Archives of Public Health

RESEARCH

Open Access

Global, regional, and national trends in the burden of breast cancer among individuals aged 70 years and older from 1990 to 2021: an analysis based on the global burden of disease study 2021

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Abstract

Background Breast cancer poses a substantial health challenge for the world's over-70 population. However, data on the impact and epidemiology of breast cancer in this age group are limited. We aimed to evaluate global, regional, and national breast cancer trends among those aged 70 and older between 1990 and 2021.

Methods In this trend analysis based on the 2021 Global Burden of Diseases (GBD), we report on the incidence rates and Global Burden of Diseases (GBD) disability-adjusted life years (DALYs) counts, as well as the incidence rates per 100,000 individuals and average annual percentage changes (AAPCs) for breast cancer among individuals aged 70 and above at the global, regional, and national levels. We analyzed these global trends by age, sex, and socio-developmental index (SDI). Joinpoint regression elucidates pivotal trend shifts.

Results From 1990 to 2021, the global incidence of breast cancer in the over-70 population modestly increased from 104 to 107 per 100,000, with significant trend changes in 1995, 2005, and 2018. Regionally, High-income North America had the highest incidence in 2021, while North Africa and the Middle East saw the steepest rise in incidence and DALYs. The only decrease was in the High SDI quintile. The 70–74 age group experienced the largest increase globally, with rates rising from 86.3 to 90 per 100,000 (AAPC 0.27).

Conclusion From 1990 to 2021, global breast cancer incidence in the over-70 population saw a slight uptick, contrasted by a significant reduction in DALYs, likely due to progress in endocrine and targeted therapies. This underscores the critical need for enhanced screening and personalized treatments for older patients.

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Text box 1. Contributions to the literature

• This study is the first to analyze breast cancer burden among those aged 70 and older, using Global Burden of Disease 2021 data.

• It highlights regional and national disparities, pointing to gaps in early detection and treatment for older adults.

• The findings emphasize the need for age-specific strategies and guide policymakers in addressing breast cancer in aging populations.

Introduction

Cancer ranks as the second leading cause of death worldwide due to its high incidence and mortality rates, imposing a significant burden on public health systems and human health [1]. Among all cancer types, breast cancer demands particular attention as it is the most common malignancy in women and ranks as the fifth leading cause of cancer-related deaths globally [2]. Projections indicate that by 2040, over 3 million women will be diagnosed with breast cancer annually [3].

In women, the incidence of breast cancer increases with age, showing a second peak, particularly in those aged 70 and above, typically occurring post-menopause [4]. While male breast cancer is rare, its incidence also rises with age, with an average diagnosis age of 67, about five years later than in women [5]. Additionally, the average age at diagnosis is gradually increasing worldwide. In China, for example, 16.6% of breast cancer patients were aged 65 and older in 2008 (compared to 42.6% in the United States), a figure expected to rise to 27.0% by 2030 [6]. These trends underscore the growing burden of breast cancer, particularly among older adults, making this issue increasingly urgent from a public health perspective.

Globally, populations are ageing at an unprecedented rate. Between 2000 and 2010, the population aged 65 and older grew by 15.1%, compared to just 2.6% growth in those under 18, driven by rising life expectancy [7]. The health of the elderly has far-reaching implications, influencing both their quality of life and broader socioeconomic factors. A healthier ageing population can mitigate the economic strain of healthcare costs and continue to contribute to society [8]. In 2015, the United Nations announced the Sustainable Development Goals (SDGs), with SDG 3.4 focusing on reducing premature mortality from noncommunicable diseases (including cancer) by one-third by 2030 [9]. However, significant gaps remain in high-quality data, especially from low-resource countries [10], limiting our understanding of breast cancer trends in older populations.

This study aims to provide a comprehensive analysis of global trends in breast cancer incidence, disability-adjusted life years (DALYs), prevalence, and mortality, with a particular focus on the older age group. By stratifying data by age, sex, and the Sociodemographic Index (SDI), this study highlights variations across populations and regions. The findings aim to equip policymakers and public health professionals with actionable insights for targeted interventions, providing evidence for future breast cancer control efforts and shaping strategies to address the challenges an aging society poses.

