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Breast cancer overall survival, annual risks of death, and survival gap apportionment in sub-Saharan Africa (ABC-DO): 7-year follow-up of a prospective cohort study

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Summary

Background There are few estimates of breast cancer survival and its determinants at 5 years and beyond in sub-Saharan Africa. We aimed to estimate survival up to 7 years, estimate annual mortality risk, and apportion survival gaps.

Methods The African Breast Cancer-Disparities in Outcomes (ABC-DO) prospective cohort study was done at eight hospitals across five sub-Saharan African countries (Namibia, Nigeria, South Africa, Uganda, and Zambia). We prospectively recruited women (aged ≥ 18 years) who attended hospital with suspected breast cancer. Vital status was updated telephonically once every 3 months for 7 years. We collected detailed sociodemographic, clinical, and treatment data. The primary outcome was overall survival. We estimated age-standardised net survival, conditional survival, and predicted survival gains if there were favourable shifts in the distribution of prognostic factors aligned with the WHO Global Breast Cancer Initiative (GBCI).

Findings Between Sept 8, 2014, and Dec 31, 2017, 2313 women were recruited and followed up to Jan 1, 2022, and for a further year in South Africa. We excluded 87 women without breast cancer, 14 women from small racial groups (eight White and six Asian women in South Africa), 57 women with previous treatment or possible recurrences, and two women without follow-up data. The remaining 2153 (93%) women were categorised by country and race, as follows: three groups in Namibia (60 White women, 50 mixed race women, and 367 Black women), two in South Africa (37 mixed race women and 638 Black women), and one group of Black women in each of Uganda (419 women), Zambia (198 women), and Nigeria (384 women). During follow-up to at most 7 years, 1323 (61%) of 2153 women died, 672 (31%) were alive at administrative censoring, and 158 (7%) were lost to follow-up, giving crude survival at 3 years, 5 years, and 7 years of 51%, 40%, and 33%, respectively. Large between-country variations in 5-year age-standardised net survival were observed: 35–42% in Zambia and Nigeria; 52–58% in Black women in Uganda, South Africa, and Namibia; and over 83% in non-Black Namibian women. The annual probability of death (1-year conditional net survival, censored before the COVID-19 pandemic) declined generally from 2–3 years after diagnosis, but remained at 8–21% for Black women in Namibia, Uganda, and Nigeria during the fifth year after diagnosis. Reaching the GBCI 60% stage I or II target and accessing treatment would lead to an approximate reduction in deaths by a third among Black women in Namibia, Nigeria, South Africa, Uganda, and Zambia.

Interpretation Survival after breast cancer is poor in several sub-Saharan African countries, with a substantial risk of death even among women who have survived beyond 3 years after diagnosis. Understanding and preventing deaths among longer-term breast cancer survivors requires further research.

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Introduction

Breast cancer is the most commonly diagnosed cancer and cause of cancer mortality among women worldwide.¹ When diagnosed at early stages, breast cancer can have excellent prognosis if treated appropriately, with 5-year survival of over 85% in many high-income countries. However, survival rates remain poor in many sub-Saharan African countries (appendix 6 pp 4–5),

where there were 68 000 breast cancer deaths in 2022, with deaths projected to rise to 170 000 annually by 2050 if age-specific mortality rates remain unchanged.²

Recognising the need to reduce breast cancer mortality, in 2021 WHO launched the Global Breast Cancer Initiative (GBCI) based on a three-pillar framework of action: early detection; timely diagnosis after first presentation to the health system; and completion of

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For the Yoruba translation of the abstract see [Online for appendix 1](#)

For the Hausa translation of the abstract see [Online for appendix 2](#)

For the Igbo translation of the abstract see [Online for appendix 3](#)

For the Luganda translation of the abstract see [Online for appendix 4](#)

For the French translation of the abstract see [Online for appendix 5](#)

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See Online for appendix 6

Research in context

Evidence before this study

We searched PubMed using the terms “breast cancer”, “survival”, and “sub-Saharan Africa” on April 8, 2024, without language or publication date restrictions, identifying 47 articles with survival estimates for breast cancer in women in sub-Saharan Africa. Only one study, in Ghana, reported survival beyond 5 years, and 21 reported 5-year survival, with figures that ranged from around 11% in Ethiopia to over 90% in Nigeria. Furthermore, several of these studies are now over 20 years old, had substantial loss to follow-up, and inadequate clinical, therapeutic, or epidemiological data needed to understand how to improve survival.

Added value of this study

We analysed data from the prospective African Breast Cancer-Disparities in Outcomes (ABC-DO) study, which included 2153 women with newly diagnosed breast cancer during 2014–17 from five sub-Saharan African countries (Namibia, Nigeria, South Africa, Uganda, and Zambia). Extensive epidemiological and clinical data were collected and active follow-up every 3 months was maintained for up to 7 years to

ensure few losses to follow-up (7.3% by the end of follow-up). Crude overall survival in women at 5 years differed substantially between countries, with estimates ranging from under 31% in Uganda and Nigeria, from 45–46% in Black women in South Africa and Namibia, to 84% in White Namibian women. These variations were mainly due to the distribution of modifiable prognostic factors. Thus survival gains could be achieved by stage shifting and improving treatments, with a projected reduction in death among Black women in all countries by a third. Although the net 1-year risk of death, accounting for the COVID-19 pandemic, decreased over time, during the fifth year after diagnosis, country and race-specific estimates remained high (8–21%) in Black women in Namibia, Uganda, and Nigeria.

