BMJ Open

Comparative examination of breast cancer burden in sub-Saharan Africa, 1990–2019: estimates from Global Burden of Disease 2019 study

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To cite: Igbokwe KK. Comparative examination of breast cancer burden in sub-Saharan Africa, 1990–2019: estimates from Global Burden of Disease 2019 study. *BMJ Open* 2024;**14**:e082492. doi:10.1136/bmjopen-2023-082492

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2023-082492).

Received 24 November 2023
Accepted 19 March 2024

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ABSTRACT

Objectives In view of the widening gap in survival data between high-income and low-income countries, this study aimed to evaluate the most up-to-date burden of female breast cancer and analyse the leading risk factors in countries and regions in sub-Saharan Africa.

Design An analysis of Global Burden of Disease (GBD) data.

Setting The data of incidences, deaths, disability-adjusted life years (DALYs) and age-standardised rates (ASR) were retrieved from GBD Results Tool (1 January 1990—31 December 2019) covering 4 sub-Saharan African regions and 44 countries. The burden estimable to the risk factors of breast cancer was also estimated. All estimates were presented as counts and ASR per 100 000 population.

Participants Participants included patients with female breast cancer.

Main outcomes and measures Absolute numbers and ASR/estimates of incidence, deaths and DALY of female breast cancer by location in 1990 and 2019, with their percentage changes from 1990 to 2019. The leading risk factors (eg, alcohol consumption) of breast cancer in sub-Saharan Africa.

Results In sub-Saharan Africa, the incidences of breast cancer increased by 247% in 2019 from 1990, with the highest incidence recorded in Nigeria. The deaths and DALYs of breast cancer increased by 184% and 178%, respectively. From 1990 to 2019, the mortality ASR and DALY ASR increased throughout the region, mostly in Equatorial and Gabon. With varying trends between countries, alcohol consumption and high fasting plasma glucose were noted to be significant contributors to breast cancer deaths between 1990 and 2019.

Conclusion The results show the increasing burden of breast cancer in sub-Saharan Africa and provide valuable information on the trends of breast cancer and the risk factors attributable to breast cancer across sociodemographic index, region and country. These findings may inform health policies and improve the rational allocation of health resources.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ In line with available evidence, this is the first systematic analysis to describe the burden and trends of breast cancer in sub-Saharan Africa using the disability-adjusted life years.
⇒ This study provided the most up-to-date regional and national burden of breast cancer from 1990 to 2019 and determined the associations with risk factors related to lifestyle.
⇒ The first limitation is that the study did not provide a comparative assessment on the genetic and histopathological risk factors for breast cancer in sub-Saharan Africa.
⇒ Another limitation is the lack of registry-based data in all the countries; therefore, estimates for breast cancer in the data-sparse countries of sub-Saharan Africa should be interpreted with caution.
⇒ The third limitation is that sociodemographic index is not a measure adopted by policy-makers at government levels and due to sparsity of data, it can be affected by the assumptions.

INTRODUCTION

Cancer is a disease associated with high morbidity and high mortality globally.[1] It is reported to be the second leading cause of death worldwide with significant limitations on patient ability and economic implications on the public healthcare system. Breast cancer is the most common cancer in women and the fifth leading cause of cancer mortality globally.[2] In sub-Saharan Africa (figure 1), the overall cancer burden is dominated by breast, cervical and prostate cancers. Breast dominates 25% new cases in women while prostate cancers account for 23% of new cases in men.[3 4] In the last three decades, the diagnosis of breast cancer has since major increments in the region being more in some countries than others. Major changes in breast cancer incidence have been noted in Zimbabwe (twofold) and South Africa over the last 15 years.[3 4]

Increasing breast cancer incidence has however been associated with increased morbidity and mortality despite improvements in healthcare systems in sub-Saharan Africa. The disparities in survival in the less

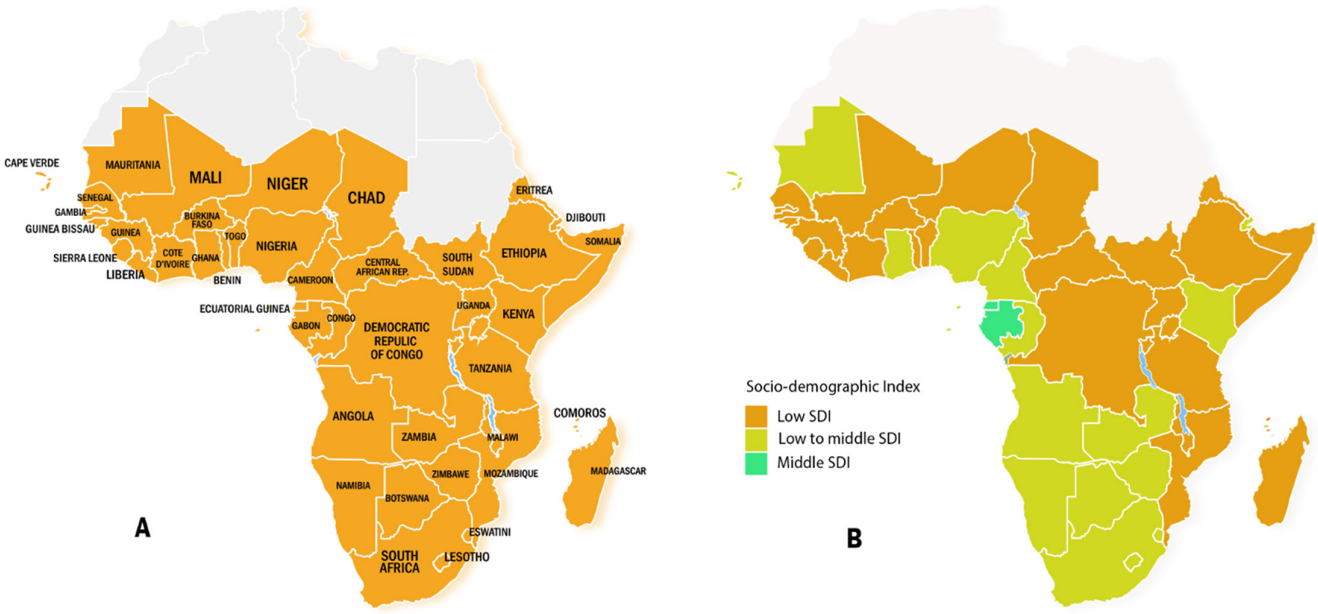

Figure 1 (A) Map of countries in sub-Saharan Africa. (B) Graded map according to sociodemographic index (SDI), Global Burden of Disease study 2019.[20]

prosperous economies in sub-Saharan Africa in comparison to their more prosperous neighbours are a growing concern.[3 5 6] Despite increased incidence in western nations, breast cancer survival has been recorded to be as high as 90% in some countries such Australia, Canada and the USA.[5 7 8] In South Africa for instance, breast cancer survival rates are as low as 40%.[7] This disparity in survival rates has become an area of growing concern as the UN, WHO and the Lancet Oncology Commission are now making global efforts to support cancer control programmes in sub-Saharan Africa.[1 4 7–10]

Regional and local health service planning for cancer control requires adequate understanding of the indices of the disease and the impact of the risk factors responsible for the progression in these indices. The Global Burden of Disease (GBD) study provides data on key measures of disease burden, incidence, mortality and disability-adjusted life years (DALY), on injuries, disease and cancer worldwide including breast cancer in sub-Saharan Africa and the 46 countries.[4 11] It is the most comprehensive worldwide observational epidemiological study to date. It was against this backdrop that this review was therefore conceived to evaluate and report the burden of breast cancer and the associated risk factors in sub-Saharan Africa.