Methods

Study population and data collection

This study is a secondary analysis of the 2021 Global Burden of Disease (GBD) study, utilizing cross-sectional datasets from 1990 to 2021 across 204 countries and territories, accessed via the Global Health Data Exchange (GHDx) platform. These datasets provide detailed records of the global burden of 369 diseases and injuries, including extensive data on breast cancer. According to the GBD classification standards [11], data for both males and females across six age groups (70–74, 75–79, 80–84, 85–89, 90–94, and 95+years) were collected and analyzed within 21 regional country groups based on geographical proximity and similar epidemiological characteristics. The absolute numbers and rates of breast cancer incidence, prevalence, mortality, and disability-adjusted life years (DALYs) were extracted for these populations. In this analysis, the rates were not age-standardized.

While the World Health Organization (WHO) defines the elderly population as those aged 60 and above [12], this study specifically focuses on breast cancer patients aged 70 and above. These patients are further subdivided into the age groups mentioned above to more accurately describe the burden of breast cancer within this demographic.

The GBD 2021 study also calculated the Sociodemographic Index (SDI), which comprehensively reflects the impact of socioeconomic conditions on health outcomes. The SDI is a geometric mean ranging from 0 to 1, based on indicators such as the total fertility rate among women under 25, the mean years of education for those aged 15 and older, and the per capita income. An SDI of 0 represents the lowest levels of education and income and the highest fertility rate. The SDI is categorized into five levels: low, low-middle, middle, high-middle, and high [11].

The data used in this study are publicly accessible, and therefore, the Ethics Committee of Harbin Medical University Cancer Hospital determined that ethical approval was not required. The study adheres to the guidelines for cross-sectional studies outlined in the Guidelines for Accurate and Transparent Health Estimates Reporting.

Statistical analysis

The primary objective of this study is to comprehensively analyze the long-term trends in the incidence, prevalence, mortality, and DALYs of breast cancer globally, with a particular focus on age-specific rates over time. We employed linear regression analysis to quantify these changes, concentrating on the evolution of log-transformed rates over the years. In this analysis, year is the independent variable, and log-transformed rates as the dependent variable, capturing annual rate changes and generating age-specific time series data. Linear regression allowed us to estimate the annual percentage change (APC) for each age group, providing insight into the trends of breast cancer indicators within different age groups. Additionally, we calculated the average annual percentage change (AAPC) for all age groups by averaging the APC values, offering a global perspective on the average annual trends of breast cancer indicators.

The calculation of AAPC involves the following steps:

1. Log transformation of breast cancer indicators (incidence, prevalence, mortality, and DALYs) for each age group to stabilize variance and simplify linear regression analysis.
2. Application of a linear regression model with year as the independent variable and log-transformed breast cancer indicators as the dependent variable.
3. Extraction of APC values for each age group from the regression results.
4. Averaging the APC values across all age groups to derive the AAPC. We calculated AAPC for 1990–1999, 2000–2009, 2010–2019, 2012–2021, 2017–2021, and 1990–2021.

The second objective is to identify the inflection points in the trends of the indicators above. For this, we employed joinpoint regression analysis, identifying trends over time and fitting the data to the simplest model on a log scale by connecting multiple line segments. The points where these segments meet are called joinpoints. The simplest model, without joinpoints, is a straight line. We tested the significance of each joinpoint using the Monte Carlo permutation method and selected the final model in Joinpoint software based on expert knowledge and the weighted Bayesian information criterion method.

The third objective is to stratify the global trends by age group, sex, and Sociodemographic Index (SDI). The fourth objective is to report regional and national trends using the same AAPC calculation method described above. Statistical results are presented and interpreted using effect sizes, confidence intervals (CI), rates, uncertainty intervals (UI), and precise p-values. All statistical tests were performed using R software (version 4.4.1) and Joinpoint software (version 5.2.0).

Results

Global trends

The global trend analysis reveals that the incidence of breast cancer among elderly patients aged 70 and above showed an increasing trend from 1990 to 1999 (AAPC 0.61 [95% CI 0.53 to 0.69]). However, in the early 21st century, from 2000 to 2009, the incidence rate declined (AAPC −0.26 [95% CI -0.30 to -0.22]). Notably, from 2017 to 2021, the incidence rate significantly decreased (AAPC −0.35 [95% CI -0.69 to -0.02]). Overall, the breast cancer incidence rate in 2021 (107 per 100,000 [95% UI 91–115]) showed no significant change compared to 1990 (104 per 100,000 [95% UI 95–110]), with a minimal average annual percentage change (AAPC 0.07, 95% CI 0.01 to 0.12) (Tables 1 and 2). Throughout the study period (1990 to 2021), the prevalence of breast cancer increased while the DALYs significantly declined (Table 1). Joinpoint regression analysis identified significant changes in the incidence rates in 1995, 2005, and 2018 (Fig. 1).