Implications of all the available evidence

Our findings reveal large disparities in long-term breast cancer survival in terms of country and race in sub-Saharan Africa and highlight the importance of stage shifting and improving treatments to potentially prevent deaths among patients with breast cancer in these and similar sub-Saharan African settings.

recommended treatment.³ An understanding of current breast cancer survival levels in sub-Saharan Africa and context-specific determinants of survival are needed to help inform breast cancer control in this region. Specifically, quantifying predicted survival if gaps were filled in these GBCI pillars would inform the most effective actions. Such breast cancer survival studies must consider survival up to 3 years or 5 years, but also longer-term survival as late recurrences of breast cancer are not uncommon.⁴ Thus, estimates of conditional survival⁵—ie, survival beyond the initial intensive treatment phase—are informative, of which there is a paucity beyond 1 year in sub-Saharan Africa.⁶

The African Breast Cancer-Disparities in Outcomes (ABC-DO) study is a data-rich hospital-based breast cancer cohort from five sub-Saharan African countries, which has followed up over 2000 women for up to 7 years since their breast diagnosis in 2017–24. We have reported 3-year survival of 18–90% between distinct groups defined by race and country (Nigeria, Uganda, Zambia, and multiracial Namibia and South Africa).⁷ In the present analysis, our aims were to estimate survival to 7 years, provide annual estimates of 1-year conditional survival, and assess how deaths can be averted by predicting survival gains if the distributions of prognostic factors were shifted in alignment with GBCI.

Methods

Study design and participants

The ABC-DO prospective cohort study recruited women who had been newly diagnosed with breast cancer at eight hospitals in five sub-Saharan African countries

(Namibia, Nigeria, South Africa, Uganda, and Zambia; appendix 6 pp 6–7).⁷ All hospitals had the capacity to provide surgery and chemotherapy, and some could provide radiotherapy; most were tertiary public hospitals. Briefly, women (aged ≥18 years) who attended hospital with histologically-confirmed or suspected breast cancer were recruited, the symptoms typically being a breast mass, nipple retraction or discharge, and skin changes. Women were recruited irrespective of any treatment subsequently received, race, residence, or insurance status. Recruitment took place with staggered start and end dates between locations. Further information on the study sites has been published previously.⁷ The ABC-DO study was approved by all institutional ethics committees (appendix 6 p 1), and all women provided written informed consent.

Procedures

Participants completed an interviewer-administered questionnaire at recruitment, consented to allow the study team access to their clinical data, and participated in regular follow-up. The questionnaire collected detailed information on education level, socioeconomic position, breast cancer awareness, cohabitation (yes vs no), and residence (urban vs rural). Race was self-reported, with each woman identifying her main ethnic group or tribe. As most groups were small, they were collapsed into broader racial categories, as follows: White, mixed race, and Black. Participants were tested for HIV infection in South Africa, but HIV infection status was self-reported (yes, no, or not known) in all other countries.

Clinical data were extracted from medical records and included American Joint Committee on Cancer-coded

TNM stage, grade, and receptor positivity (oestrogen and progesterone hormone receptors and human epidermal growth factor receptor 2 [HER2]; appendix 6 p 2). Data on treatment (surgery, chemotherapy, and radiotherapy) were obtained from medical records and self-reports from women. Full details on clinical data collected have been reported previously.⁷

Outcomes

The primary outcome was overall survival, which was measured by ascertaining vital status via a telephone call to the participant or their next of kin once every 3 months. If a woman was attending the hospital for routine clinical management (which was not organised by the study), this information was used to update her vital status. This active follow-up approach resulted in few losses to follow-up; further detail has been published previously.⁷ With cohort recruitment between 2014 and 2017, 7-year follow-up was achieved in 2021–24, meaning some follow-up might have occurred during the COVID-19 pandemic.

Statistical analysis

Overall survival was estimated on a time-since-diagnosis scale, where the date of diagnosis was considered as the date of biopsy in accordance with European Network of Cancer Registry guidelines.⁸ When this date was unavailable, the date of histology report (preferentially) or of recruitment was used. Follow-up time commenced on the ABC-DO recruitment date (left censored) and ended at the earliest occurrence of date of death, 7 years after diagnosis, the last known date alive, or at the latest potential follow-up on Jan 1, 2023, for South Africa and Jan 1, 2022, elsewhere. Kaplan–Meier survival curves were used to visually represent the results, from which crude survival at 3, 5, and 7 years was calculated. Net survival was also estimated, factoring in the country–age–calendar year-specific background mortality for women,^{9,10} as well as age-standardised net survival (appendix 6 p 2) by use of the International Cancer Survival Standard-I.¹¹ We also calculated 1-year conditional net survival, which is the probability of surviving 1 additional year given having already survived for x years:

$$\frac{NS(x+1)}{NS(x)}$$

where $NS(x)$ is the net survival from time 0 to time x . Finally, to remove any potential differential effect of the COVID-19 pandemic on patients with cancer beyond that captured in background mortality rates, we recalculated survival with right censoring on June 1, 2020, when the COVID-19 pandemic first hit Africa.¹²

Determinants of breast cancer survival were assessed via Cox proportional hazards models, stratified by country and race and adjusted for age (categorical) and stage, based on associations in previous analyses.⁷ To identify factors affecting survival beyond 3 years after diagnosis, we

