

Research Article

Cancer in Africa 2012

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Abstract

Background: Noncommunicable diseases, and especially cancers, are recognized as an increasing problem for low and middle income countries. Effective control programs require adequate information on the size, nature, and evolution of the health problem that they pose.

Methods: We present estimates of the incidence and mortality of cancer in Africa in 2012, derived from "GLOBOCAN 2012," published by the International Agency for Research on Cancer.

Results: There were 847,000 new cancer cases (6% of the world total) and 591,000 deaths (7.2% of the world total) in the 54 countries of Africa in 2012, with about three quarters in the 47 countries of Sub-Saharan Africa. While the cancer profiles often differ markedly between regions, the most common cancers in men were prostate (16.4% of new cancers), liver (10.7%), and Kaposi sarcoma (6.7%); in women, by far the most important are cancers of the breast (27.6% of all cancers) and cervix uteri (20.4%).

Conclusions: There are still deficiencies in surveillance systems, particularly in Sub-Saharan Africa and, specifically, of their most vital component, population-based cancer registries. With the number of annual cancer cases and deaths likely to increase by at least 70% by 2030, there is a pressing need for a coordinated approach to improving the extent and quality of services for cancer control in Africa, and better surveillance systems with which they can be planned and monitored.

Impact: The results are the best data currently available and provide a reasonable appraisal of the cancer situation in Africa. *Cancer Epidemiol Biomarkers Prev*; 23(6); 953–66. ©2014 AACR.

Introduction

During the 65th World Health Assembly, member states of the WHO agreed to adopt a global target of a 25% reduction in premature mortality from the four major noncommunicable diseases (NCD) by the year 2025. This was in response to the growing burden of NCDs, in which, in 2011, cancer was estimated to be the leading global cause of death, ranking above ischemic heart disease, stroke, and lower respiratory tract infections (1).

Cancer is an increasing problem in Africa because of aging and growth of the population as well as increased prevalence of risk factors associated with economic transition (including smoking, alcohol, obesity, physical inactivity, and reproductive behaviors), and of certain infectious agents of importance in cancer etiology. According to United Nations population estimates (2), the population of Africa between 2010 and 2030 is

projected to increase by 60% overall (from 1.03 billion to 1.63 billion) and by 90% for those 60 and older (from 55 million to 103 million), the age at which cancer most frequently occurs.

Despite this growing burden, cancer continues to receive a relatively low public health priority in Africa, largely because of limited resources and other pressing public health problems, including communicable diseases such as Acquired Immune Deficiency Syndrome (AIDS)/Human Immunodeficiency Virus (HIV) infection, malaria, and tuberculosis. Another factor may be a general lack of awareness among policy makers, the general public, and international private or public health agencies, concerning the magnitude of the current and future cancer burden on the continent and its economic impact.

In this review, we present data on the estimated burden for common cancers in Africa based on the most recent GLOBOCAN estimates of incidence and mortality for 2012 (3). These data are built upon results from the network of population-based cancer registries that have grown up over the last 30 years. In Africa, data from cancer registries are particularly important, as there are no accurate mortality statistics available from civil registration systems on the continental mainland.

Data Sources and Methods

The numbers and rates presented here were extracted from the GLOBOCAN 2012 database of the International

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Table 1. The data sources and methods used to estimate incidence rates

Source		Method						Total
		1	2	6	7	8	9	
C	High-quality ^a regional data (coverage <10%)			4	3			7
D	National data (rates)	2	4				1	7
E	Regional data (rates)			4	7	1		12
F	Frequency data					6	2	8
G	No data						20	20
	Total	2	4	8	10	7	23	54

NOTE: Number of countries, according to type of data source, and method used to estimate national incidence from this source. Methods: 1, Rates projected to 2012; 2, Most recent rates applied to 2012 population; 6, Estimated as the weighted average of the local rates; 7, One regional cancer registry considered representative; 8, Rates for all cancers partitioned using relative frequency data; 9, Rates from neighboring countries or registries in the same area.
^aData published in "Cancer Incidence in Five Continents."

Agency for Research on Cancer (IARC), which presents estimates of incidence of, and mortality from all cancers and 27 major types in 184 countries or territories worldwide for 2012 (3). The data sources and methods used to estimate incidence in each country are described in the Supplementary Table S1 and are summarized in Table 1. Of the 54 countries of Africa for which estimates are available, relatively recent cancer registry data were used for 34, while the absence of any recent data for 20 meant that estimates were based on data from neighboring countries. Fig. 1 depicts the data sources and methods used in map form.

In seven countries (Algeria, Egypt, Libya, Malawi, Tunisia, Uganda, and Zimbabwe) there were local ("regional") registries which cover less than 10% of the national population, but which were judged to be of sufficient quality for inclusion in the latest volume of "Cancer Incidence in Five Continents" (CI5; ref. 4). Their data were used to estimate national incidence [methods 6 (>1 registry per country) and 7 (a single registry)].

National cancer registry data were available from seven countries (Botswana, Mauritius, Namibia, Reunion, The Gambia, Swaziland, and Republic of South Africa). Although none were of a quality sufficient for inclusion in CI5, the incidence rates of six of them were used in making estimates for the country.

Cancer-specific mortality statistics were available from four countries, but they were of only medium quality in two (Mauritius and Reunion) and of low quality in Egypt and Republic of South Africa (quality criteria as defined by Mathers and colleagues; ref. 5). Recent mortality rates from these countries were used for the 2012 estimates. For the remaining countries, mortality was estimated by combining the estimates of cancer incidence with survival probabilities predicted from country-specific levels of the Human Development Index (6).

Estimates of the incidence of Kaposi sarcoma (KS) for countries in Sub-Saharan Africa were calculated by a

different approach, using data on prevalence of HIV infection, as most KS cases are HIV-related.

1. The number of endemic (pre-AIDS) KS cases was first estimated, using the percentage frequency of the disease, by sex and age, based on data from Uganda, Kampala (1961–1980), and Nigeria, Ibadan (1971–1990). These percentages were applied to countries in Eastern and Western Africa, respectively. For countries in Middle and Southern Africa, a simple average of these frequencies was applied.
2. The number of epidemic (AIDS-related) KS cases was then estimated for both sexes combined for the year 2011, using estimates of AIDS deaths by country in 2011 (7) and an estimate of the ratio of deaths from AIDS to incident cases of KS. This ratio was based on observed KS rates in several countries (from the sentinel registries listed below, minus the endemic KS), and was specific by region (varying from 0.7% in Western Africa to 6.0% in Eastern Africa). This total number of AIDS-related KS was partitioned by sex and age using sex- and age-specific proportions in sentinel registries of Malawi, Blantyre, Uganda, Kampala and Zimbabwe, Harare (Eastern Africa), Congo, Brazzaville (Middle Africa), Botswana and Namibia (Southern Africa), Mali, Bamako and Niger, Niamey (Western Africa).

We present the results for 2012 in terms of the numbers of new cancer cases and deaths, and cumulative risk of developing, or dying from cancer before age 75, expressed as a percentage, assuming an absence of competing causes of death.