Table 1 Global AAPCs in breast cancer

	Incidence		Prevalence		Deaths		DALYs	
	AAPC (95% CI)	p value	AAPC (95% CI)	p value	AAPC (95% CI)	p value	AAPC (95% CI)	p value
1990–1999	0.61 (0.53 to 0.69)	< 0.001	-0.63 (-0.79 to -0.47)	< 0.001	-0.24 (-0.34 to -0.13)	< 0.001	-0.27 (-0.36 to -0.18)	< 0.001
2000–2009	-0.26 (-0.3 to -0.22)	< 0.001	-0.1 (-0.19 to -0.01)	0.024	-0.82 (-1.08 to -0.56)	< 0.001	-0.99 (-1.14 to -0.85)	< 0.001
2010–2019	0.04 (-0.02 to 0.11)	0.216	0.09 (0.04 to 0.13)	< 0.001	-0.26 (-0.34 to -0.18)	< 0.001	-0.37 (-0.55 to -0.19)	< 0.001
2012–2021	-0.1 (-0.25 to 0.06)	0.222	0.01 (-0.06 to 0.09)	0.745	-0.46 (-0.63 to -0.28)	< 0.001	-0.41 (-0.63 to -0.2)	< 0.001
2017–2021	-0.35 (-0.69 to -0.02)	0.041	-0.13 (-0.29 to 0.03)	0.118	-0.82 (-1.21 to -0.43)	< 0.001	-0.56 (-0.89 to -0.24)	0.001
1990–2021	0.07 (0.01 to 0.12)	0.021	0.14 (0.05 to 0.23)	0.003	-0.48 (-0.58 to -0.38)	< 0.001	-0.57 (-0.65 to -0.48)	< 0.001

AAPC = average annual percentage change. DALYs = disability-adjusted life-years

Table 2 The incidence and DALYs of breast cancer and its AAPCs from 1990 to 2021 at the global and regional levels