re-evaluated these determinants, restricting the analysis to 1101 women who survived for at least 3 years. We used flexible parametric survival models to predict country-specific and race-specific 5-year and 7-year net survival under the following seven cumulative scenarios, from which we calculated the survival gains (ie, the absolute differences between current survival and predicted survival): (1) stage-shifting to GBCI pillar 1—ie, 35%, 25%, 15%, 10%, 7%, and 8% at stages I/IIA, IIB, IIIA, IIIB, IIIC, and IV, respectively; for country and race groups who had achieved this distribution, we applied the stage distribution of Namibian White women—ie, 56%, 18%, 7%, 7%, 5%, and 5% respectively, which we label as GBCI pillar 1+ (ie, beyond the current GBCI pillar 1 target); (2) stage-shifting to GBCI pillar 1+ for all groups; survival predictions for these stage-shifted scenarios also incorporated treatment access according to the observed site and stage-specific treated proportions; (3) improving treatment to all women receiving surgery, systemic therapy, and radiotherapy; and eliminating (in theory) survival deficits associated with (4) HIV positivity, (5) young age (<30 years) at diagnosis, and (6) not having hormone receptor-positive (ie, oestrogen or progesterone receptor-positive) or HER2– tumours. The final scenario was (7) reducing survival deficits linked to social inequalities, in which women were shifted to a higher educational level (none, primary, or secondary). For predictions, we excluded 76 women from a private clinic in Nigeria that mostly cared for patients with terminal disease.⁷ Absolute differences in survival or death probabilities are expressed using percentage points. Analyses were done in STATA version 17 and R studio.

Role of the funding source

The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

Between Sept 8, 2014, and Dec 31, 2017, 2313 women were recruited into ABC-DO. We excluded 87 women without breast cancer whose histology indicated that they did not have a breast malignancy, 14 women from small racial groups (eight White and six Asian women in South Africa), 57 women with previous treatment or possible recurrences, and two women without follow-up data. The remaining 2153 (93%) women were categorised by country and self-reported race, as follows: three groups in Namibia (60 White women, 50 mixed race women, and 367 Black women), two in South Africa (37 mixed race women and 638 Black women), and one group of Black women in each of Uganda (419 women), Zambia (198 women), and Nigeria (384 women). Characteristics of the participating hospitals, patients, cancer, and therapy are summarised in appendix 6 (pp 6–7). The mean participant age at diagnosis was 52 years, ranging from 48 years in Ugandan women to 59 years in White Namibian women. Only two (3%) of

	Total	Namibia			South Africa			Uganda (Black)		Zambia (Black)		Nigeria (Black)	
		White	Black	Mixed race	Black	Mixed race	Black						
Number of women followed up	2153	60	367	50	367	37	638	419	198	384			
Median time since diagnosis, years*	3.1 (1.3–5.6)	6.3 (5.2–7.0)	4.0 (1.7–6.1)	5.7 (3.9–6.3)	4.0 (1.7–6.1)	5.3 (2.1–5.9)	3.9 (1.6–5.9)	2.6 (1.1–5.2)	2.5 (1.0–4.8)	2.1 (0.8–4.1)			
Status at end of follow-up†													
Died	1323 (61%)	11 (18%)	214 (58%)	24 (48%)	214 (58%)	19 (51%)	368 (58%)	288 (69%)	114 (58%)	285 (74%)			
Administrative censoring	490 (23%)	25 (42%)	85 (23%)	13 (26%)	85 (23%)	15 (41%)	226 (35%)	77 (18%)	38 (19%)	11 (3%)			
Early censoring before 5 years after diagnosis	158 (7%)	5 (8%)	13 (4%)	0	13 (4%)	0	27 (4%)	28 (7%)	34 (17%)	51 (13%)			
Early censoring at 5–7 years after diagnosis	182 (8%)	19 (32%)	55 (15%)	13 (26%)	55 (15%)	3 (8%)	17 (3%)	26 (6%)	12 (6%)	37 (10%)			
Number of deaths during the period since diagnosis, years													
>0–3	999/1323 (75%)	6/11 (55%)	148/214 (69%)	11/24 (46%)	148/214 (69%)	12/19 (63%)	269/368 (73%)	217/288 (75%)	98/114 (86%)	238/285 (84%)			
>3–5	234/1323 (18%)	3/11 (27%)	43/214 (20%)	4/24 (17%)	43/214 (20%)	5/19 (26%)	70/368 (19%)	55/288 (19%)	15/114 (13%)	39/285 (14%)			
>5–7	90/1323 (7%)	2/11 (18%)	23/214 (11%)	9/24 (38%)	23/214 (11%)	2/19 (11%)	29/368 (8%)	16/288 (6%)	1/114 (1%)	8/285 (3%)			
Median age at death, years	52 (43–63)	65 (51–72)	54 (44–67)	62 (50–72)	54 (44–67)	58 (42–65)	56 (46–89)	49 (41–58)	51 (40–65)	49 (41–60)			
Number of deaths aged <40 years‡	229/1323 (17%)	1/11 (9%)	32/214 (15%)	0	32/214 (15%)	4/19 (21%)	38/368 (10%)	65/288 (23%)	25/114 (22%)	64/285 (22%)			
Mean 3-year survival													
Crude survival	51% (49–53)	90% (79–95)	57% (51–62)	77% (62–86)	57% (51–62)	68% (50–80)	57% (54–61)	45% (40–50)	46% (38–53)	35% (30–40)			
Net survival§	..	..	60% (54–66)	82% (70–95)	60% (54–66)	70% (55–86)	61% (57–66)	48% (43–53)	48% (40–55)	37% (32–42)			
ASNS‖	..	..	63%	82%	63%	72%	67%	61%	48%	47%			
5-year survival													
Crude survival	40% (38–42)	84% (72–92)	45% (40–50)	69% (54–80)	45% (40–50)	54% (37–68)	46% (42–50)	31% (27–36)	37% (30–44)	24% (20–29)			
Net survival§	..	..	50% (44–56)	77% (63–92)	50% (44–56)	59% (41–76)	52% (47–57)	35% (30–40)	41% (33–49)	27% (22–31)			
Net survival censored at start of COVID-19	..	..	50% (44–57)	79% (64–94)	50% (44–57)	66% (48–83)	53% (45–60)	34% (28–40)	47% (39–55)	22% (16–27)			
ASNS‖	..	..	53%	83%	53%	64%	58%	52%	42%	35%			
ASNS censored at start of COVID-19	..	..	54%	87%	54%	74%	59%	45%	50%	30%			
7-year survival													
Crude survival	33% (30–35)	80% (67–89)	36% (31–42)	45% (29–59)	36% (31–42)	42% (22–61)	39% (34–43)	26% (21–30)	..	14% (7–24)			
Net survival§	..	..	42% (36–49)	54% (34–73)	42% (36–49)	49% (28–71)	46% (41–52)	30% (25–36)	..	16% (7–25)			
ASNS‖	..	..	46%	54%	46%	64%	54%	47%	..	27%			