Results: The Cancer Burden

Incidence

Overall, 847,000 new cancer cases (6.0% of the world total) and 591,000 cancer deaths (7.2% of the world total)

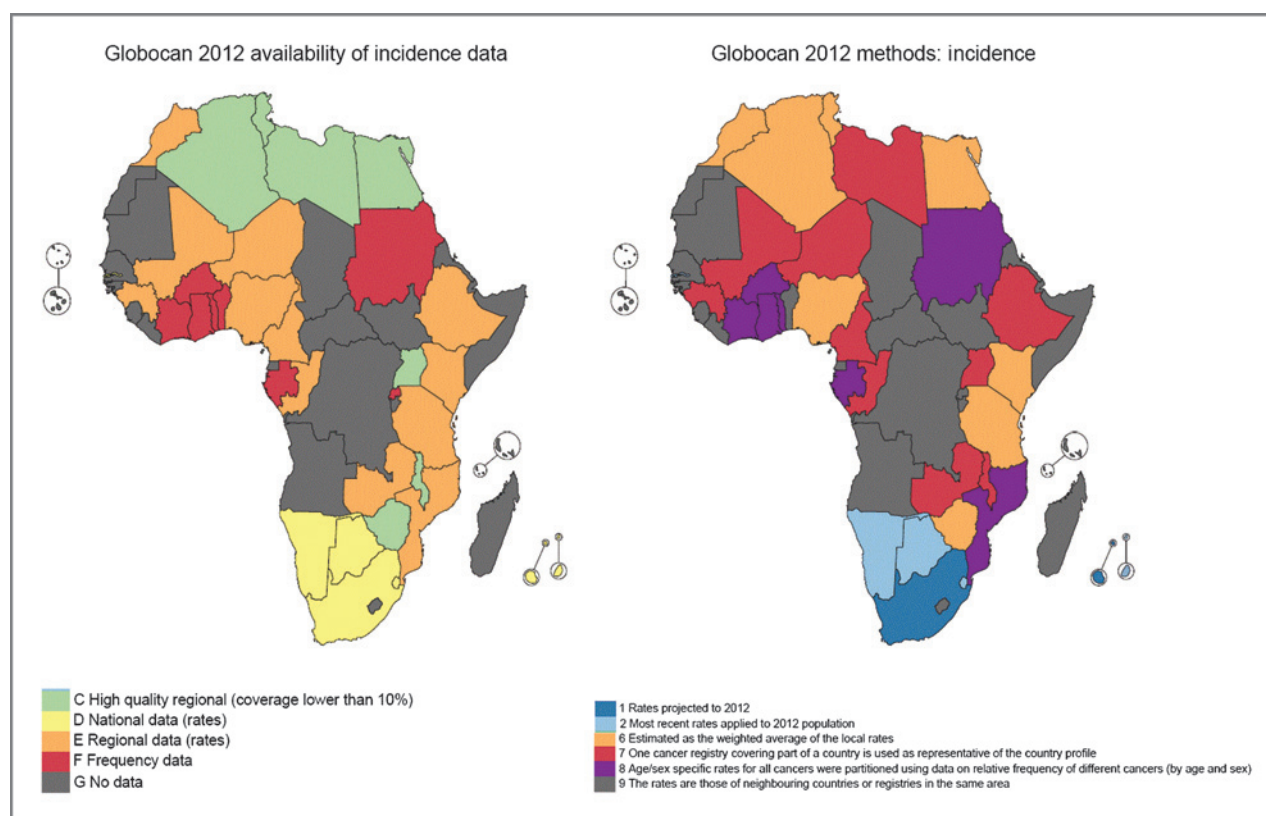


Figure 1. The sources of incidence data used for Globocan 2012 (A) and the method used to make the national estimate of incidence (B), by country.

were estimated to have occurred in Africa in 2012 (Table 2). Crude rates of incidence and mortality are much lower than the global average because of the young age of the African population (the median age in 2010 was 19.2, compared with 28.5 for the world; ref. 2). In terms of cumulative risk, however, the difference is much less pronounced. Indeed, cumulative mortality in African women is greater than the global average.

Fig. 2 shows the contribution of different cancers to the total burden of incidence in Africa. In females, cancer of the breast (133,900 or 27.6% of cases) and cervix (99,000 or 20.4% of cases) are by far the most important. In Sub-Saharan Africa, the numbers of cases of these two cancers are almost equal: 94,300 (25.5% of cancers in women) and 93,200 (25.2%), respectively.

In males, cancer of the prostate dominates in terms of number of cases, both in Africa as a whole (59,500 cases, 16.4% of cancers in men), and, even more so in Sub-Saharan Africa (51,900 cases, 20.3% of the total), followed by liver cancer (38,700 cases, 10.7%) and KS (23,800 cases 6.6% of the total).

Figure 3 (left) shows the cumulative risk percent (0–74) of the 10 major cancers in Africa, Sub-Saharan Africa, and North Africa.

Within Africa there are, however, quite marked geographic variations in these, and other important cancers, due, presumably, to different exposures and, possibly,

susceptibility of populations to them. Figure 4 shows the most numerous cancers in each country, for males (Fig. 4A) and females (Fig. 4B).

Mortality

As described in "Data Sources and Methods," almost all of the mortality data were estimated from incidence rates, and survival appropriate to the level of development of the country. Ratios of incidence to mortality of the different cancers are therefore somewhat similar in the various countries, and geographic patterns of mortality follow closely those of incidence.

Figure 3 (right side) shows the cumulative mortality percent (0–74) for the 10 major cancers in Africa, Sub-Saharan Africa, and North Africa. The overall ratio of deaths to cases (70% for Africa, 72% for Sub-Saharan Africa, and 65% for North Africa) reflects the rather different cancer patterns. As can be deduced from Fig. 3, the M:I ratio for individual cancers is very similar: 47% for breast cancer, 61% for cervix cancer, 68% for KS, 71% for prostate cancer, 72% for colorectal cancers, and 96% for liver cancer.

Discussion

The 2012 estimates

The numbers and rates of cancer for individual countries are estimates based on data of varying quality, ranging from population-based close-to-complete and

Table 2. Estimated numbers of new cases and deaths, rates (per 10⁶) and cumulative risk (%) from cancer, Africa 2012

Population	Incidence (cases)				Mortality (deaths)			
	Cases	% of world	Crude rate (per 100,000)	Cumulative risk % (0–74)	Deaths	% of world	Crude rate (per 100,000)	Cumulative risk % (0–74)
Both sexes								
World	14,090,149		199.7	18.5	8,201,030		116.3	10.5
Africa	846,961	6.0	79.0	12.8	591,169	7.2	55.1	9.4
Sub-Saharan Africa	626,399	4.4	72.5	12.5	447,745	5.5	51.8	9.5
North Africa	220,562	1.6	106.1	13.4	143,424	1.7	69.0	9.3
Male								
World	7,427,148		208.8	21.0	4,653,132		130.8	12.7
Africa	362,037	4.9	67.5	12.3	277,849	6.0	51.8	9.5
Sub-Saharan Africa	256,261	3.5	59.3	11.5	200,881	4.3	46.5	9.1
North Africa	105,776	1.4	101.6	14.2	76,968	1.7	74.0	10.7
Female								
World	666,3001		190.5	16.4	3,547,898		101.5	8.4
Africa	484,924	7.3	90.4	13.4	313,320	8.8	58.4	9.4
Sub-Saharan Africa	370,138	5.6	85.6	13.5	246,864	7.0	57.1	9.8
North Africa	114,786	1.7	110.5	12.8	66,456	1.9	64.0	8.0