	Incidence						DALYs					
	Cases (n), 1990	**Incidence (per 100000 population), 1990**	**Cases (n), 2021**	**Incidence (per 100000 population), 2021**	**AAPC,1990–2021**	**p-value**	**Cases (n), 1990**	**DALYs (per 100000 population), 1990**	**Cases (n), 2021**	**DALYs (per 100000 population), 2021**	**AAPC,1990–2021**	**p-value**
Global	210,871 (191985–221262)	104.4 (95.0 -109.5)	527,869 (451786–568778)	106.8 (91.4 -115.1)	0.07 (0.01 to 0.12)	0.021	1,899,416 (1749140–2003315)	940.3 (865.9 -991.7)	3,901,538 (3429648–4216617)	789.2 (693.7 -852.9)	-0.57 (-0.65 to -0.48)	< 0.001
Sex												
Male	2672 (2375–3071)	3.2 (2.9–3.7)	11,586 (8292–13746)	5.3 (3.8–6.3)	1.71 (1.37 to 2.06)	< 0.001	28,861 (24976–34699)	34.9 (30.2–41.9)	91,254 (65898–109077)	42.0 (30.3–50.2)	0.66 (0.48 to 0.85)	< 0.001
Female	208,199 (189325–218560)	174.5 (158.7 -183.2)	516,283 (441841–556930)	186.4 (159.5 -201.1)	0.21 (0.14 to 0.28)	< 0.001	1,870,555 (1720074–1975050)	1568.1 (1441.9 -1655.7)	3,810,284 (3343574–4125606)	1375.8 (1207.3 -1489.7)	-0.42 (-0.5 to -0.34)	< 0.001
Age group												
70–74 years	73,085 (68663–76197)	86.3(81.1–90)	195,494 (177921–207425)	95(86.4-100.8)	0.27 (0.17 to 0.37)	< 0.001	714,418 (675057–751884)	843.9 (797.4 -888.1)	1,518,717 (1401503–1621915)	737.8 (680.9–788.0)	-0.45 (-0.55 to -0.34)	< 0.001
75–79 years	64,733 (59561–67608)	105.2(96.8-109.8)	131,284 (114946–140082)	99.5(87.2-106.2)	-0.21 (-0.33 to -0.08)	0.001	576,640 (535533–605848)	936.8 (870.0 -984.2)	952,326 (855791–1024941)	722.1 (648.9 -777.2)	-0.87 (-0.99 to -0.75)	< 0.001
80–84 years	42,256 (36832–45153)	119.4(104.1-127.6)	98,839 (80292–108847)	112.9(91.7-124.3)	-0.17 (-0.25 to -0.09)	< 0.001	356,744 (316189–382986)	1008.4 (893.8 -1082.6)	699,556 (591383–767106)	798.7 (675.2 -875.9)	-0.75 (-0.85 to -0.65)	< 0.001
85–89 years	22,991 (18986–25125)	152.1(125.6-166.3)	67,625 (52376–76012)	147.9(114.6-166.2)	-0.07 (-0.38 to 0.24)	0.648	172,152 (147087–188386)	1139.2 (973.4 -1246.7)	417,580 (333824–467261)	913.3 (730.1–1022.0)	-0.7 (-0.96 to -0.44)	< 0.001
90–94 years	6324 (5069–6987)	147.6(118.3-163.1)	26,220 (19536–29874)	146.6(109.2–167)	-0.01 (-0.18 to 0.15)	0.863	61,619 (50379–67693)	1438.0 (1175.7 -1579.7)	221,571 (168871–251259)	1238.6 (944.0 -1404.5)	-0.47 (-0.67 to -0.27)	< 0.001
95 + years	1482 (1120–1675)	145.6(110-164.5)	8408 (5985–9693)	154.3(109.8-177.9)	0.17 (-0.15 to 0.5)	0.298	17,843 (13789–20085)	1752.6 (1354.4 -1972.8)	91,788 (66860–104948)	1684.1 (1226.7 -1925.5)	-0.13 (-0.46 to 0.19)	0.421
Sociodemographic index												
Middle SDI	16,157 (14809–17401)	35.4 (32.4–38.1)	84,064 (73815–93190)	59.6 (52.4–66.1)	1.74 (1.64 to 1.85)	< 0.001	218,961 (201146–237531)	479.2 (440.2 -519.8)	786,871 (698279–872640)	558.1 (495.3 -618.9)	0.53 (0.41 to 0.65)	< 0.001
Low-middle SDI	6401 (5604–7173)	24.4 (21.4–27.4)	33,283 (29887–36327)	47.5 (42.6–51.8)	2.22 (2.04 to 2.39)	< 0.001	101,348 (88850–114174)	386.5 (338.8 -435.4)	429,468 (387257–472326)	612.7 (552.5 -673.8)	1.53 (1.34 to 1.72)	< 0.001

Table 2 (continued)