Data are n, median (IQR), n (%), n/N (%), mean survival (95% CI), or mean survival. ASNS=age-standardised net survival. *Regardless of vital status. †End of follow-up to earliest of 7 years after diagnosis or Jan 1, 2023, for South Africa and Jan 1, 2022, for other countries, whichever came first. ‡Expressed as a proportion of those who had died at the end of follow-up. §Net survival accounted for background age-specific national mortality in women but was not estimated in White Namibian women because of insufficient race-specific mortality data for this population. ‖

Table: Survival estimates in the African Breast Cancer-Disparities in Outcomes cohort, by country and race

60 White Namibian women were diagnosed when they were younger than 40 years, contrasting with 115 (27%) of 419 women in Uganda, 55 (28%) of 198 women in Zambia, and 101 (26%) of 384 women in Nigeria. Of women with stage information (2073 [96%] of 2153 women), early stage (0, I, or II) disease was diagnosed in 82 (75%) of 110 non-Black Namibian women, 22 (59%) of 37 mixed race South African women, 298 (47%) of 638 Black South African women, 128 (35%) of 367 Black women in Namibia, 146 (38%) of 387 women in Uganda, 78 (44%) of 178 women in Zambia, and 88 (25%) of 356 women in Nigeria.

Cohort follow-up, survival estimates, and Kaplan–Meier survival curves are shown in the table, figure 1, and appendix 6 (p 14). During follow-up (to 7 years at latest), 1323 (61%) of 2153 women died, 672 (31%) were alive at administrative censoring, and 158 (7%) were lost to follow-up. Loss to follow-up was slightly higher in Zambia (46 [23%] of 198 women) and Nigeria (88 [23%] of 384 women) than elsewhere, but was nonetheless low given the long follow-up. The median age at death was 52 years (IQR 43–63) and 229 (17%) of 1323 deaths occurred under age 40 years. Crude 5-year survival was 40% (95% CI 38–42) in the full cohort but showed large racial variations in Namibia (84% in White women, 69% in mixed race women, and 45% in Black women) and South Africa (54% in mixed race women and 46% in Black women), with lower 5-year survival elsewhere (37% in Zambia, 31% in Uganda, and 24% in Nigeria). At 5 years, net survival was 3–8 percentage points higher than crude survival. Age-standardised net survival was 1–8 percentage points higher than net survival (8 percentage points higher in Uganda), due to the down-weighting of reduced survival in the large proportion of young women and up-weighting of higher survival in a very small number of older women. Thus, age-standardised net survival is an unstable estimate, and unstandardised net survival might be more robust for this study.

Chronologically, with diagnoses in 2014–17, cohort follow-up since the COVID-19 pandemic start (June, 2020) had a negligible effect on 3-year survival, but for 5-year estimates, 12% of follow-up time and 7% of deaths occurred after the pandemic commenced. Recalculating survival estimates based on follow-up before the COVID-19 pandemic showed changes in 5-year net survival estimates within 1 percentage point in Black women in Namibia, South Africa, and Uganda but changes of up to 6 percentage points in Zambia (increase) and Nigeria (decrease).

Beyond 5 years, survival continued to decline to a crude estimate of 33% (95% CI 30–35) at 7 years. Between 5 years and 7 years, crude survival decreased by 5% (relative scale) among Namibian White women, but declined more sharply in all groups of Black women, illustrating a high mortality rate beyond 5 years after diagnosis. Correspondingly, although the group-specific 1-year conditional net survival (based on pre-COVID-19 follow-up) generally increased from a peak at 2 or 3 years