valid observed counts of cases and deaths, through estimates based on samples, to those based solely on data from neighboring countries. They represent the best estimates that can be attained given existing information sources, and, although it is often suggested that the numbers of cases are underestimates of the true situation (refs. 8–10), there is no reason to suppose that this is the case. The country-specific cancer incidence rates (and mortality using the 5-year survival method) are usually based on data reported by local cancer registries that generally cover the capital city or predominantly urban areas. Adjustments are made for known causes of under-enumeration of cancer cases, but this remains a possibility, particularly in some of the unpublished datasets that have been used. Of more concern, however, is the very sparse data available for rural Africa (where life expectancy was less than 50 years in 2000), and the likelihood that incidence rates for most cancers are much lower in rural areas than those reported by the cancer registries covering urban areas. If the urban:rural incidence rate ratios that are reported by Indian cancer registries (11) were applicable to African countries, then the 2012 estimates for Africa would be overestimated, as only 40% of the population is urban (2). The estimates presented in GLOBOCAN 2012 are the most accurate that can be made at present, although there is obviously a need for more reliable cancer registry data, especially in Sub-Saharan Africa, and promoting population-based cancer registration systems for assessing local cancer control priorities in these countries is clearly very important.

The major cancers

Breast cancer. Breast cancer is the most commonly diagnosed cancer in Africa, and in Sub-Saharan Africa,

and is also the leading cause of death from cancer (63,100 deaths in 2012). Figure 4 shows that breast cancer is the most commonly diagnosed cancer in women in all of North Africa, and has also become the leading cancer in women in many Sub-Saharan countries. However, the geographic pattern does not closely follow the conventional regions (Fig. 5). Apart from the island populations of Mauritius and Reunion, the highest rates are seen in Egypt, Algeria, Nigeria, and Republic of South Africa. Although the reasons for the increasing importance of breast cancer must be speculative, they most likely include increases in the prevalence of risk factors such as early menarche, late child bearing, having fewer children, obesity, and increased awareness and detection, which are associated with urbanization and economic development. There have been rapid increases in the incidence of breast cancer in Sub-Saharan Africa; rates of increase in the last 20 years were 3.6% per year in Kampala (Uganda) and 4.9% per year in the Black population of Harare (Zimbabwe; refs. 12, 13). In North Africa, the increase in Central Tunisia was 2.5% annually in the last 15 years (14).

It has been known for some time that breast cancer among Black Americans is more likely to be early onset, higher grade, and estrogen receptor (ER) negative than is observed among White Americans (15) and the same is true in the Black population of the United Kingdom. (16) Early age at onset and aggressive clinical features have frequently been documented in clinical series from Africa and case series from several centers in Africa have reported that hormone receptor-negative cases are predominant (17–19), for example, only 25% of cases in a large multicenter series of patients from West Africa were ER-positive, less than half that observed in the U.S. Black

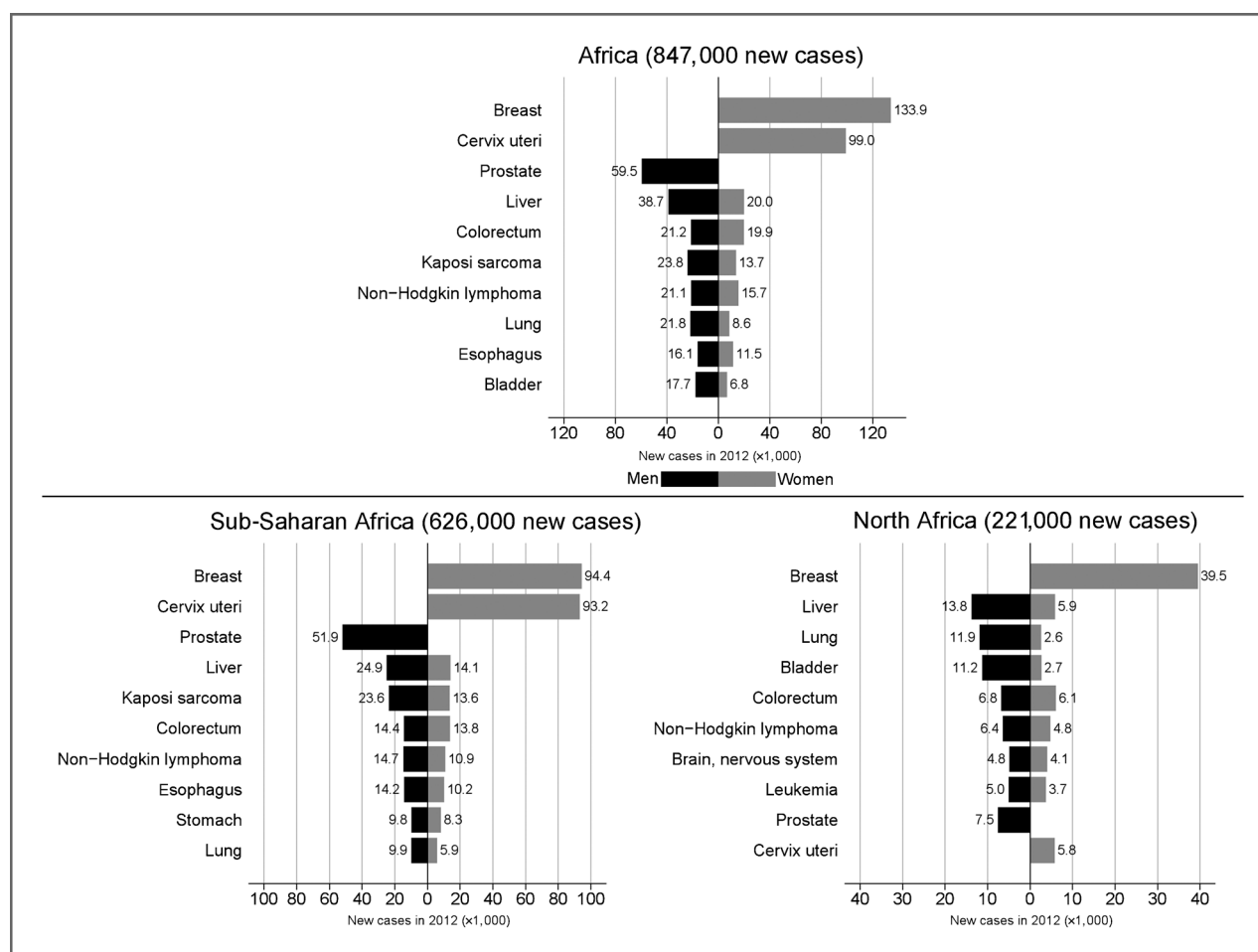


Figure 2. The estimated numbers of cases of the 10 most frequent cancers, by sex, in Africa, Sub-Saharan Africa, and North Africa.

population overall and in those born in Africa (20, 21). However, these findings from Africa were based on archival materials and the role of antigen degradation and false negative results could not be ruled out (18). Indeed, a more recent prospective case-series study in South African Black women found that only 35% of breast cancer cases were ER negative (22), which was comparable with those which had been reported in U.S. Black women (20, 21).