METHODS

This section provides a summary of GBD 2019 cancer estimation methods. Additional detail is provided in GBD 2019 summary publications.[11] This study complies with the Guidelines for Accurate and Transparent Health Estimates Reporting.[12]

Study design

This study is a secondary database systematic analysis of GBD 2019 study estimates for female breast cancer in sub-Saharan Africa and the 46 countries: Angola, Central African Republic, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mozambique, Rwanda, Somalia, South Sudan, Uganda, United Republic of Tanzania, Zambia, Botswana, Eswatini, Lesotho, Namibia, South Africa, Zimbabwe, Benin, Burkina Faso, Cabo Verde, Cameroon, Chad, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome and Principe, Senegal, Sierra Leone and Togo.

Diseases and injuries in GBD 2019 were organised into a comprehensive hierarchy of nested levels, with neoplasms as one of 22 level II groups. The annual incident cases, deaths and DALY and respective age-standardised rates in sub-Saharan Africa and the 46 countries from 1990 to 2019 were retrieved by female sex where the specific filter rules were predefined, including 'Breast cancer' for 'Cause', '1990–2019' for 'Year', and 'Incidence, Deaths, DALY' for 'Measure'.

Deaths and DALYs attributable to risk factors were assessed. GBD 2019 used the comparative risk assessment framework[13 14] to determine the burden of several causes and impairments attributable to 87 environmental and occupational, metabolic and behavioural risks.[15] High fasting plasma glucose (FPG), high body mass index (BMI), tobacco smoking, alcohol consumption and low physical activity were identified as breast cancer risk factors.

Search strategy and selection criteria

The Global Health Data Exchange (GHDx) database provides a key systematic and scientific instrument for retrieving annual data on incidence, prevalence, mortality and DALY for cancer estimation.[16] All data are computed by direct inquiry and downloaded through the GBD Results Tool.[17] GHDx database for breast cancer globally in the GBD 2019 study used 29 226 cancer-specific, location-specific and year-specific sources of data, of which 23 378 (79.99%) were from vital registration systems, 5333 (18.24%) from cancer registries and 515 (1.76%) from verbal autopsy reports.[11] The database also provides data on risk factors attributable to breast cancer over three decades between 1990 and 2019 in sub-Saharan Africa and the 46 countries. The corresponding age-standardised incidence rate (ASIR), age-standardised death rate (ASMR) and age-standardised DALY rates (ASR DALY) are visualised and retrieved from the database by regions and countries. These estimates were visualised along with a 95% uncertainty interval (UI) on GHDx.[16] The 95% UIs were determined following several calculations (1000 times), each time sampling from distributions. Uncertainty was a representation of the 2.5th and the 97.5th percentile of the distribution of 1000 draws of data inputs at each step.[11]

Data analyses

The annual ASIR, ASMR and ASR DALY were used to calculate the corresponding estimated annual percentage changes (EAPCs). The EAPC was introduced to measure the temporal trends in ASIR, ASMR and ASR DALY for breast cancer between 1990 and 2019. A regression model, $y = \alpha + \beta x + \varepsilon$, was fitted to the natural logarithm of the rates, where y is the ln(ASR), and x the calendar year. EAPC was calculated as follows:

$$100 \times (\exp[\beta] - 1)$$

and its 95% CIs were obtained from the regression model.

The trend was upward if the EAPC value and its lower limit of 95% CI are both positive, downward if the EAPC value and its upper limit are both negative and stable if otherwise. ASIR, ASMR and ASR DALY for the SDI regions were comparatively analysed against the risk factors. The Pearson correlation coefficient between ASRs and SDI value was used to examine the correlation between ASRs and the development of society. ρ represents Pearson's correlation coefficient.

The results are presented by countries in tables and figures. World maps and graphs were generated to display the distribution and change trends of global, regional and national disease burden and risk factors attributable to breast cancer. All calculations and figures were performed and made using EXCEL 2013 (Microsoft Corporation) and R software (V.4.3.0) with 'Rcan' 'ggplot2', and other packages.[18]

The per cent change over the 1990–2019 period is calculated by respectively subtracting the estimates of incidence, mortality and DALY for the year 1990 from the estimates of incidence, mortality and DALY for the year 2019 and dividing it by the respective incidence, mortality and DALY estimates of the reference starting point (ie, the year 1990). A positive change indicates an increase of the burden resulting from breast cancer during the 30-year study period, whereas a negative change indicates a decrease.

The GBD world population age standard was used to calculate age-standardised rates. All rates, ASIR, ASMR and ASR DALY, are reported per 100 000 person years using the GBD standard population.[11] The age-standardised rates allow comparisons between populations adjusted for differences in age structures. The 5-year population data for females above the age of 15 have been included in online supplemental table 1.[19] The statistical code used for GBD 2019 study estimation is publicly available online.[20]

The sociodemographic index (SDI) scaled from 0 to 1 is a summary indicator of overall health outcomes of specific location secondary to levels of social and economic conditions in that location. It is based off a summary of three indices: income per capita, average education for those aged 15 and above. In the GBD study, the countries were categorised into five SDI quintiles—low, low-middle, middle, high-middle and high levels.[21] Sub-Saharan African countries constituted the low, low-middle and middle SDI countries (online supplemental table 2).

Patient and public involvement

The GBD 2019 Study is a global collaborative scientific effort involving more than 7500 people from about 150 countries. We did not consider involving patients when designing the study and no patients were involved in setting the specific research question, collecting and analysing the data, interpreting the results, or writing up the manuscript. The research findings will be disseminated to the wider community by press releases, social media platforms such as X and Facebook, presentations at international fora, reports to relevant government agencies and academic societies.

RESULTS

Breast cancer incidence

Table 1 shows the number of incident breast cancer cases, the ASIRs between 1990 and 2019 and the changes in the trend of new cases. In 2019, the incident cases of breast cancer increased from 25 358 (95% UI 21 628 to 29 148) to 83 133 (95% UI 70 370 to 97 051), which corresponds with a percentage increase of 247.35%. Majority (45.76%) of these cases were distributed in western sub-Saharan Africa, predominantly in Nigeria (21 121, 95% UI 14 363 to 29 578). The overall ASIR in the region was stable with 29.54/100 000 persons (95% UI 25.27 to 34.05) in 2019 (EAPC: 1.19; 95% CI −0.75 to 3.16). Additionally, the EAPC of ASIR of the 46 countries was correlated with SDI (ρ=0.419, 95% CI 0.163 to 0.23, p=0.002).