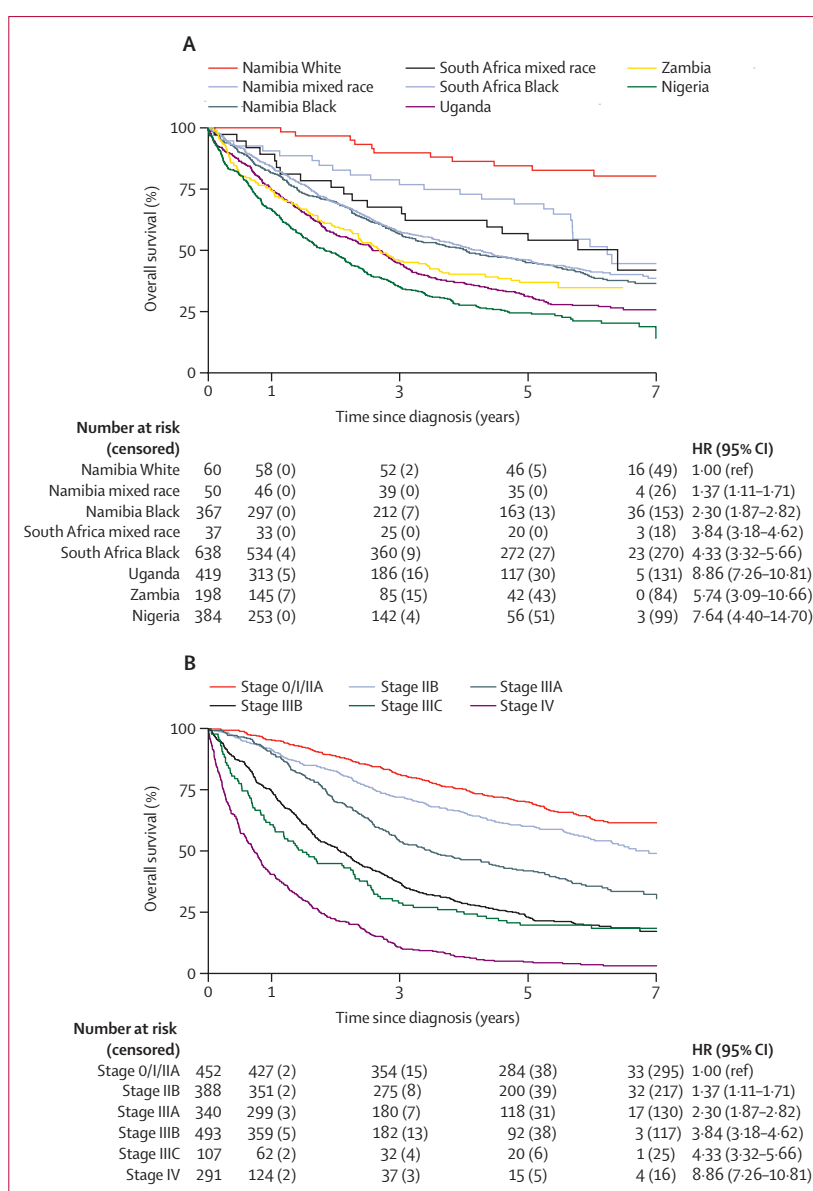


Figure 1: Crude overall survival up to 7 years after breast cancer diagnosis

Crude 7-year overall survival by country and race (A) and by stage at diagnosis (B). HR=hazard ratio.

after diagnosis, it did not reach levels near 1 (a survival of 1 indicating no remaining excess mortality compared with background rates), as the annual risk of death remained high. For example, among 4-year survivors, the risk of death in the subsequent year was substantial, at 8–21% for Black women in Namibia, Uganda, and Nigeria (figure 2A; appendix 6 p 8). Risks of death at least as high as these estimates were observed in women initially diagnosed with stage IIB or higher disease (figure 2B).

The strongest determinant of survival was stage at diagnosis. For the full cohort, 5-year crude survival was 70% for stage up to IIA, 60% at stage IIB, 20–42% at stages IIIA–C, and 5% at stage IV, with corresponding

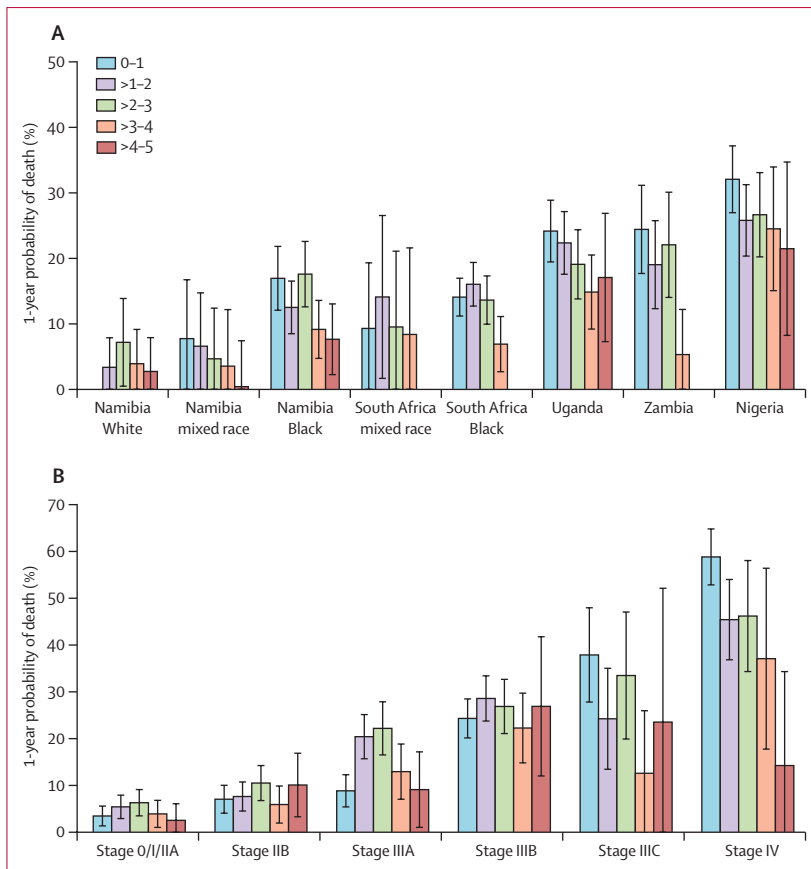


Figure 2: 1-year probability of death adjusted for country and age-specific background mortality in women, with all follow-up censored on June 1, 2020, thus estimates are unaffected by the COVID-19 pandemic, by country and race (A) and stage at the time of diagnosis (B)

Each bar represents the 1-year probability of death of each 1-year interval, conditional on being alive at the start of the interval, in each year up to 5 years since diagnosis. Error bars represent 95% CIs. No Namibian White women died in the first year after diagnosis. The 1-year probability of death in year 5 was not estimated in South Africa and Zambia because of a sample smaller than 20 people.