Cervical cancer. Cervical cancer is the second most frequently diagnosed cancer in Africa (99,000 cases) and Sub-Saharan Africa (93,200, 25.2% of cancers in women) in 2012, but is much rarer in North Africa (only 5800 cases, 5.1% of cancers in women). Figure 6A shows cumulative incidence by country, and illustrates the very high risk in East Africa, with cumulative risk in Malawi, Zimbabwe, and Mozambique in excess of 6%, whereas in some countries of North Africa (Egypt, Sudan and Tunisia) the cumulative risk is below 1%. These high rates reflect a high prevalence of the causative virus, HPV (23) as well as a lack of screening services for the prevention and early detection of the disease (24). It is noteworthy that before the introduction and wide dissemination of Pap testing in the 1960s in the United States, the inci-

dence of cervical cancer (cumulative risk, 0–74) in ten selected metropolitan areas in 1947–48 [3.1% in whites and 6.7% in non-whites (24)] was of the same order of magnitude as the highest rates found in Eastern Africa today. There is little evidence for any decline in incidence in recent years; incidence rates in both Kampala (12) and Harare (13) show persistent increases in incidence.

Prostate cancer. With almost 60,000 new cases estimated in 2012, cancer of the prostate is the most frequently diagnosed cancer in men, although in North Africa, it lies in fourth position (after lung, liver, and bladder). It is the third most common neoplasm overall (after breast and cervix), both in Africa as a whole and in Sub-Saharan Africa. In the latter region, the risk of developing prostate cancer before age 75 (3.4%, affecting almost 1 in 30 men) is in fact not dissimilar to the equivalent risks for breast (3.5%) and cervical cancer (3.8%) among women (Fig. 3).

As is evident in Fig. 4, the disease is the leading cause of cancer among men in many African countries (23 of 54). There remains however a 10-fold variation in cumulative incidence of prostate cancer in Sub-Saharan countries (Fig. 6B), with risk in 2012 ranging from 0.8% in Ethiopia to

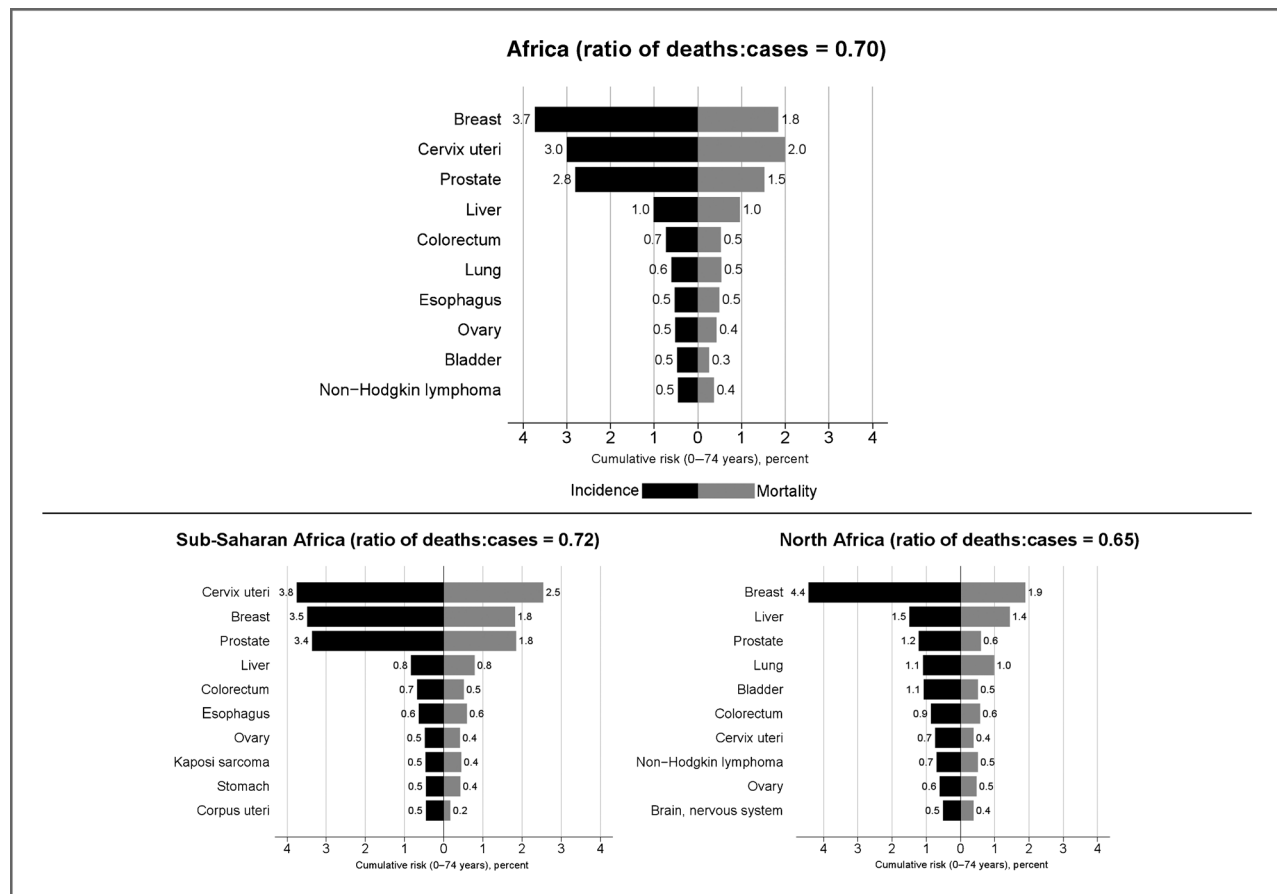


Figure 3. The cumulative risk percent (0–74) of the 10 most frequent cancers, by sex, in Africa, Sub-Saharan Africa, and North Africa.

more than 8% in the Republic of South Africa. Even in the latter country, rates are modest compared with those in men of African descent in the United States and Caribbean (3), although incidence is markedly increasing in a number of African populations, for example in Kampala and in the Black population of Harare (13). Most cancer registries are situated in major cities or urban populations on the continent, and it thus remains difficult to ascribe such geographical and temporal differences to risk factors linked to increasing affluence (a westernization of lifestyle), or to inherent and well-known artifacts [enhanced diagnostic capabilities, notably via the increasing availability (and affordability) of PSA testing].

Liver cancer. Given the poor prognosis of liver cancer, the number of new cases (58,500) and deaths (56,000) estimated in 2012 are rather similar, and in terms of both indicators, liver cancer (predominantly hepatocellular carcinoma) ranks as the fourth most frequent cancer on the African continent and in Sub-Saharan Africa, accounting for about 7% of the total cancer burden. Rates are 2-fold greater in North Africa than in Sub-Saharan Africa (Fig. 3) largely because of the very high incidence rates in Egypt (Fig. 6C) and indeed liver cancer rates tends to be low elsewhere in the region; compare, for example, the cumulative incidence in Morocco (0.2%), Algeria (0.2%),

and neighboring Libya (0.7%) among men with those estimated for Egypt (4.6%). The incidence and mortality rates are also elevated elsewhere, particularly in Western Africa, where liver cancer is the most common malignancy of men in 12 countries (Fig. 4) with a cumulative risk ranging from 1% to 3% in 2012.