Table 1 Incidence of breast cancer in sub-Saharan Africa 1990–2019 and its temporal trends

Location		1990		2019		1990–2019	
		Incident cases no × 10^2 (95% UI)	ASIR per 100 000 no (95% UI)	Incident cases no × 10^2 (95% UI)	ASIR per 100 000 no (95% UI)	Change in incidence %	EAPC no (95% CI)
1	**Sub-Saharan Africa**	253.58 (216.29 to 291.49)	20.97 (17.86 to 24.24)	831.33 (703.70 to 970.51)	29.54 (25.27 to 34.05)	227.83	1.19 (–0.75 to 3.16)
2	**Central sub-Saharan Africa**	28.85 (22.60 to 35.90)	20.94 (16.67 to 25.61)	97.10 (69.53 to 128.20)	28.98 (20.86 to 38.55)	236.48	1.13 (–0.82 to 3.11)
3	Angola	3.83 (2.63 to 5.20)	16.17 (11.09 to 21.63)	19.40 (13.76 to 26.21)	26.43 (19.50 to 35.22)	405.98	1.71 (–0.44 to 3.90)
4	Central African Republic	1.60 (1.21 to 2.06)	22.05 (16.82 to 28.18)	3.31 (2.07 to 5.37)	23.74 (15.04 to 38.43)	107.18	0.25 (–1.73 to 2.28)
5	Congo	1.96 (1.35 to 2.73)	30.46 (21.34 to 41.95)	6.51 (3.85 to 9.77)	40.47 (24.48 to 59.65)	231.90	0.98 (–0.64 to 2.63)
6	Democratic Republic of the Congo	20.38 (15.68 to 26.09)	21.15 (16.66 to 26.56)	64.15 (45.06 to 87.16)	28.78 (20.24 to 39.45)	214.79	1.07 (–0.87 to 3.04)
7	Equatorial Guinea	0.20 (0.13 to 0.29)	16.21 (10.50 to 23.07)	1.25 (0.69 to 2.10)	38.99 (22.14 to 63.87)	523.04	3.07 (1.03 to 5.15)
8	Gabon	0.88 (0.67 to 1.12)	28.10 (21.44 to 35.80)	2.45 (1.58 to 3.49)	39.98 (25.63 to 56.16)	179.92	1.22 (–0.45 to 2.92)
9	**Eastern Sub-Saharan Africa**	78.58 (64.62 to 93.22)	17.94 (14.68 to 21.14)	239.06 (201.70 to 278.39)	24.04 (20.78 to 27.49)	204.23	1.01 (–1.09 to 3.17)
10	Burundi	2.88 (2.06 to 3.93)	20.33 (14.70 to 27.51)	5.48 (3.75 to 7.72)	20.73 (14.48 to 28.85)	89.96	0.07 (–2.02 to 2.20)
11	Comoros	0.21 (0.10 to 0.30)	16.89 (8.66 to 24.26)	0.74 (0.53 to 0.99)	26.52 (19.39 to 35.13)	258.67	1.57 (–0.55 to 3.73)
12	Djibouti	0.15 (0.09 to 0.20)	16.83 (10.93 to 22.95)	0.94 (0.60 to 1.37)	27.62 (19.03 to 37.82)	541.49	1.72 (–0.38 to 3.87)
13	Eritrea	1.12 (0.65 to 1.65)	16.05 (9.49 to 23.75)	5.12 (3.60 to 7.26)	28.73 (20.57 to 39.91)	355.54	2.03 (–0.10 to 4.20)
14	Ethiopia	24.45 (17.40 to 32.00)	21.17 (15.62 to 27.81)	54.60 (42.11 to 68.57)	23.00 (18.38 to 28.15)	122.75	0.29 (–1.73 to 2.35)
15	Kenya	6.68 (4.41 to 10.03)	13.86 (9.27 to 20.46)	31.62 (22.50 to 43.22)	22.96 (16.63 to 30.58)	373.15	1.76 (–0.56 to 4.12)
16	Madagascar	5.19 (4.21 to 6.43)	17.32 (14.25 to 20.93)	15.51 (10.81 to 21.24)	21.91 (15.67 to 29.78)	198.68	0.81 (–1.35 to 3.03)
17	Malawi	3.78 (2.89 to 4.71)	16.14 (12.41 to 19.87)	9.85 (7.16 to 12.90)	22.17 (16.48 to 28.41)	160.59	1.10 (–1.11 to 3.36)
18	Mozambique	5.94 (4.48 to 7.57)	16.71 (13.17 to 20.91)	19.00 (12.67 to 26.72)	27.15 (19.08 to 37.62)	219.52	1.69 (–0.43 to 3.85)
19	Rwanda	4.54 (3.39 to 6.00)	25.07 (18.81 to 32.60)	10.60 (7.74 to 14.26)	27.26 (20.49 to 35.95)	133.28	0.29 (–1.57 to 2.18)
20	Somalia	2.33 (1.54 to 3.41)	13.74 (9.28 to 20.28)	6.51 (3.93 to 10.33)	14.94 (9.05 to 23.87)	179.67	0.29 (–2.21 to 2.86)
21	South Sudan	1.72 (1.25 to 2.27)	14.63 (10.86 to 19.02)	3.49 (2.27 to 4.96)	15.91 (10.77 to 22.10)	103.50	0.29 (–2.14 to 2.78)
22	Uganda	6.54 (4.62 to 8.66)	17.56 (12.79 to 22.88)	29.40 (21.58 to 38.38)	31.44 (23.54 to 40.11)	349.20	2.03 (–0.01 to 4.10)
23	United Republic of Tanzania	9.42 (7.49 to 11.53)	15.59 (12.50 to 18.68)	34.52 (26.38 to 43.23)	23.86 (18.68 to 29.23)	266.60	1.48 (–0.73 to 3.73)
24	Zambia	3.59 (2.78 to 4.57)	21.36 (17.11 to 26.80)	11.71 (8.43 to 15.61)	27.35 (20.32 to 36.66)	226.52	0.86 (–1.09 to 2.84)