7-year crude survival of 61%, 49%, 19–31%, and 3%, respectively (figure 1B, appendix 6 pp 9, 16). However, for women initially diagnosed at stage IIA or less, variations in survival were large between groups, with absolute differences in 5-year crude survival of up to 40 percentage points between racial groups in Namibia and South Africa, and of up to 37 percentage points between Black women in different countries (appendix 6 p 9). In line with previous analyses up to 3 years,⁷ other (age-stage-adjusted) factors associated with low survival included younger age at diagnosis (<30 years), rural residence, lower educational level or socioeconomic position, lack of knowledge that breast cancer is potentially curable, being HIV-positive, and being diagnosed with an oestrogen receptor-negative, triple-negative breast cancer, or a grade 3 tumour (figure 3). Additionally, women who did not receive comprehensive treatment (ie, surgery, systemic therapy, and radiotherapy) had reduced survival. Beyond 3 years after diagnosis, the effect of most of these factors diminished,

with stage remaining the strongest determinant and treatment being the primary driver of survival (appendix 6 pp 17–18).

Predictions of 5-year and 7-year net survival under different scenarios reveal the potential to improve survival through actionable factors (figure 4; appendix 6 p 11). Accounting for the country–age–calendar year-specific background mortality in women, the most substantial gains could be made by stage shifting and treatment improvement, which would lead to combined survival gains of 23–39 percentage points at 5 years and 24–39 percentage points at 7 years in Black women. The specific survival gains associated with a shift to 60% stage I or II would be 6–13 percentage points at 5 years and 5–11 percentage points at 7 years, and larger at 10–17 percentage points for 74% stage I or II—an 11–22 percentage point survival gain for improved treatment. Realising these stage and treatment improvements among Black women would lead to 46–55% fewer deaths at 5 years and 42–51% fewer deaths at 7 years. By contrast, at both timepoints, the contribution of survival deficits due to HIV and young age were both less than 2 percentage points and deficits caused by tumours that were hormone receptor-negative and HER2-negative were less than 4 percentage points. Given the imperative of mitigating social disparities, improvement in education levels could potentially eliminate up to 3 percentage points in survival disadvantages. When incorporating all these potential scenarios, between-group survival differences were halved, transitioning net survival from an observed 27–84% to a predicted 72–88% at 5 years, and from 16–80% to 66–86% at 7 years.

Discussion

The present ABC-DO analysis provides survival data for up to 7 years of follow-up. This cohort had detailed clinical and epidemiological data and few losses to follow-up, giving important insights into breast cancer control in sub-Saharan Africa. Our findings reiterate the large survival disparities between countries and races, and emphasise the importance of early diagnosis and treatment access to improve survival. Crucially, these results endorse the WHO GBCI framework. Additionally, longer-term follow-up enabled analyses of conditional survival. Although annual risks of death decreased with time since diagnosis, deaths remained high even among women who survived beyond 3 years since their original diagnosis, showing that improvements are still needed in breast cancer management and care.

The extent of 5-year and 7-year net survival disparities between country and race groups is stark. The predicted 5-year net survival if stage at diagnosis distributions (GBCI pillar 1–2) and treatment access (GBCI pillar 3) were improved would reduce these differences. In line with our previous 3-year analyses,⁷ these changes would lead to a substantial reduction in deaths up to 7 years in Black women. The remaining differences in net survival