The major risk factors in operation for liver cancer on the African continent are infections with the hepatitis viruses and aflatoxin (26, 27), particularly chronic carriage of the hepatitis B virus (HBV) in Sub-Saharan Africa, with chronic hepatitis C virus (HCV) infection more prevalent in Northern Africa. This is markedly the case in Egypt, where the burden of HCV prevalence is the highest in the world and largely attributed to public health campaigns to reduce schistosomiasis via mass parenteral antischistosomal therapy (28).

Colorectal cancer. Colorectal cancer is the fifth most common malignancy in Africa according to estimates for 2012, with 41,000 new cases and around 29,000 deaths, and a slight preponderance of cases in men. It is certainly more common in Northern Africa (Fig. 6D), where, in Algeria, it ranks second only to breast cancer in terms of incidence when both sexes are combined. In Tunisia and Libya, colorectal cancer takes second place among women, and lifetime risk (0–74) is above 1%. Cumulative risk is even

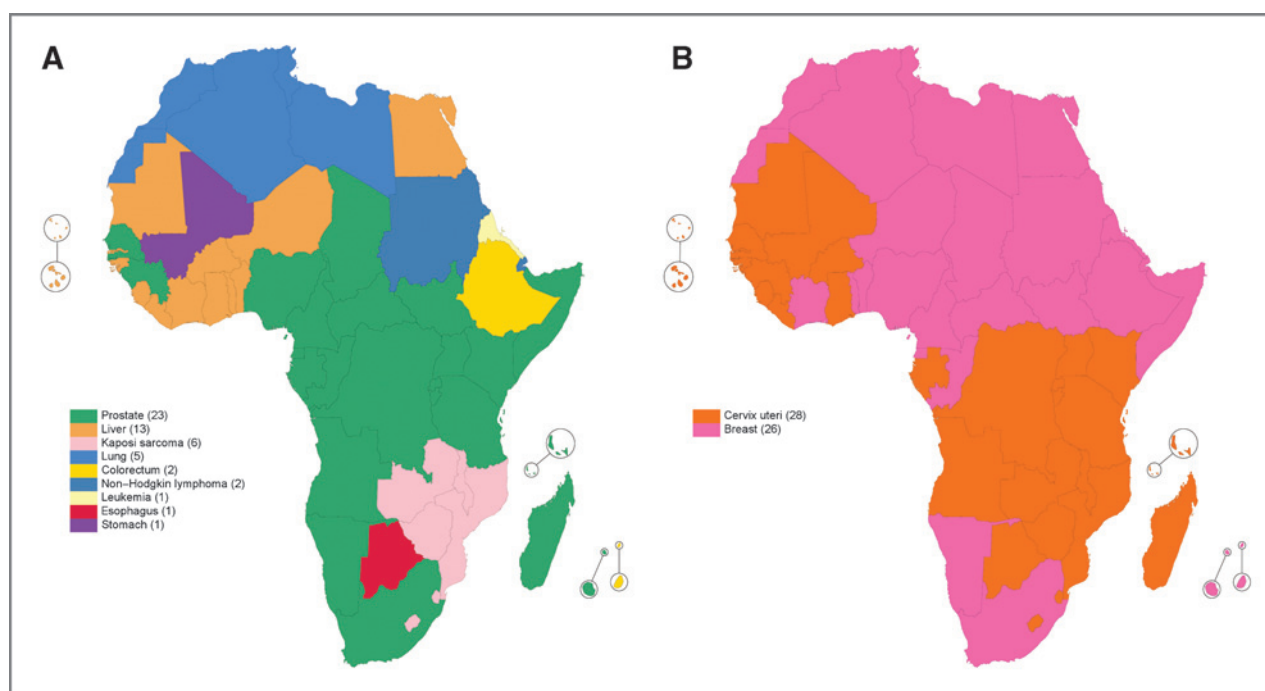


Figure 4. The most common cancer (number of cases), by country, in males (A) and females (B).

higher in the Indian Ocean islands of Mauritius and Reunion, as well as in Republic of South Africa, where rates are many times greater in Whites compared with Blacks (29).

Given the relative diagnostic biases associated with prostate and breast cancer, cancers of the large bowel may be considered a more robust marker of the extent of transition in a given population (30), probably linked to a number of ill-defined dietary factors as well as nutritional correlates (sedentary lifestyle and obesity). While Burkitt's review of colorectal cancer over 40 years ago revealed its rarity across Sub-Saharan Africa (31), cumulative incidence is now above 1% in Zimbabwe in 2012, and time trends in incidence over the 20-year period up to 2010 revealed increases in colorectal rates of around 4% per annum among both Black men and women in Harare (13).

Kaposi sarcoma. An estimated 37,500 cases of KS (23,800 cases in males and 13,700 cases in females) were diagnosed in Africa in 2012, all but about 300 in Sub-Saharan Africa. Figure 7 shows that the area of highest incidence is in East Africa, where in six countries it is the most common cancer in males (Fig. 4). The incidence rates for KS rose several fold in East Africa and other parts Sub-Saharan Africa during the 1990s, consistent with the HIV/AIDS epidemic in these regions (32, 33), and incidence rates still correlate, at least to some extent, with the prevalence of HIV/AIDS (Fig. 7). KS is an HIV-associated cancer caused by human herpes virus-8 (34, 35). Although KS continues to be a leading cause of cancer in most parts of Eastern Africa, rates are declining because of reduction in prevalence of HIV and wider availability of highly active antiretroviral therapy (12, 13, 36).

Non-Hodgkin lymphoma. An estimated 36,700 new cases and 26,400 deaths from non-Hodgkin lymphoma (NHL) occurred in Africa in 2012. Incidence rates in both sexes are rather higher than the world average (cumulative risk 0.54%) in North Africa (cumulative risk 0.70%) but lower in Sub-Saharan Africa (cumulative risk 0.37%). NHL encompasses a variety of histologically distinct forms (37). Burkitt lymphoma (BL) is a very common cancer of children in parts of tropical Africa, where it may account for up to three-quarters of all childhood cancers (26). In the zone of high incidence of childhood BL in central Africa, almost all cases are associated with Epstein-Barr virus (EBV), as demonstrated by the presence of either EBV nuclear antigen (EBNA) or EBV DNA in the tumor cells. Intense (holoendemic) malaria infection is a cofactor: BL cases have evidence of more frequent or intense infection with malaria than control children (38). The risk of adult NHL is increased by HIV infection, although the relative risk in HIV-positive subjects in Africa is lower than in Europe and North America, and the association between endemic BL and HIV is even less clear (39). In 2002, it was estimated that about one quarter of NHL cases in Sub-Saharan region were associated with AIDS (40). However, it is not clear that the incidence of NHL in areas where there is a high prevalence of HIV infection has been much impacted by increasing use of antiretroviral therapy (ART). In the Western Cape of South Africa, for example, cases of HIV-related lymphoma accounted for 37% of all lymphomas seen in 2009 (an increase from 5% in 2002), and BL is now the commonest HIV-related lymphoma, followed by diffuse large B-cell lymphoma subtypes (41). In Harare (Zimbabwe) the