Continued

Table 1 Continued

Location		1990		2019		1990–2019	
		Incident cases no × 10^2 (95% UI)	ASIR per 100 000 no (95% UI)	Incident cases no × 10^2 (95% UI)	ASIR per 100 000 no (95% UI)	Change in incidence %	EAPC no (95% CI)
25	**Southern sub-Saharan Africa**	43.26 (38.95 to 48.10)	25.67 (22.94 to 28.83)	115.43 (102.56 to 129.70)	33.89 (30.14 to 38.02)	166.82	0.96 (–0.81 to 2.76)
26	Botswana	0.87 (0.61 to 1.22)	25.43 (18.30 to 35.04)	4.38 (2.76 to 6.55)	49.02 (31.66 to 72.18)	401.91	2.29 (0.61 to 3.99)
27	Eswatini	0.38 (0.27 to 0.49)	20.67 (14.71 to 26.35)	1.16 (0.68 to 1.76)	31.61 (19.22 to 47.07)	204.81	1.48 (–0.45 to 3.43)
28	Lesotho	0.91 (0.68 to 1.23)	16.21 (12.19 to 21.64)	2.86 (1.77 to 4.36)	37.00 (23.32 to 55.81)	213.50	2.89 (0.84 to 4.98)
29	Namibia	0.88 (0.64 to 1.11)	21.34 (16.03 to 26.84)	4.23 (2.87 to 6.24)	48.17 (33.07 to 70.08)	384.05	2.85 (1.06 to 4.67)
30	South Africa	34.39 (30.63 to 3.90)	26.48 (23.40 to 30.40)	85.40 (73.70 to 98.20)	32.08 (27.82 to 36.95)	148.32	0.66 (–1.11 to 2.47)
31	Zimbabwe	5.83 (4.76 to 6.98)	24.81 (20.40 to 29.44)	17.40 (11.91 to 24.13)	37.63 (26.33 to 51.69)	198.36	1.45 (–0.31 to 3.24)
32	**Western sub-Saharan Africa**	102.89 (81.40 to 128.23)	21.95 (17.39 to 27.21)	380.00 (294.85 to 468.62)	32.91 (25.93 to 40.11)	269.09	1.41 (–0.46 to 3.31)
33	Benin	1.76 (1.30 to 2.24)	15.48 (11.51 to 19.61)	6.34 (4.48 to 8.69)	21.18 (15.37 to 28.34)	260.49	1.09 (–1.17 to 3.40)
34	Burkina Faso	5.23 (4.01 to 6.61)	21.13 (16.50 to 26.39)	15.66 (11.96 to 20.02)	27.07 (21.30 to 33.66)	199.27	0.86 (–1.10 to 2.86)
35	Cabo Verde	0.24 (0.20 to 0.28)	19.39 (16.44 to 22.81)	0.69 (0.55 to 0.85)	27.75 (22.23 to 34.21)	188.49	1.24 (–0.76 to 3.29)
36	Cameroon	5.48 (4.33 to 6.79)	21.08 (16.80 to 25.85)	22.42 (15.11 to 32.85)	30.84 (21.13 to 44.30)	309.31	1.32 (–0.60 to 3.28)
37	Chad	2.03 (1.49 to 2.70)	12.89 (9.56 to 17.14)	5.50 (3.80 to 7.46)	17.70 (12.49 to 23.56)	171.55	1.10 (–1.37 to 3.63)
38	Côte d'Ivoire	3.66 (2.74 to 4.67)	15.88 (12.29 to 19.71)	13.12 (9.27 to 17.84)	21.39 (15.79 to 28.34)	258.44	1.03 (–1.20 to 3.32)
39	Gambia	0.17 (0.12 to 0.23)	8.95 (6.51 to 11.96)	0.94 (0.61 to 1.34)	17.02 (11.01 to 24.13)	450.31	2.24 (–0.57 to 5.14)
40	Ghana	12.20 (9.31 to 15.62)	31.97 (24.67 to 40.32)	46.91 (35.88 to 60.49)	45.06 (35.11 to 57.59)	284.47	1.19 (–0.38 to 2.78)
41	Guinea	3.26 (2.61 to 3.96)	18.32 (14.66 to 22.30)	7.65 (5.51 to 10.38)	24.65 (17.86 to 32.91)	134.72	1.03 (–1.06 to 3.16)
42	Guinea-Bissau	0.52 (0.36 to 0.71)	20.73 (14.51 to 27.67)	1.43 (0.97 to 2.10)	29.45 (20.36 to 42.75)	175.17	1.22 (–0.72 to 3.20)
43	Liberia	0.99 (0.78 to 1.23)	18.04 (14.43 to 22.29)	3.10 (2.09 to 4.71)	25.51 (17.51 to 38.56)	214.63	1.20 (–0.88 to 3.33)
44	Mali	4.24 (3.45 to 5.12)	17.81 (14.52 to 21.63)	11.26 (8.20 to 14.91)	23.16 (17.29 to 30.32)	165.71	0.91 (–1.22 to 3.08)
45	Mauritania	1.18 (0.86 to 1.58)	21.41 (15.69 to 28.45)	3.02 (2.12 to 4.04)	26.42 (18.65 to 35.10)	154.98	0.73 (–1.23 to 2.73)
46	Niger	1.90 (1.35 to 2.60)	11.83 (8.40 to 16.21)	6.66 (4.42 to 10.06)	14.37 (9.79 to 21.43)	251.04	0.67 (–1.96 to 3.38)
47	Nigeria	53.30 (37.72 to 74.46)	24.29 (17.31 to 33.67)	211.21 (143.63 to 295.78)	38.82 (27.00 to 52.89)	296.26	1.63 (–0.13 to 3.42)
48	Sao Tome and Principe	0.05 (0.04 to 0.07)	15.59 (11.95 to 19.25)	0.21 (0.13 to 0.31)	32.13 (20.24 to 47.71)	282.92	2.52 (0.41 to 4.69)
49	Senegal	3.72 (2.81 to 4.63)	20.44 (15.72 to 25.22)	12.75 (8.89 to 16.71)	29.11 (20.76 to 38.03)	243.03	1.23 (–0.73 to 3.22)
50	Sierra Leone	1.47 (1.05 to 1.94)	14.64 (10.63 to 19.25)	4.99 (3.51 to 7.21)	24.02 (17.10 to 34.67)	240.19	1.72 (–0.53 to 4.03)
51	Togo	1.51 (1.20 to 1.87)	18.90 (15.27 to 22.96)	5.93 (4.35 to 8.08)	24.41 (18.52 to 32.55)	293.04	0.89 (–1.18 to 3.00)

ASIR, age-standardised incidence rate; ASMR, age-standardised mortality rate; DALY, disability-adjusted life years; UI, uncertainty intervals.

Breast cancer mortality

In sub-Saharan Africa, breast cancer mortality cases increased by 184%, from 19 324 (95% UI 16 637 to 22 600) to 54 878 (95% UI 46 095 to 64 122) between 1990 and 2019. Table 2 shows the number of breast cancer deaths, the ASMR and percentage change in deaths between 1990 and 2019 and the changes in the trend of mortality.

Death cases were increased in a total of the 50 countries and SDI regions (table 2). In 2019, the highest number of death cases were observed in Nigeria (24%) (13 332; 95% UI 9350 to 18 430) and South Africa (9%) (5209, 95% UI 4576 to 5915), while the lowest number of death cases were recorded in Sao Tome and Principe (12; 95% UI 8 to 18) and Cabo Verde (38; 95% UI 30 to 47) in 2019. Ghana and Congo had the highest ASMR, 30.32 per 100 000 people (95% UI 24.07 to 38.21) and 29.88 per 100 000 people (95% UI 18.45 to 43.32) respectively, whereas Niger had the lowest (11.16 per 100 000 people; 95% UI 7.72 to 16.28). The highest percentage increase in mortality counts between 1990 and 2019 was detected in Djibouti (447.55%). The EAPC of ASMR of the 46 countries was correlated with SDI (ρ=0.405, 95% CI 0.146 to 0.612, p=0.003).

Breast cancer-related DALY

In sub-Saharan Africa, breast cancer-related DALY increased from 639 105 (95% UI 552 514 to 751 065) to 1 781 708 (95% UI 1 473 679 to 2 101 543) over the three decades. Nigeria (435 400; 95% UI 302 154 to 619 864) had the highest DALY, followed by the Democratic Republic of Congo (152 667; 95% UI 107 284 to 205 031). Namibia (866 per 100 000 people) and Ghana (863 per 100 000 people) had the highest ASR DALY (online supplemental file 1). The highest change in breast cancer-related DALY was observed in Djibouti (increased by ~fourfold). An upward trend in the DALY ASRs was noted in 28 countries. The highest increase was observed in Kenya (EAPC: 3.57; 95% CI 3.11 to 4.03). The EAPC of ASR DALY of the 46 countries correlated with SDI but was not statistically significant (ρ=0.068, 95% CI −0.211 to 0.337, p=0.632).

Attributable burden due to SDI

Figure 2 shows the age-standardised incident cases of breast cancer increased in all SDI countries, with a steep increase in the low-middle SDI countries and the lowest increase in the middle SDI countries.

There was constant increase in the death cases between 1990 and 2019. A steeper increase was observed in the low-middle SDI countries and accounted for the highest number (54%) of breast cancer deaths in 2019 (29 760 deaths (95% UI 22 018–396 120)). The ASMR also increased in the low and middle SDI countries.

The DALY increased in all SDI countries, though the rise was steeper in the low-middle SDI countries and less prominent in the middle SDI countries. In addition to the ASMR and ASIR, the age-standardised DALY rates of breast cancer also increased in the low and middle SDI countries. The age-standardised DALY rates in low-middle SDI countries noted a minimal decline in 2019.

Risk factors for breast cancer burden

In the GBD database, ASMRs are attributable to five risk factors, namely tobacco smoking, alcohol consumption, high BMI, high FPG and low physical activity. High FPG and alcohol consumption were ranked as significant contributors to increased ASMR in 2019. In 1990, alcohol consumption and high FPG were the most significant contributors to ASMR in the three SDI quintiles.