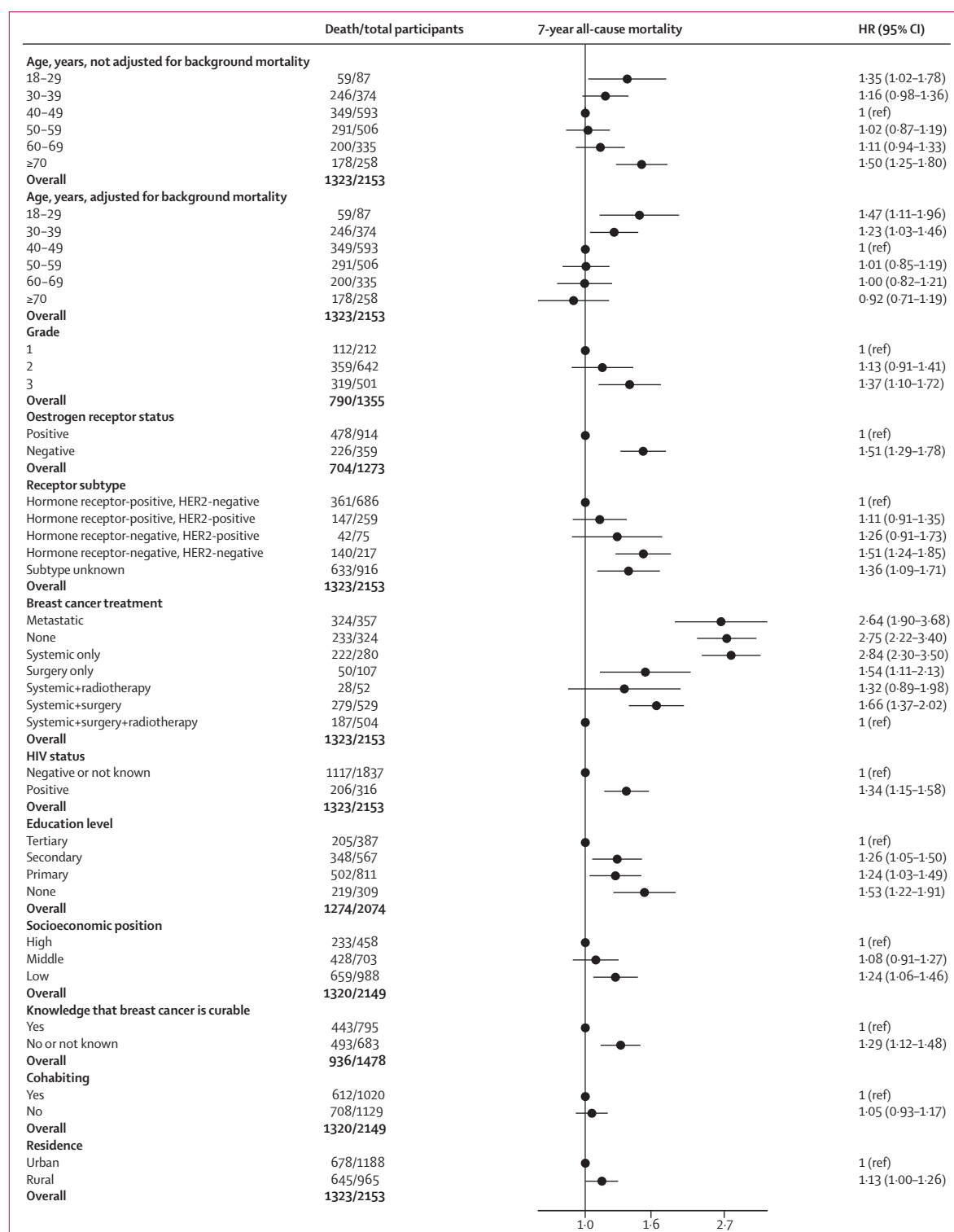


Figure 3: Age-stage-adjusted HRs for 7-year all-cause mortality in all 2153 women, by age, tumour characteristics, HIV status, and sociodemographic characteristics

Knowledge about breast cancer was estimated in all countries except for South Africa. For breast cancer treatment, no women received only surgery and radiotherapy. HER2=human epidermal growth factor receptor 2. HR=hazard ratio.

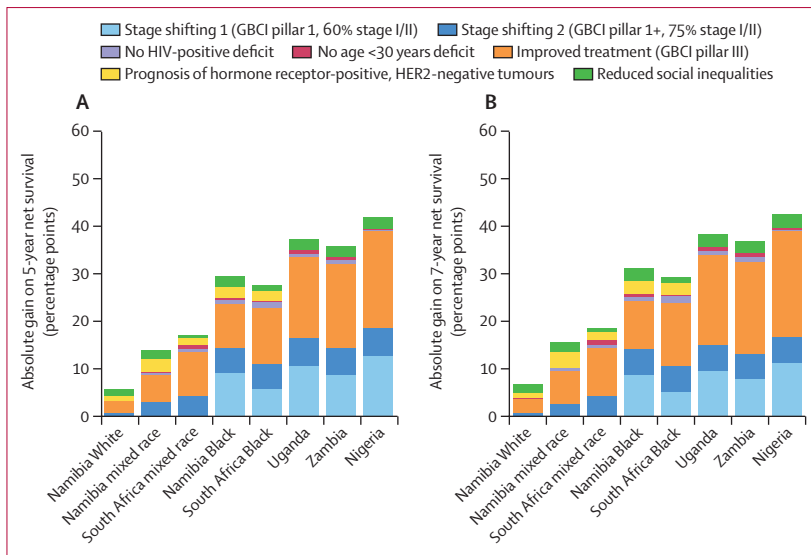


Figure 4: Predicted net survival gains after breast cancer diagnosis at 5 years (A) and 7 years (B)

Survival predictions are under specified improved scenarios, by country and race. The predicted survival gains were estimated if the following cumulative added improvements were made: (1) stage shifting 1: stage-shifting to a stage at diagnosis distribution consistent with GBCI pillar I key performance indicator (ie, 35% at stage I or IIA, 25% at stage IIB, 15% at stage IIIA, 10% at stage IIIB, 7% at stage IIIC, and 8% at stage IV) or in White and mixed race women in Namibia, and mixed race women in South Africa, for whom this distribution is already achieved, downstaging to the same distribution of Namibian White women in the study (ie, 56% at stage I or IIA, 18% at stage IIB, 7% at stage IIIA, 7% at stage IIIB, 5% at stage IIIC, and 7% at stage IV), labelled as GBCI pillar 1+; (2) stage shifting 2: stage-shifting all groups to a stage at diagnosis distribution of GBCI pillar 1+; (3) improving treatment, whereby all women receive surgery and systemic therapy; (4) eliminating survival deficits associated with HIV-positive status; (5) eliminating survival deficits associated with age younger than 30 years; (6) eliminating survival deficits associated with not having hormone receptor-positive or HER2-negative tumours; and (7) reducing survival deficits associated with social inequalities (measured by level of education), whereby, for a given country and race group, women in each of the three education categories (none, primary, and secondary) have the same survival as that of women in the category above. For White Namibian women, the background mortality was set to zero because of the absence of race-specific mortality data for this minority race. For Uganda, Zambia, and Nigeria, where subtypes were largely missing, survival prediction under scenario 6 was not done. Survival model fits are presented in appendix 6 (p 9). GBCI= Global Breast Cancer Initiative. HER2=human epidermal growth factor receptor 2.

might be partly explained by systematic under-staging due to scarce imaging equipment, implying that the stage-shifting survival gains could be larger still, or they could be due to unfavourable tumour biology, most notably in west Africa.¹³