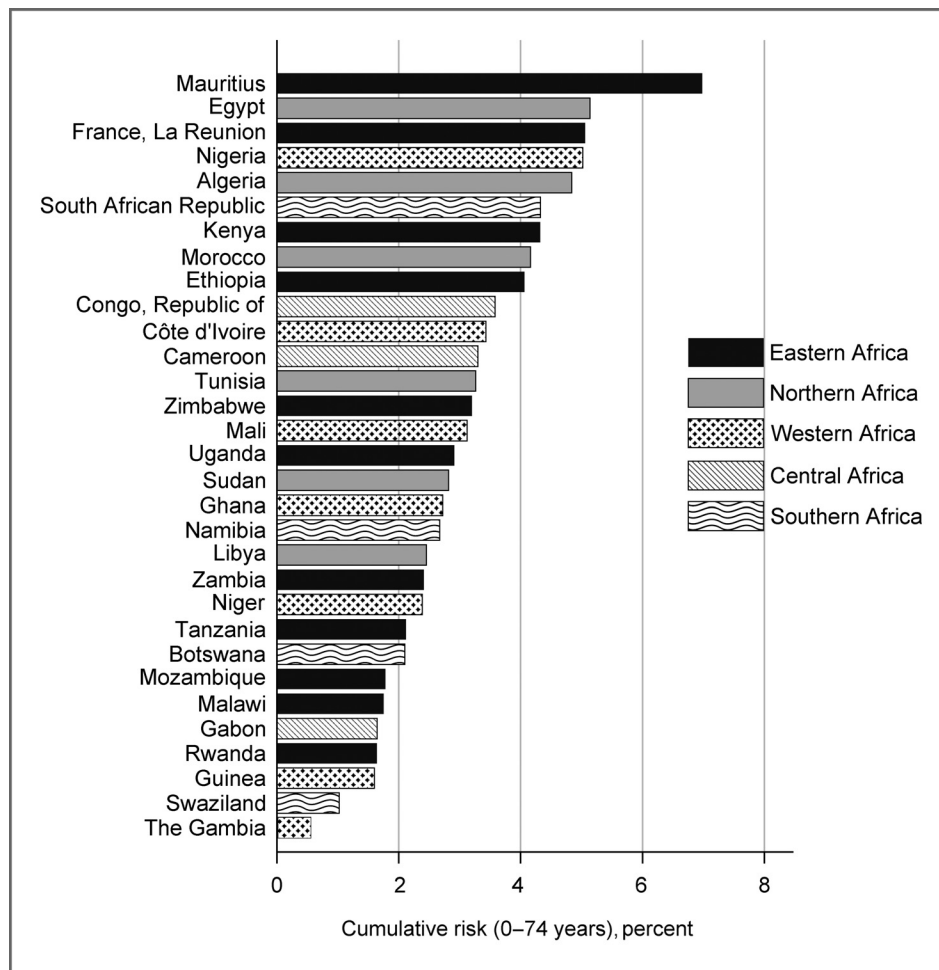


Figure 5. Cumulative risk (0-74) percent of breast cancer in females in 31 countries (for which estimates were based on cancer registry data).

incidence of NHL has shown a steady increase since 1991 (6.7-6.9% annually), although rates in young adults (15-39) have decreased since 2001 (13). The rate of increase in Kampala (Uganda) in 1991-2010 was similar (5.2% annually in men, 6.9% in women), although there was a small decrease among young adults (15-49) since 2007/2008 (12). It is not clear why ART appears to have been less successful in reducing incidence of NHL compared with that of KS (above), although as noted, the risk associated with HIV infection is much lower for NHL than for KS, and poor coverage, late commencement of ART, and incomplete viral suppression may mask any effect at population level. In neither Harare nor Kampala has there been much change in incidence of BL, although a recent decline in incidence has been reported in northern Tanzania (42).

Lung cancer. About 30,300 new lung cancer cases and 27,000 deaths were estimated to have occurred in 2012 in Africa, with men accounting for over 70% of the total cases and deaths. There is over a 30-fold difference in incidence and mortality rates between countries in both males and females, with the lowest rates found in the Western Africa and Middle Africa and the highest rates in Southern and

Northern Africa. Notably, lung cancer is the most commonly diagnosed cancer among males in most countries in Northern Africa, including Tunisia, Libya, Morocco, and Algeria (Fig. 4).

Data on time trends in lung cancer rates in Africa are sparse. Chokunonga and colleagues reported that lung cancer incidence rates decreased from 1991 through 2010 in Black population of Harare, Zimbabwe, in both men and women (13). In South Africa, Bello and colleagues (43) documented decreasing lung cancer mortality rates in men but increasing rates in women from 1995 through 2006, and an increasing incidence in women has also been noted in Kampala (Uganda; ref. 12). The decrease in men may reflect reduction in tobacco use due to antitobacco policies over the past decades, including increased excise tax on cigarettes and banning smoking in public places (43, 44). In general, tobacco consumption and lung cancer rates are expected to increase in many parts of Africa because of continued tobacco promotion (45, 46) and lack of comprehensive tobacco control policies in the region (47). According to data from the Global Youth Tobacco Survey, initiation of smoking increased from 1999 to 2008 in some African countries (48).