These two risk factors have gradually increased in low SDI, low-middle SDI and middle SDI regions over the past three decades. Figure 3 shows that in 1990, alcohol consumption and high FPG were the most significant contributor to ASMR in low SDI countries; however, by 2019, high FPG became the most significant contributor in these countries. This makes high FPG the most significant contributor to ASMR in low and low-middle SDI countries, while alcohol consumption contributes the most in the middle SDI countries. Although a sustained increase in ASMR attributable to alcohol consumption was noted in low-middle SDI countries, it remained the second highest cause of death between 1990 and 2019. A sustained rise in ASMR accountable to high BMI was noted in three SDI regions. High BMI was observed to be the third highest contributor to ASMR in sub-Saharan Africa. Furthermore, other factors were observed to be relatively stable, and the changes are not remarkable.

Deaths attributed to DALY followed the same pattern as risk factors in the low-middle and middle SDI countries. In the low SDI and low-middle countries, ASR DALY, secondary to high BMI, low physical activity and tobacco smoking, maintained relative stability over the three decades. While a gradual rise in ASR DALY was observed for high FPG and high BMI, alcohol consumption and high FPG were the most significant contributors to ASR DALY in middle SDI countries. A steep increase in ASR DALY in middle SDI countries was also observed for high BMI while increments in ASR DALY for tobacco smoking and low physical activity remained relatively stable. Online supplemental table 4 gives the data on how the figures were generated.

DISCUSSION

Overall, breast cancer is the most common cancer among women in Africa. In 2012, about 56.8% of the global incidence of breast cancer was identified in low-income countries with most of the deaths recorded in sub-Saharan Africa.[22] Our results show that between 1990 and 2019, there was a 247% increase in incidence in sub-Saharan Africa. Some experts have suggested that the rising incidence can reflect a growing awareness of breast cancer and improvements in availability of screening and diagnostics in the region. However, many reports have shown the poor availability of screening services, diagnostic skills and technology within the region; therefore, this

Table 2 Mortality from breast cancer 1990–2019 in sub-Saharan Africa and its temporal trends

Location		1990		2019		1990–2019	
		Deaths no × 10^2 (95% UI)	ASMR per 100 000 no. (95% UI)	Death cases no × 10^2 (95% UI)	ASMR per 100 000 no. (95% UI)	Change in mortality %	EAPC No (95% CI)
1	**Sub-Saharan Africa**	193.24 (166.37 to 226.00)	17.02 (14.63 to 19.92)	548.78 (460.95 to 641.22)	21.30 (18.19 to 24.56)	184.00	0.78 (–1.41 to 3.01)
2	**Central sub-Saharan Africa**	22.63 (18.04 to 27.70)	17.84 (14.45 to 21.48)	68.46 (49.64 to 90.07)	22.42 (16.16 to 29.76)	202.48	0.79 (–1.35 to 2.97)
3	Angola	3.08 (2.15 to 4.17)	14.02 (9.91 to 18.60)	13.08 (9.44 to 17.62)	19.96 (15.03 to 26.29)	325.38	1.23 (–1.13 to 3.64)
4	Central African Republic	1.29 (0.99 to 1.67)	19.10 (14.52 to 24.20)	2.61 (1.65 to 4.20)	20.23 (13.05 to 32.30)	101.60	0.20 (–1.94 to 2.38)
5	Congo	1.54 (1.07 to 2.12)	25.53 (18.16 to 34.47)	4.33 (2.61 to 6.43)	29.88 (18.45 to 43.32)	181.42	0.54 (–1.27 to 2.39)
6	Democratic Republic of the Congo	15.88 (12.20 to 20.27)	17.98 (14.08 to 22.33)	46.12 (32.62 to 62.37)	22.52 (15.82 to 30.58)	190.43	0.78 (–1.35 to 2.96)
7	Equatorial Guinea	0.17 (0.11 to 0.24)	14.22 (9.03 to 20.26)	0.75 (0.42 to 1.24)	26.72 (15.53 to 42.62)	354.13	2.20 (–0.04 to 4.49)
8	Gabon	0.68 (0.52 to 0.87)	22.55 (17.36 to 28.59)	1.57 (1.02 to 2.20)	27.68 (18.01 to 38.24)	130.49	0.71 (–1.20 to 2.66)
9	**Eastern sub-Saharan Africa**	61.99 (51.07 to 73.34)	15.18 (12.37 to 17.91)	163.95 (140.24 to 189.22)	18.15 (15.65 to 20.60)	164.46	0.62 (–1.72 to 3.01)
10	Burundi	2.34 (1.69 to 3.16)	17.29 (12.61 to 23.23)	3.89 (2.70 to 5.47)	16.16 (11.31 to 22.54)	66.44	–0.23 (–2.54 to 2.13)
11	Comoros	0.17 (0.09 to 0.24)	14.41 (7.78 to 20.44)	0.53 (0.39 to 0.69)	19.66 (14.76 to 25.75)	212.31	1.08 (–1.26 to 3.47)
12	Djibouti	0.11 (0.07 to 0.15)	13.92 (9.20 to 18.64)	0.60 (0.40 to 0.85)	20.01 (14.59 to 27.14)	447.55	1.26 (–1.10 to 3.68)
13	Eritrea	0.92 (0.54 to 1.37)	14.03 (8.45 to 20.86)	3.66 (2.60 to 5.16)	22.50 (16.20 to 31.20)	299.58	1.64 (–0.67 to 4.01)
14	Ethiopia	19.64 (14.13 to 25.45)	18.29 (13.42 to 24.39)	37.02 (29.66 to 45.09)	17.36 (14.30 to 20.50)	88.51	–0.18 (–2.42 to 2.11)
15	Kenya	4.84 (3.25 to 7.11)	10.84 (7.41 to 15.70)	21.23 (15.47 to 29.02)	17.05 (12.66 to 22.79)	338.50	1.57 (–1.06 to 4.28)
16	Madagascar	3.99 (3.27 to 4.87)	14.23 (11.60 to 16.94)	10.77 (7.61 to 14.65)	16.80 (12.27 to 22.44)	169.50	0.57 (–1.85 to 3.05)
17	Malawi	2.91 (2.25 to 3.620)	13.26 (10.25 to 16.24)	7.09 (5.30 to 9.07)	17.25 (13.15 to 21.70)	143.28	0.91 (–1.55 to 3.43)
18	Mozambique	4.91 (3.79 to 6.19)	14.85 (11.90 to 18.27)	13.69 (9.51 to 19.04)	21.48 (15.50 to 29.44)	178.56	1.28 (–1.00 to 3.62)
19	Rwanda	3.66 (2.73 to 4.83)	21.36 (16.18 to 27.55)	7.10 (5.31 to 9.41)	19.96 (15.41 to 25.64)	94.15	–0.23 (–2.31 to 1.89)
20	Somalia	1.88 (1.26 to 2.74)	11.95 (8.16 to 17.47)	5.24 (3.25 to 8.31)	12.91 (8.01 to 20.56)	178.55	0.27 (–2.42 to 3.02)
21	South Sudan	1.40 (1.04 to 1.83)	12.63 (9.42 to 16.33)	2.62 (1.69 to 3.75)	13.12 (8.86 to 18.09)	86.53	0.13 (–2.50 to 2.84)
22	Uganda	5.09 (3.68 to 6.65)	14.50 (10.69 to 18.63)	19.35 (14.44 to 24.99)	22.42 (17.13 to 28.38)	280.07	1.51 (–0.77 to 3.85)
23	United Republic of Tanzania	7.34 (5.87 to 8.87)	13.18 (10.59 to 15.69)	23.64 (18.62 to 29.04)	17.84 (14.24 to 21.43)	222.04	1.05 (–1.40 to 3.56)
24	Zambia	2.75 (2.16 to 3.47)	17.89 (14.42 to 22.12)	7.41 (5.43 to 9.88)	19.47 (14.81 to 25.70)	169.93	0.29 (–1.90 to 2.54)
25	**Southern sub-Saharan Africa**	29.38 (26.22 to 33.13)	18.46 (16.33 to 21.11)	71.24 (63.29 to 79.46)	22.06 (19.72 to 24.54)	142.45	0.61 (–1.51 to 2.78)
26	Botswana	0.62 (0.45 to 0.85)	19.28 (14.11 to 26.16)	2.30 (1.47 to 3.35)	28.63 (19.05 to 41.04)	271.87	1.37 (–0.63 to 3.41)

