively high in certain developing regions such as the Caribbean, South America and sub-Saharan Africa. Prostate cancer is the sixth leading cause of death from cancer in men (6.1% of the total). In Sudan the incidence was 9(903 cases) and mortality rate of 7.3 (725 cases) in 2008 (GLOBOCAN, 2008). Prostate cancer represented 14.6% in this series. However, few reports from Sudan were among prostate cancer literature, none of them dealing with the overall epidemiological estimation (Khalid, *et al.* 2011; Abdrabo, *et al.* 2011). The world cancer report of 2008 ranked OC as the fifth most common cancer type among males in the less developed countries (Boyle and Levin, 2008). In Sudan, OC is the fifth most common cancer type with incident rate

(920/year), comprising 9% of the cases reported annually in Africa (GLOBOCAN, 2002). This is strongly attributed to the use of local type of snuff known as *Toombak*, a very popular material in the Sudanese community (Idris, *et al.* 1998). The association between *Toombak* dipping and OC has been investigated thoroughly during the last three decades (Idris, *et al.* 1995; Ahmed, *et al.* 2007). However, a recent review examined 33 publications devoted to aetiology of oral cancer in the Sudan, in addition to some risk factors that are commonly practiced in the Sudan (Ahmed, 2013), is useful in this context. Oral cancer represents 14.3% in our findings. In a study described the pattern of cancer among 261 cases attending a referral oral and maxillofacial hospital in Sudan during the period 2006-2007. Of the 261 cases included in this study, the most common pattern was found to be an intraoral squamous cell carcinoma (73.6%). The male to female ratio was approximately 3:2 (Osman, *et al.* 2010).

Lung cancer represented 13.9% of our studied group. Lung cancer has been the most common cancer in the world for several decades, and by 2008, there were an estimated 1.61 million new cases, representing 12.7% of all new cancers. It was also the most common cause of death from cancer, with 1.38 million deaths (18.2% of the total). The majority of the cases now occur in the developing countries (55%). Lung cancer is still the most common cancer in men worldwide (1.1 million cases, 16.5% of the total), with high rates in Central-Eastern and Southern Europe, Northern America and Eastern Asia. Very low rates are still estimated in Middle and Western Africa (ASRs 2.8 and 3.1 per 100,000 respectively). In females, incidence rates are generally lower, but, worldwide, lung cancer is now the fourth most frequent cancer of women (516 000 cases, 8.5% of all cancers) and the second most common cause of death from cancer (427 000 deaths, 12.8% of the total). The highest incidence rate is observed in Northern America (where lung cancer it is now the second most frequent cancer in

women), and the lowest in Middle Africa (15th most frequent cancer). Because of its high fatality (the ratio of mortality to incidence is 0.86) and the lack of variability in survival in developed and developing countries, the highest and lowest mortality rates are estimated in the same regions, both in men and women. In Sudan, the death rates were 2.2 (251 cases) among men and 1.1(143 cases) among women (GLOBOCAN, 2008)

Cervical cancer is the second cancer among women in Sudan, with more than two-thirds of all women with invasive cervical cancer being diagnosed at an advanced stage (Ahmed, *et al.* 2011). In 2000, cancer in Sudanese hospitals was the third leading cause of death represented 5% of all deaths (Hamad. 2006). Cervical cancer represented 10.6% in this study. Cervical cancer is the third most common cancer in women, and the seventh overall, with an estimated 530 000 new cases in 2008. More than 85% of the global burden occurs in developing countries, where it accounts for 13% of all female cancers. High-risk regions are Eastern and Western Africa (ASR greater than 30 per 100,000), Southern Africa (26.8 per 100,000), South-Central Asia (24.6 per 100,000), South America and Middle Africa (ASRs 23.9 and 23.0 per 100,000 respectively). Rates are lowest in Western Asia, Northern America and Australia/New Zealand (ASRs less than 6 per 100,000). Cervical cancer remains the most common cancer in women only in Eastern Africa, South-Central Asia and Melanesia. Overall, the mortality: incidence ratio is 52%, and cervical cancer is responsible for 275 000 deaths in 2008, about 88% of which occur in developing countries: 53 000 in Africa, 31 700 in Latin America and the Caribbean, and 159 800 in Asia. In Sudan the incidence rate in 2008 was 7(923 cases) and death rate of 4.9(613 cases) (GLOBOCAN, 2008). Cancer of the cervix is the second most prevalent cancer of women to date in the Sudan, in a concerted review of the records of the hospital-based cancer registry of the Radiation & Isotope Centre of Khartoum (RICK). A total of 287 cases were reviewed

and 195 cases were included in the study. The mean of cervical cancer cases diagnosed per year at NHL is 7.9%. Histologically, 95.9% of the cases were carcinomas (Husain, *et al.* 2011). Most of cases of cervical cancer were linked to Human Papilloma Virus etiology (Gafar, *et al.* 2013).

Stomach cancer represented 9.6% in this study. About one million new cases of stomach cancer were estimated to have occurred in 2008 (988 000 cases, 7.8% of the total), making it currently the fourth most common malignancy in the world, behind cancers of the lung, breast and colo-rectum. The incidence of stomach cancer in 2008 was 2.5(280 cases) for men and 0.9(113 cases) for women (GLOBOCAN, 2008). However, other scattered cancers have been mentioned, but with lower proportions, which may further indicate the diversity of cancer even among public.

However, recently a National Cancer Registry has been established in Sudan to develop a system that will facilitate creation and maintenance of local and regional data and assembling these data into a single central accessible system. We hope that this registry come into reality and provides accurate data on magnitude cancer in Sudan.

In conclusion: The burden of cancer in Sudan is unknown, due to the lack of national cancer registry, and the few studies that examined the hospital-based data in addition to the approximate findings in this study, showed that cancer is widespread in Sudan. This study indicates the importance of cancer registration in Sudan as a basic infrastructure part of a broad cancer control in Sudan.

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ARABIC SUMMARY

عبء السرطان في شمال السودان: مسحة مجتمعية

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الهدف: كان الهدف من هذه الدراسة للتحقق من وبائيات التقريبية لعبء السرطان في عدد سكان البالغين من شمال السودان.

الطريقة: تم إجراء دراسة استقصائية مستعرضة بين ١٢٠٠ شخص. تم استخدام استمارة هادفة لجمع البيانات المتعلقة بالسرطان.

النتائج: قد استجاب حوالي ٨٦٥ مشارك من المستطلعين. من بين ٨٦٥، كان ٣٤٦ (٤١.١٪) أقارب المصابين بالسرطان. وكانت السرطانات الأكثر شيوعاً المذكورة الثدي، سرطان الدم، القولون، البروستاتا، الفم، الرئة، عنق الرحم والمعدة، وهو ما يمثل، ٢٤.٨٪، ١٧٪، ١٥٪، ١٤.٦٪، ١٤.٣٪، ١٣.٩٪، ١٠.٦٪ و ٩.٦٪، على التوالي.

الاستنتاج: كان انتشار السرطان مرتفع بين السكان البالغين في شمال السودان. العبء الكامل من السرطان في السودان لا تزال غامضة، نظراً لعدم وجود سجل فعال للسرطان في البلاد.