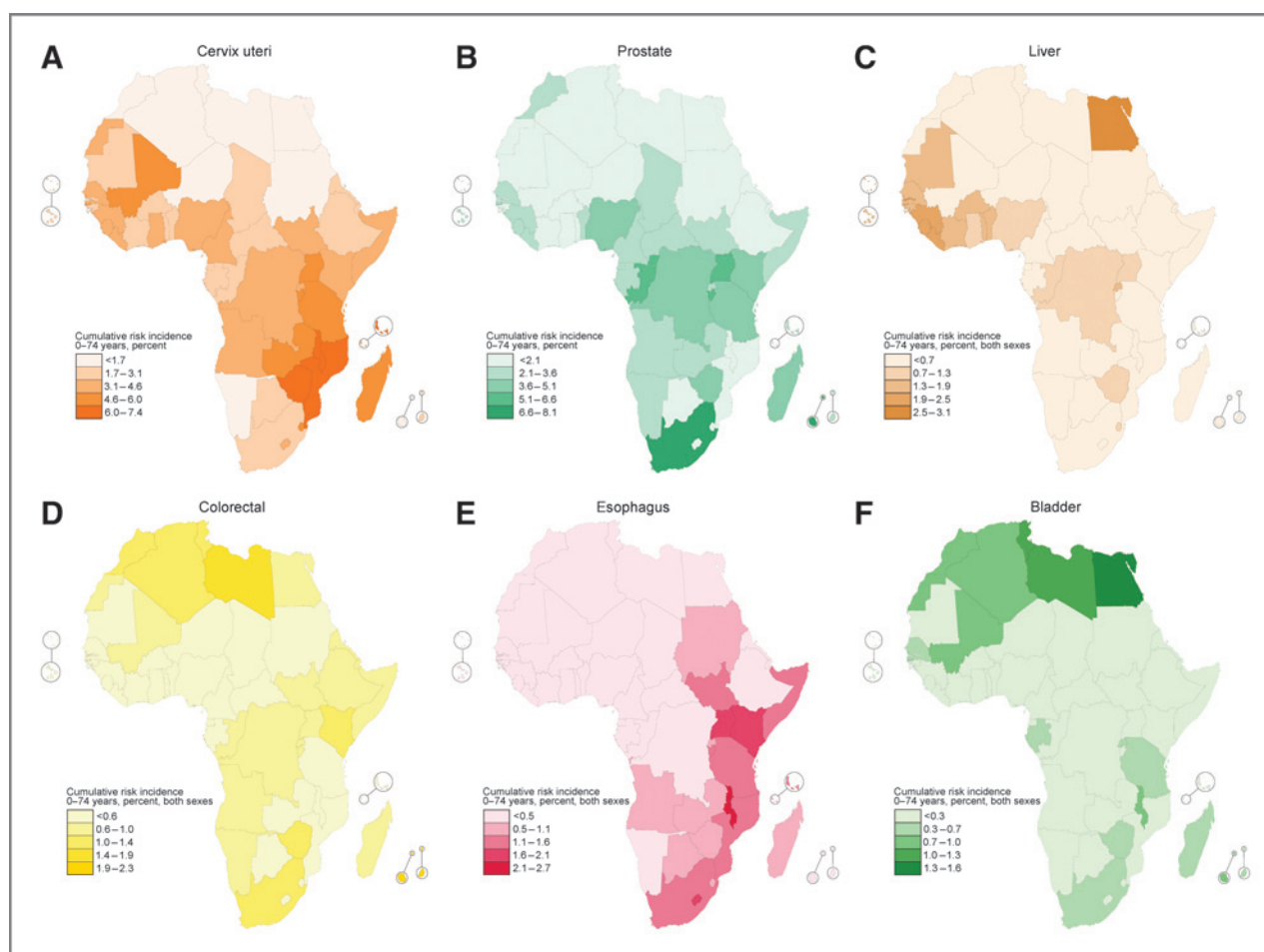


Figure 6. Maps showing estimate of cumulative risk, percent (0–74). A, cervix cancer (females); B, prostate cancer (males); C, liver cancer (both sexes); D, colorectal cancer (both sexes); E, esophageal cancer (both sexes); and F, bladder cancer (both sexes).

Esophageal cancer. About 27,500 new cancer cases and 25,200 deaths from esophageal cancer were estimated to have occurred in Africa in 2012, 89% of these in Sub-Saharan Africa (Fig. 2). It is more common in males than females (sex ratio = 1.4) and incidence rates are particularly high in East Africa (Fig. 6E). Exceptionally high incidence rates have been recorded in the East Cape Province (former Transkei) area of South Africa (49). Almost all of the esophageal cancers in these high risk areas are squamous cell carcinomas (4). The reasons for the high burden of esophageal cancers in several parts of Eastern Africa and Southern Africa are not fully understood. Tobacco and alcohol are, as elsewhere, clear risk factors (50), but obviously do not explain the dramatic regional variation within Africa. Many other hypotheses have been advanced, including nutritional deficiencies secondary to poor dietary patterns such as consumption of a maize-based diet that is low in fruits and vegetables, and the contamination of maize with fungi that produces fumonisins, a cancer-initiating agent in experimental animals (26, 51). Although a small decline in registered death rates from esophageal cancer

in males was recorded in the Republic of South Africa between 1999 and 2006 (52), no decline in incidence has been seen in cancer registries in the high risk populations of the Eastern Cape (53), Harare, Zimbabwe (13) and Kampala, Uganda (12).

Bladder cancer. Bladder cancer is the fourth most common cancer of men in North Africa, with a cumulative risk of 1.1% (Fig. 3), but the incidence elsewhere in Africa is much lower (Fig. 6F). Incidence and mortality rates among men in Northern Africa are twice as high as those in Southern Africa, which has the second highest regional rates (cumulative risk 0.8%). Egyptian men have by far the highest bladder cancer incidence rates in Africa (cum risk 2.6%). A large proportion of bladder cancer cases in Africa are squamous cell carcinoma (54), and between 30% and 60% of all bladder cancer cases in this region are caused by chronic infection with the parasite *Schistosoma haematobium* (55). Treatment of schistosomiasis with the drug praziquantel coupled with lower infection rates (probably because of urbanization) are thought to have contributed to the substantial decrease in incidence of *Schistosoma*-associated

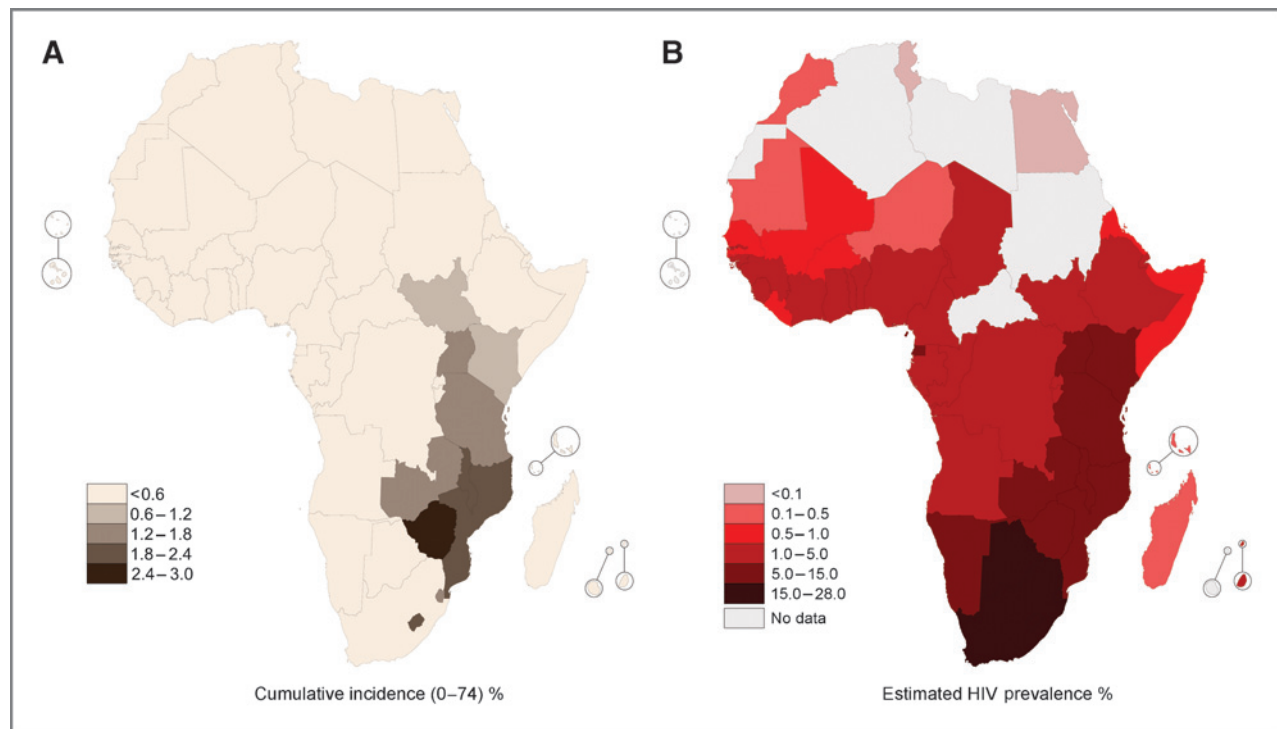


Figure 7. Map showing estimate of cumulative risk, percent (0–74) of KS (both sexes; A) and estimated HIV prevalence (percentage of adults; B; ref. 7).

bladder cancer in Egypt over the past few decades (56, 57).