Continued

Table 2 Continued

Location		1990		2019		1990–2019	
		Deaths no × 10^2 (95% UI)	ASMR per 100 000 no. (95% UI)	Death cases no × 10^2 (95% UI)	ASMR per 100 000 no. (95% UI)	Change in mortality %	EAPC No (95% CI)
27	Eswatini	0.28 (0.20 to 0.36)	16.55 (11.84 to 21.09)	0.78 (0.48 to 1.17)	23.03 (14.59 to 33.51)	174.64	1.15 (–1.03 to 3.37)
28	Lesotho	0.73 (0.55 to 0.97)	13.29 (10.17 to 17.55)	2.08 (1.31 to 3.12)	28.37 (18.11 to 41.78)	185.46	2.65 (0.37 to 4.98)
29	Namibia	0.67 (0.50 to 0.84)	16.73 (12.73 to 20.90)	2.50 (1.73 to 3.58)	29.68 (20.88 to 41.74)	274.92	2.00 (–0.09 to 4.13)
30	South Africa	23.21 (20.31 to 26.88)	18.83 (16.34 to 22.12)	52.09 (45.76 to 59.15)	20.48 (18.08 to 23.22)	124.44	0.29 (–1.85 to 2.48)
31	Zimbabwe	3.88 (3.18 to 4.66)	17.72 (14.65 to 21.14)	11.50 (7.93 to 16.00)	26.93 (18.75 to 37.24)	196.45	1.45 (–0.62 to 3.57)
32	**Western sub-Saharan Africa**	79.23 (64.33 to 99.25)	17.70 (14.33 to 22.18)	245.13 (192.27 to 308.40)	23.25 (18.65 to 28.62)	209.39	0.94 (–1.19 to 3.12)
33	Benin	1.39 (1.03 to 1.76)	12.77 (9.50 to 16.09)	4.37 (3.17 to 5.86)	15.77 (11.65 to 20.53)	215.34	0.73 (–1.80 to 3.33)
34	Burkina Faso	4.15 (3.21 to 5.20)	17.98 (14.14 to 22.17)	10.81 (8.48 to 13.53)	20.54 (16.41 to 25.14)	160.83	0.46 (–1.71 to 2.68)
35	Cabo Verde	0.17 (0.15 to 0.20)	13.81 (11.89 to 16.05)	0.38 (0.30 to 0.47)	15.38 (12.17 to 18.77)	120.01	0.37 (–2.11 to 2.92)
36	Cameroon	4.20 (3.28 to 5.19)	17.19 (13.68 to 21.23)	14.51 (9.98 to 20.87)	21.93 (15.58 to 30.83)	245.87	0.84 (–1.33 to 3.06)
37	Chad	1.64 (1.23 to 2.19)	10.87 (8.09 to 14.40)	4.03 (2.81 to 5.40)	14.04 (10.04 to 18.58)	144.82	0.89 (–1.83 to 3.68)
38	Côte d'Ivoire	2.71 (2.05 to 3.42)	12.99 (10.15 to 15.97)	8.91 (6.48 to 11.87)	16.13 (12.23 to 20.81)	228.63	0.75 (–1.76 to 3.32)
39	Gambia	0.13 (0.09 to 0.17)	7.09 (5.21 to 9.33)	0.64 (0.41 to 0.91)	12.15 (7.85 to 17.36)	398.23	1.87 (–1.33 to 5.18)
40	Ghana	8.86 (6.76 to 11.25)	24.94 (19.33 to 31.35)	28.94 (22.54 to 36.93)	30.32 (24.07 to 38.21)	226.75	0.68 (–1.15 to 2.53)
41	Guinea	2.66 (2.15 to 3.22)	15.52 (12.48 to 18.88)	50.62 (4.09 to 7.45)	19.16 (14.04 to 25.24)	110.99	0.73 (–1.57 to 3.08)
42	Guinea-Bissau	0.40 (0.28 to 0.54)	17.07 (12.11 to 22.52)	0.99 (0.69 to 1.44)	22.28 (15.65 to 32.07)	146.81	0.92 (–1.25 to 3.14)
43	Liberia	0.79 (0.63 to 0.98)	15.13 (12.22 to 18.55)	2.07 (1.41 to 3.13)	18.76 (13.16 to 28.04)	160.41	0.74 (–1.58 to 3.12)
44	Mali	3.35 (2.73 to 4.04)	14.66 (11.94 to 17.74)	7.74 (5.78 to 10.10)	16.92 (12.90 to 21.98)	131.32	0.50 (–1.90 to 2.95)
45	Mauritania	0.94 (0.70 to 1.25)	17.54 (13.07 to 23.16)	1.9 (1.37 to 2.54)	18.10 (13.13 to 23.61)	104.87	0.11 (–2.13 to 2.40)
46	Niger	1.51 (1.08 to 2.09)	10.14 (7.17 to 13.85)	4.75 (3.21 to 7.08)	11.16 (7.72 to 16.28)	214.32	0.33 (–2.57 to 3.32)
47	Nigeria	41.16 (29.36 to 58.66)	19.32 (13.83 to 27.43)	133.32 (93.50 to 184.30)	26.98 (19.48 to 36.34)	223.87	1.16 (–0.86 to 3.22)
48	Sao Tome and Principe	0.04 (0.03 to 0.05)	12.34 (9.66 to 15.15)	0.12 (0.08 to 0.18)	20.82 (13.09 to 30.67)	194.52	1.82 (–0.62 to 4.32)
49	Senegal	2.86 (2.19 to 3.52)	16.69 (13.00 to 20.35)	8.70 (6.17 to 11.41)	21.28 (15.35 to 27.78)	204.74	0.84 (–1.36 to 3.09)
50	Sierra Leone	1.18 (0.86 to 1.55)	12.27 (9.02 to 16.00)	3.43 (2.44 to 4.94)	17.80 (12.90 to 25.72)	191.28	1.29 (–1.22 to 3.86)
51	Togo	1.10 (0.88 to 1.35)	14.98 (12.15 to 18.05)	3.90 (2.92 to 5.20)	17.59 (13.59 to 23.17)	253.69	0.56 (–1.81 to 2.97)

ASIR, age-standardised incidence rate; ASMR, age-standardised mortality rate; DALY, disability-adjusted life years; UI, uncertainty intervals.