To our knowledge, this is the first study to provide breast cancer survival estimates beyond 5 years in Namibia, Nigeria, South Africa, Uganda, and Zambia. For Nigeria, our 5-year estimate is lower than that in three previous studies,^{14–16} likely reflecting greater treatment access elsewhere (95–100% of patients) compared with the ABC-DO cohort, and the exclusion of metastatic disease from one study.¹⁴ Similarly, previous 5-year survival estimates in Uganda are higher than in ABC-DO, but previous studies had 33–72% loss to follow-up.^{17–20} There are no comparable studies in Zambia and Namibia; however, our 5-year estimate for Zambia is similar to that of neighbouring Zimbabwe.^{20,21} For South Africa, ABC-DO estimates are similar to previous findings.^{22–25} Finally, compared with estimates outside Africa, 5-year survival in Black women in the ABC-DO cohort lags behind most international

estimates (net survival of 90% in the USA and 66% in India).²²

In the context of advanced disease, cumulative mortality includes many deaths in the first few years (steeply declining Kaplan–Meier curve) and the subsequent relative flattening of survival curves can visually mask continued high mortality rates, which is the case in Black women in the ABC-DO cohort. Breast cancer is a malignancy that is known to recur; nevertheless, these mortality rates are excessive, with annual mortality risks in the ABC-DO cohort as high as the cumulative 5-year mortality risk since diagnosis among women with stage II disease in the UK (10%).²⁶ In the UK, annual mortality risks peak at 2·5 years after breast cancer diagnosis and drop to 1% or less at 10 years.²⁶ In ABC-DO, continuing high mortality rates indicate a more critical situation likely involving a combination of substantial under-staging and lack of comprehensive breast cancer therapy. We have documented the extent of treatment delays and inadequate multimodal therapy,^{27,28} particularly highlighting women with non-metastatic disease who do not undergo surgery and do not complete chemotherapy courses.²⁷ Quality of surgery (often radical mastectomy in ABC-DO) is more difficult to assess, but could be a contributor to recurrence, as reported in India.²⁹

The study has some limitations. Women who reached the study hospitals, which were predominantly tertiary hospitals located in urban settings, were unlikely to be fully representative of all patients with breast cancer. In sub-Saharan Africa, a non-negligible proportion of all patients with breast cancer will never receive a formal diagnosis, even by clinical means; more still will be diagnosed and referred for treatment, but never present to tertiary hospitals. We also grouped women from different Black tribes together in each country. The majority of women from Nigeria were Igbo, but in other countries multiple large tribes were represented (eg, Baganda, Basogo, Iteso, and Ankole in Uganda; Bemba and Tonga in Zambia; and Ovambo, Damara, Herero, and Nama in Namibia). The study did not have the power to examine these groups individually. Despite the wealth of data in ABC-DO there are crucial gaps, as the study was intentionally purely observational. Notably, several clinical variables were not completed to an acceptable level, including grade and, outside southern Africa, receptor status. Information on recurrence was also incomplete, as follow-up visits were not systematically made; thus, mortality was the hard endpoint. Finally, cause of death could not be systematically ascertained, but the fact that stage at diagnosis was the strongest determinant of survival suggests that many deaths were due to breast cancer.

The WHO GBCI is timely in light of our findings, as this initiative lays out the actions that need to be taken to improve breast cancer control in low-income and middle-income settings.³ For the sub-Saharan African setting, GBCI pillar 1 activities must include improvements in

breast health awareness at the community level and among health-care professionals to promote early presentation to the health system, coupled with effective referral or management of women who present with symptoms, ideally by ensuring they undergo a clinical breast examination at first contact. Women with a positive clinical breast examination would then be referred through a clear accelerated referral pathway for expert examination and, if needed, full diagnostic investigation, typically involving imaging, biopsy, and pathology (GBCI pillar 2). These efforts will only reap benefits if comprehensive multimodal therapy is available and accessible to all patients with breast cancer (GBCI pillar 3) through training of oncologists and other health-care professionals, availability of drugs for cancer treatment included in the WHO list of essential medicines, and implementation of universal health care. The ABC-DO findings show that timely and appropriate treatment is key to improving survival, although quantification of precise impact is difficult because of the way treatments were categorised. In this analysis, a combination of surgery plus radiotherapy plus systemic therapy was assumed to be the recommended treatment as most women had at least locally-advanced disease, even if this might not have been the recommended treatment for all patients. Helping patients navigate this care pathway is crucial, supporting women to ensure that care journeys are not delayed (other than for safety or medical reasons) and that treatment is supported. This support should encompass affordable costs both for treatment and—critically for cancer treatment in large countries—for transport and accommodation while away from home. Such a supported navigational pathway is essential throughout the care continuum; thus, the GBCI has produced a comprehensive practical guide to aid this implementation.³⁰ Concerning the WHO African region in particular, the WHO Regional Office for Africa is leading the development of two technical products to enable implementation of the GBCI in this region. These products address one of the priority breast cancer issues in the region—integration of early detection of breast cancer with other primary care services. These products will be key in driving progress, especially on the first two pillars of the GBCI. However, although these products, coupled with technical support from the WHO regional office, are key components, only sustained action at national and subnational levels, marshalling political support and convening wide stakeholder support, will yield the desired reduction in breast cancer mortality by 2040.

In summary, mortality rates among Black women with breast cancer in sub-Saharan Africa remain high up to 7 years after diagnosis. Endorsing WHO's GBCI, we found that a large proportion of these deaths can be averted by strengthening early diagnosis and clinical care, greatly contributing to reducing avoidable deaths of women in these settings.

Contributors

TM did the analyses and drafted the paper under the supervision of VM. VM and Id-S-S co-designed the study. MG, AZ, GP, HC, MJ, and AA led each country's fieldwork. All other authors participated in data management or data collection and commented on the draft paper. All authors contributed to data quality, management, interviews, interpretation of results, and writing of the report. All authors had access to all the data in the study and had final responsibility for the decision to submit for publication. TM and VM have accessed and verified the data.

Equitable partnership declaration

The authors of this paper have submitted an Equitable Partnership Declaration (appendix 7). This statement allows researchers to describe how their work engages with researchers, communities, and environments in the countries of study. This statement is part of *The Lancet Global Health's* broader goal to decolonise global health.

See Online for appendix 7

Declaration of interests

BOA reports consulting fees from Astra Zeneca. All other authors declare no competing interests.

Data sharing

The data that support the findings of this study are available from the corresponding author, VM, upon reasonable request.

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