Opportunities for cancer prevention and control

Opportunities for reducing suffering and death from cancer in Africa exist across all stages of the cancer control spectrum. Recent reviews have described the current status and future opportunities with respect to cancer treatment (58, 59) and palliative care in Africa (60, 61). Here, we focus on the prospects for cancer prevention, based on our understanding of etiology and the nature history, and applicable resource-dependant approaches to early detection strategies (27, 62, 63).

Prevention is rightly proposed as of primary importance as it is undoubtedly more logical, and cost-effective to prevent disease that to deal with it once it has occurred. The benefits of preventive interventions take a long time to be manifest, and the more urgent needs of alleviating suffering among patients with cancer will take priority, but this should not preclude relatively modest investments to reduce the size of the problem to be dealt with in future.

It has been estimated (64) that at least 32.7% of cancers in Sub-Saharan Africa are caused by infectious agents including cervix, liver, and bladder cancers and KS—but excluding some that result from infection with HIV. A substantial proportion of these cancers is potentially preventable by vaccination, improved hygiene, sanitation, and/or treatment.

Vaccination against Hepatitis B (responsible for the majority of liver cancers in Sub-Saharan Africa), has been

available since the early 1980s and has been recommended as part of routine national infant immunization programs since 1992 (65). Although almost all African countries have included the vaccine as part of their national infant immunization schedule, vaccination coverage was less than optimal (<80%) in at least 20 countries in 2012 (65). More recently, effective vaccines against the oncogenic subtypes of the human papillomavirus (HPV) have become available. They provide protection against HPV-16 and -18 that cause 70% of cervical cancer in Africa (66). The strategy to date has aimed to vaccinate girls at around age 11 to 13 years, and the practicalities of this, in addition to cost, could be a major impediment in the wide application of the vaccines in the region (67). By the end of 2012, only one country in Africa (Rwanda) had implemented comprehensive HPV vaccination of girls (although pilot studies had been carried out elsewhere; ref. 68).

Transmission of other cancer-causing infectious agents for which no vaccines are currently available can be reduced by improving hygiene in the health care delivery system and by educating people to modify high-risk behaviors. HIV-AIDS increases the risk of a variety of cancers, not only KS and NHL (as described above), but also squamous cell cancers of the conjunctiva, Hodgkin lymphoma, and most likely several HPV-related cancers, especially cancer of the cervix. HIV transmission can be reduced by practicing safe sex (condom use, commitment to one partner), abstinence, and circumcision (69). Increased availability of ART to HIV-infected persons seems to be associated with a decrease in the incidence

of AIDS-related cancers (41, 70). Infections that cause liver cancer can be prevented by screening blood products, sterilizing injection needles and equipment, and/or stopping injection drug use.

For most populations, tobacco control is generally the most important preventive measure to consider in cancer prevention, but at present, the rates of tobacco-related cancers in Africa are relatively low, and tobacco use probably accounts for only about 6% of cancer deaths in Africa (71). The prevalence of smoking is very variable in Africa, between 8% and 48% in adult males (72), and those who do smoke may consume rather few cigarettes per day. Tobacco use remains low among women, but is increasing, especially among the young. Few African countries have implemented tobacco control measures or policies according to the Framework Convention on Tobacco Control (72), although timely action now might avoid much of the future health problem resulting from the tobacco, similar to the changes observed in developed countries.

Although there are almost no population-based data on unselected patients with cancer, many clinical series from hospitals throughout Africa attest to the late stage at presentation of many cancers, most seriously, those that are curable if treated early (73–75). This undoubtedly reflects the low level of cancer awareness in Africa, both in the general population and among health care workers (76). Efforts to ameliorate this situation, so that patients with cancer present with disease at an earlier stage is surely a greater priority than attempting to implement population-based screening programs. With respect to cancer of the cervix, programs to detect and treat pre-cancer through visual inspection and rapid treatment (with cryotherapy or cold coagulation) can undoubtedly be as effective as screening by cytology, and demand less laboratory infrastructure (77), and, although the logistical requirements are not negligible, a large number of trials and projects, if not national-level screening programs, have been implemented (78). For breast cancer, only for frequent mammographic screening is there evidence of benefit in terms of a (relatively modest) reduction in mortality. Earlier diagnosis can be achieved by programs of breast self-examination (79) or breast examinations by trained volunteers (80), but it remains to be shown whether this can materially improve mortality. Perhaps where prognosis is so poor (because of late stage presentation) a tangible improvement in mortality and morbidity is possible. In any case, there is little else that can be proposed to counter the rising numbers of breast cancer deaths.

Establishing and maintaining cancer control programs in Africa

The World Health Organization has promoted the development of National Cancer Control Programmes. Their aim is to reduce the incidence and mortality of cancer and improve the quality of life of patients with cancer in a particular country or state, through the systematic and equitable implementation of evidence-based

strategies for prevention, early detection, treatment, and palliation, making the best use of available resources (81). This policy was endorsed by the member states of WHO, when, in 2005, the World Health Assembly passed a resolution on cancer prevention and control, calling on Member States to intensify action against cancer by developing and reinforcing cancer control programs (82). Yet, in a survey carried out in 2010, WHO found that only 14 of the 47 countries in the African region responded to questionnaire survey by reporting the existence of an operational policy/strategy/action plan for cancer (83). In fact, this does not imply the existence of a formal national cancer control plan. In any case, rational planning is impossible without a means of identifying the main health problems, determining priorities for preventive and curative programs, evaluating whether goals are reached in the target groups, and determining what has been achieved in relation to resources expended (84).

The need for a functional cancer surveillance system is explicit in all of the documents relating to cancer control planning, as is, in the context of low and middle income countries, the essential role of cancer registries in this respect. Cancer-specific incidence data (per 100,000) from (population-based) cancer registries is one of the core indicators promoted by WHO as part of the framework for NCD surveillance in the Global Status Report on Non-Communicable Diseases (85). It is disappointing that at present only 20 of the countries of Sub-Saharan Africa have a functioning population-based cancer registry (86). Cancer registration is always a feasible system to introduce in a country and does not need to cover an entire national population—a common misapprehension (87); unless the country is small or wealthy, most cancer surveillance needs can be met in a cost-effective manner through registration of a sample of the population from which national estimates can be derived (88).

Conclusion

The number of new cancer cases will increase by 70% between 2012 and 2030, faster than any other region of the world, simply because of population growth and ageing (3). The increase is likely to be even greater, given the ongoing urbanization of Africa, with associated changes in lifestyles (30). This tide of disease demands a coordinated approach to improving the extent and quality of services for cancer control and better surveillance systems with which they can be planned and monitored.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Authors' Contributions

Conception and design: D.M. Parkin, A. Jemal

Development of methodology: D.M. Parkin

Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): D.M. Parkin, F. Bray

Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): D.M. Parkin, F. Bray, J. Ferlay, A. Jemal

Writing, review, and/or revision of the manuscript: D.M. Parkin, F. Bray, J. Ferlay, A. Jemal

Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): D.M. Parkin, J. Ferlay

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