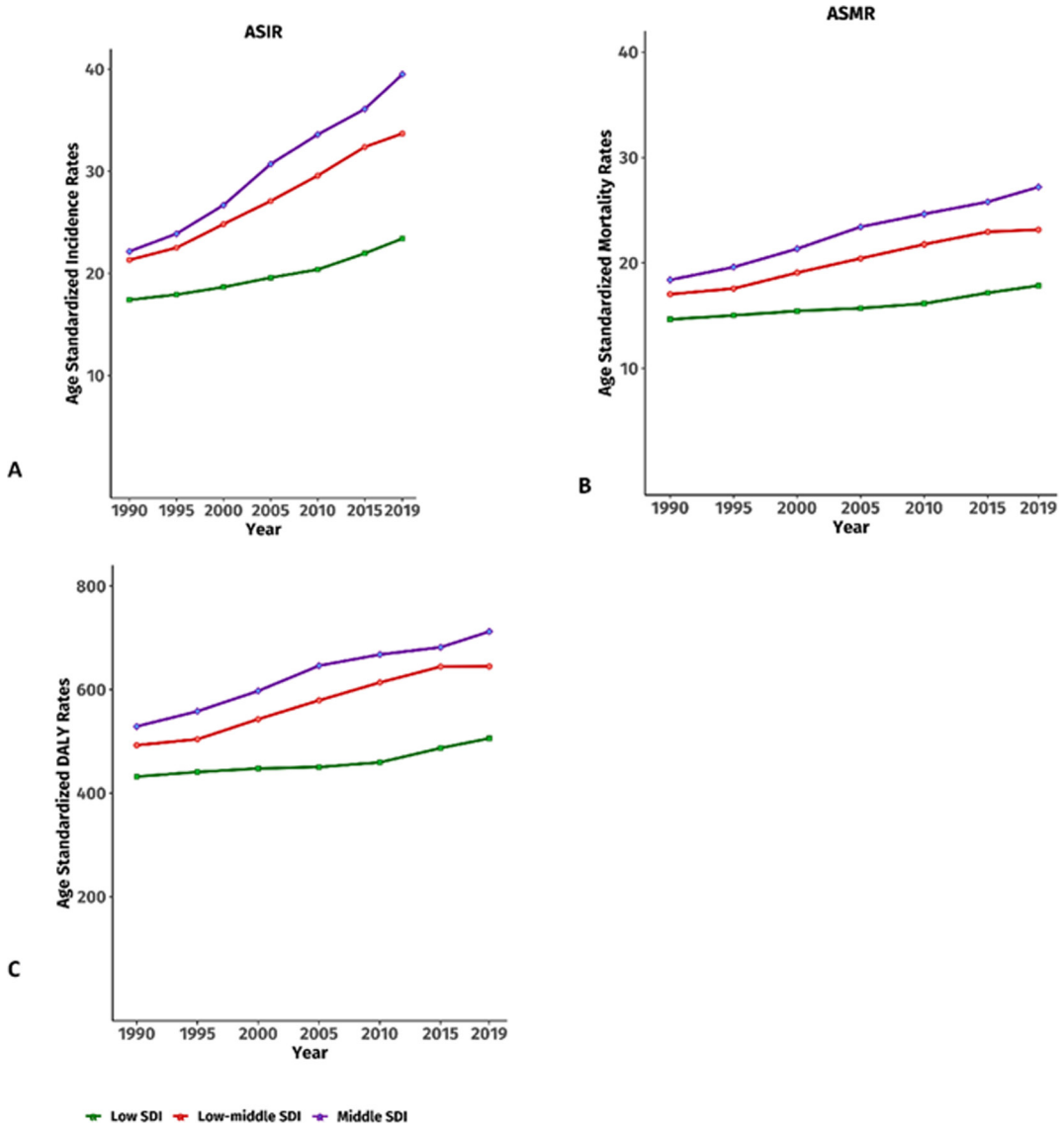

Figure 2 The burden and trends of breast cancer in sub-Saharan Africa and in the three sociodemographic index (SDI) quintiles from 1990 to 2019. (A) Age-standardised incidence rates (ASIR). (B) Age-standardised mortality rates (ASMR). (C) Age-standardised rates for disability-adjusted life years (DALYs).

is not conclusive.[23 24] The increasing population and life expectancy for women in sub-Saharan Africa secondary to improvement of other healthcare indices such as infectious disease control have also been proposed to contribute to the rising incidence of the disease. This is because women can now live long enough to experience breast cancer at some point during their lifetime.[25 26] This might be inconclusive as several reports have shown that women with breast cancer in sub-Saharan Africa are reportedly younger and under 46 years often presenting with advanced breast cancer.[27–29]

As reported in the literature,[5 30 31] breast cancer trends in sub-Saharan Africa were in the upward direction as ASIR, ASMR increased between 1990 and ASIR, 2019 and correlated significantly with the SDI. Various reasons have been cited for this however, the most attributed reason is the 'westernisation' of the lifestyle in sub-Saharan African women.[32 33] This terminology is used to refer to reproductive and other lifestyle changes that have been adapted from the western world such as a relatively late age at first childbirth, fewer children, a short duration of breast feeding, reduced physical activity and high BMI.[25 32 33] These adapted lifestyle changes conflict with the established risk factors of breast cancer such as age at first full-term pregnancy, parity, breast feeding, obesity and physical activity. Despite this western lifestyle, incidence rates in the western world are higher while survival rates are also high, being up to 90% in some countries.[5 9] And in comparison, to sub-Saharan Africa, there is a marked difference in survival being as low as 40% in South Africa.[5] Low quality of healthcare systems, characterised by inadequate health promotion efforts and limited diagnostic and treatment facilities, contribute to the low survival rates.[3 9 12]

In this study, alcohol consumption and high FPG were both found to be the most potential risk factors for breast

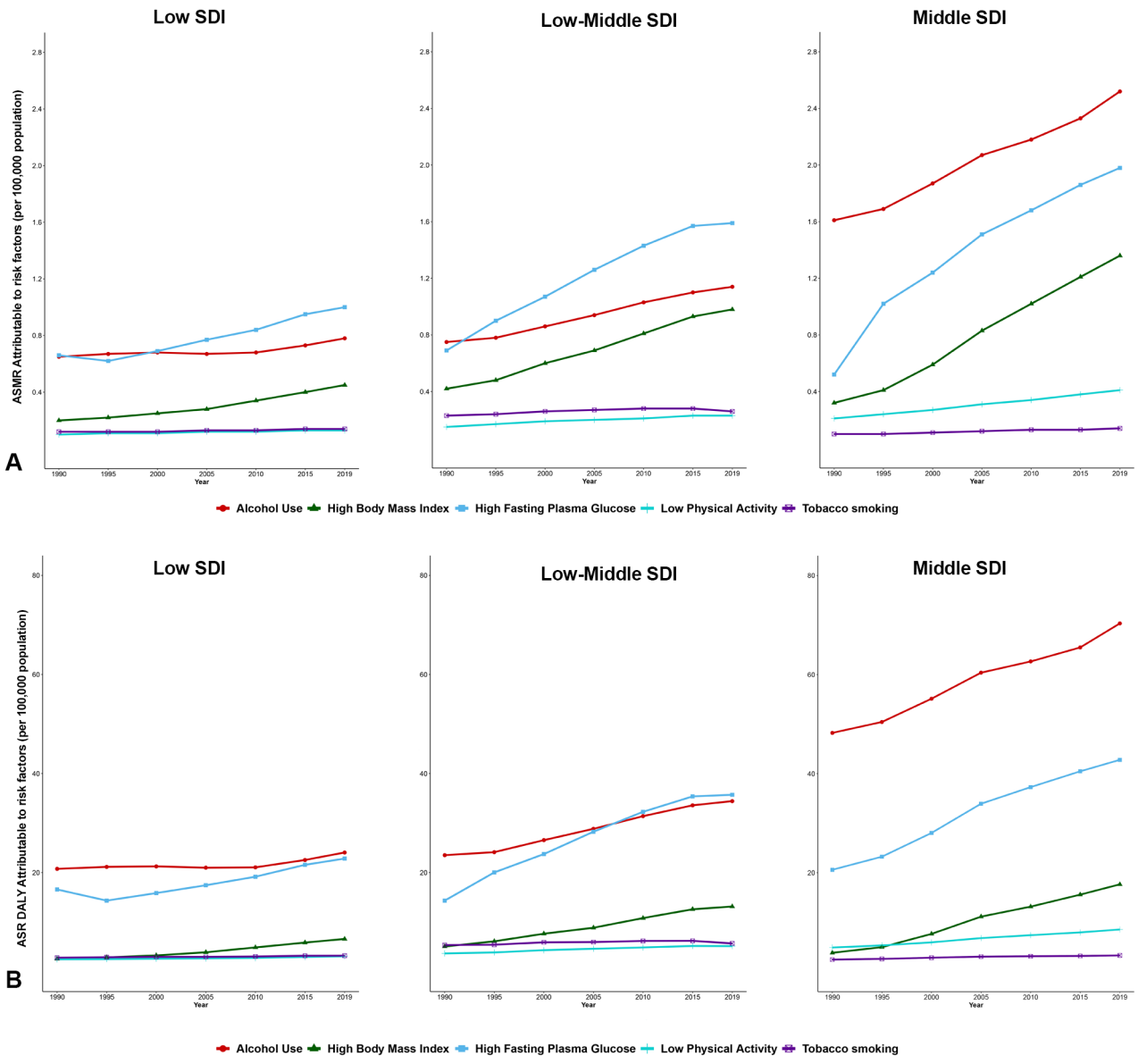

Figure 3 Contribution of risk factors to breast cancer-related deaths and DALYs by SDI regions. (A) ASMRs attributable to main risk factors by SDI regions from 1990 to 2019. (B) ASR DALYs attributable to main risk factors by SDI regions from 1990 to 2019. ASMR, age-standardised mortality rate; ASR DALYs, age-standardised rate for disability-adjusted life years; SDI, sociodemographic index.

cancer deaths and DALY in sub-Saharan Africa with gradual increments in low-SDI regions and steeper increments in low-middle, and middle SDI regions (figure 2). According to WHO, approximately 30% of breast cancer incidence results from four leading lifestyle choices including high BMI, low physical activity, harmful use of alcohol and exposure to tobacco smoking.[1] Studies on the global burden of breast cancer have shown that risk factors for breast cancer deaths and DALY are predominantly high FPG, alcohol consumption and high BMI.[30 31] The WHO Global Breast Cancer Initiative strives to address the widened gap in survival rates through its three pillars—health promotion and early detection, timely diagnosis and comprehensive breast cancer management. Targeted health promotion efforts for breast cancer prevention remain a key tool in reducing the burden of breast cancer from the listed risk factors.[7 34]

The GBD 2019 study shows an upward trend in breast cancer-associated DALY in sub-Saharan Africa. Subregional data showed upward trends in western and central sub-Saharan Africa. Several reports have shown that breast cancer is the leading cause of cancer-related DALY among women globally and disproportionately affects women in low-income regions including sub-Saharan Africa.[6 16] Sub-Saharan African women with breast cancer are often young and this presents significant drawbacks on

their societal participation in various industrial strata.[35] This can lead to in unexpected loss of productivity with negative economic impact on the already struggling gross domestic product of many countries in the region.[26 35 36] Worse outcomes will result in gender disparities in education, employment and income.[37] Some women suffer discrimination by their families and are accused of sexual promiscuity as a cause of their illness.[35 36] This discrimination and community neglect contribute to the psychological trauma and barriers to assessing care for their treatment.[37] The financial burden given the treatment costs and care-giving costs present a huge challenge to families. The grave consequences following the tragic loss of life in female breast cancer are intergenerational as it has been linked with increased financial, health and educational disadvantages for the maternally orphaned children and increases the risk of child mortality.[36–38] As such, services for health promotion, early detection and comprehensive management must be scaled up to limit the grave challenges facing generations beyond ours.[7 39]

Implementation of the three-pronged approach of the WHO's GBCI is crucial to closing the gap in breast cancer survival.[7 40] In countries showing successful improvements in breast cancer survival, most patients with breast cancer are diagnosed at an early stage, when the disease is more likely curable.[41] In sub-Saharan Africa, high proportions of late-stage diagnosis and inadequate access to specialist breast cancer care led to high death rates.[28 34 42] Late-stage diagnoses are accompanied by high costs of care, and reduced ability to earn an income to support their care. This presents educational and financial disadvantages for the women and presents grave consequences for their dependents.[26 36] Public policy must promote health advocacy and breast cancer awareness drives which are important in addressing misbeliefs in public and mitigation of the risk factors. Establishment of cost-effective screening infrastructure for early detection and treatment is essential.[23 43] In addition, regulations should strengthen existing cancer control programmes to regularly assess their breast cancer burden and establish strategic priorities to reduce mortality and morbidity based on specific data on local prevalence.

This study is limited by the scarce availability of population-based cancer registries in the subnational and national territories in some regions in sub-Saharan Africa. Due to the absence of the actual data on disease burden in some countries, the GBD estimates are often extrapolated from neighbouring countries or calculated based on local registry data if available.[9] Thus, increased surveillance and reporting are essential to strengthen the quality of data generated for sub-Saharan Africa. Second, it would be more convincing if the study provided a comparative assessment on the genetic and histopathological risk factors. Third, the GBD study conditions individually when determining mortality and morbidity estimates; however, because multimorbidity is highly prevalent in some groups often defined by age, it is probable that when a cause shows in a high burden individual, it may account for a higher fraction of ill health and early mortality, meaning that population-level averages may not fully reflect individual cause risk. Finally, SDI is not a measure adopted by policy-makers at government levels and due to sparsity of data, it can be affected by the assumptions. Therefore, the results should be interpreted with caution.

CONCLUSION

The burden of female breast cancer in sub-Saharan Africa is on the rise and has been associated with alcohol consumption, high FPG and high BMI. Alcohol consumption and high FPG are the most contributors to death and disability from female breast cancer. This scenario presents far-reaching consequences on society and the economy given the pivotal role of the female labour force in sub-Saharan Africa. Breast cancer prevention and treatment programmes should not be ranked below other public health problems but should be prioritised to improve survival in sub-Saharan Africa and to reduce global disparities in breast cancer outcomes.

Population-based breast cancer survival is increasingly recognised as a key indicator of the overall effectiveness of the health systems in managing care and treatment for patients with breast cancer. Further research studies should be initiated to guide the direction of interventions for the control of breast cancer mortality in the context of scarce resources.

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Acknowledgements This study was undertaken as partial fulfilment of the requirements for the MSc Surgical Sciences at The University of Edinburgh. The author acknowledges Professor Emmanuel Ameh for his patience, motivation and support during the production of this manuscript.

Contributors Guarantor, conceptualisation, project administration, formal analysis, writing–original draft, Visualisation, Writing–review and editing: KKI

Funding There was no specific funding received for this work. The Global Burden of Diseases (GBDs) study received funding from the Bill and Melinda Gates Foundation.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study is a meta-analysis of a secondary database; therefore, ethical approval was not required by the University of Edinburgh Medical School Ethics board.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. All data relevant to the study are included in the article or uploaded as supplementary information. Data regarding the burden of breast cancer for sub-Saharan Africa, at the regional and national levels, were obtained from the Global Health Data Exchange (GHDx) query online tool, over 30 years from 1990 to 2019, which is publicly available at http://ghdx.healthdata.org/gbd-results-tool. All data relevant to the study are included in the article or uploaded as online supplemental information.

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