	Incidence						DALYs					
	Cases (n), 1990	**Incidence (per 100000 population), 1990**	**Cases (n), 2021**	**Incidence (per 100000 population), 2021**	**AAPC,1990–2021**	**p-value**	**Cases (n), 1990**	**DALYs (per 100000 population), 1990**	**Cases (n), 2021**	**DALYs (per 100000 population), 2021**	**AAPC,1990–2021**	**p-value**
Low SDI	3130 (2715–3540)	33.5 (29.1–37.9)	11,533 (10227–12857)	52.6 (46.6–58.6)	1.49 (1.35 to 1.62)	< 0.001	53,395 (46299–60570)	572.2 (496.1 -649.1)	173,013 (154287–193241)	788.8 (703.4–881.0)	1.06 (0.93 to 1.19)	< 0.001
High-middle SDI	43,389 (39657–45477)	84.3 (77.1–88.4)	125,450 (108205–136345)	106.9 (92.2 -116.1)	0.8 (0.68 to 0.91)	< 0.001	472,876 (436939–496303)	918.9 (849.0 -964.4)	968,294 (858094–1054692)	824.8 (730.9 -898.4)	-0.36 (-0.48 to -0.24)	< 0.001
High SDI	141,555 (127198–149363)	205.0 (184.2 -216.3)	272,903 (228051–296018)	190.2 (158.9 -206.3)	-0.26 (-0.34 to -0.17)	< 0.001	1,050,128 (956736–1113734)	1520.7 (1385.4 -1612.8)	1,538,249 (1296536–1681407)	1072.1 (903.6 -1171.9)	-1.13 (-1.33 to -0.93)	< 0.001
Region												
Andean Latin America	374 (311–447)	36.6 (30.5–43.8)	1990 (1500–2679)	60.7 (45.7–81.7)	1.65 (1.02 to 2.28)	< 0.001	5244 (4398–6328)	513.9 (431.0 -620.1)	20,354 (15715–27016)	620.5 (479.1 -823.6)	0.59 (0.01 to 1.18)	0.047
Australasia	2921 (2607–3195)	200.4 (178.9 -219.2)	7059 (5731–8203)	193.7 (157.3 -225.2)	-0.15 (-0.45 to 0.15)	< 0.001.323	22,579 (20283–24545)	1549.3 (1391.8 -1684.2)	38,273 (31517–44115)	1050.5 (865.0 -1210.8)	-1.28 (-1.51 to -1.06)	< 0.001
Caribbean	1289 (1191–1387)	87.3 (80.7–94.0)	3976 (3466–4458)	124.3 (108.3 -139.3)	1.03 (0.8 to 1.27)	< 0.001	13,505 (12526–14525)	914.9 (848.5–984.0)	33,577 (29134–37685)	1049.5 (910.6 -1177.8)	0.36 (0.15 to 0.57)	0.001
Central Asia	1438 (1328–1536)	63.8 (59.0 -68.1)	2127 (1910–2337)	62.6 (56.2–68.8)	0.01 (-0.6 to 0.63)	0.973	19,681 (18326–20966)	873.5 (813.3 -930.5)	25,478 (22916–28058)	749.5 (674.2 -825.4)	-0.47 (-1.13 to 0.19)	0.162
Central Europe	7615 (7203–8002)	96.4 (91.2 -101.3)	22,276 (19841–24201)	150.1 (133.7–163.0)	1.43 (1.3 to 1.57)	< 0.001	94,787 (89790–99515)	1200.0 (1136.7 -1259.8)	212,926 (191608–229888)	1434.4 (1290.8 -1548.6)	0.56 (0.44 to 0.68)	< 0.001
Central Latin America	2133 (1992–2242)	52.8 (49.3–55.5)	11,796 (10332–13198)	86.3 (75.6–96.6)	1.62 (1.37 to 1.88)	< 0.001	22,876 (21566–23935)	566.3 (533.8 -592.5)	92,594 (81776–103951)	677.8 (598.6 -760.9)	0.56 (0.27 to 0.86)	< 0.001
Central Sub-Saharan Africa	296 (221–375)	36.5 (27.3–46.3)	1191 (913–1528)	63.2 (48.4–81.0)	1.8 (1.74 to 1.86)	< 0.001	5210 (3827–6612)	642.7 (472.2 -815.7)	18,517 (14010–24036)	982.1 (743.1 -1274.9)	1.39 (1.34 to 1.43)	< 0.001
East Asia	10,731 (8963–12626)	27.6 (23.0 -32.4)	64,718 (52200–77909)	52.4 (42.2–63.0)	2.11 (1.98 to 2.25)	< 0.001	140,716 (117372–165744)	361.6 (301.6 -425.9)	456,797 (372158–549823)	369.6 (301.1 -444.9)	0.08 (-0.07 to 0.24)	0.306
Eastern Europe	11,994 (11256–12554)	79.2 (74.3–82.9)	29,031 (26128–31829)	135.9 (122.3–149.0)	1.68 (1.32 to 2.04)	< 0.001	137,730 (129949–144504)	909.1 (857.8 -953.8)	246,328 (220437–273856)	1153.2 (1032.0 -1282.0)	0.66 (0.33 to 0.99)	< 0.001

Table 2 (continued)

	Incidence						DALYs					
	Cases (n), 1990	**Incidence (per 100000 population), 1990**	**Cases (n), 2021**	**Incidence (per 100000 population), 2021**	**AAPC,1990–2021**	**p-value**	**Cases (n), 1990**	**DALYs (per 100000 population), 1990**	**Cases (n), 2021**	**DALYs (per 100000 population), 2021**	**AAPC,1990–2021**	**p-value**
Eastern Sub-Saharan Africa	1601 (1381–1925)	51.4 (44.3–61.8)	5676 (4941–6517)	82.4 (71.7–94.6)	1.54 (1.46 to 1.62)	< 0.001	27,440 (23663–33052)	881.1 (759.8 -1061.2)	85,595 (75118–98150)	1242.3 (1090.2 -1424.5)	1.12 (1.06 to 1.18)	< 0.001
High-income Asia Pacific	4481 (3896–4936)	39.8 (34.6–43.9)	34,938 (26864–39946)	100.0 (76.9 -114.3)	3.02 (2.66 to 3.38)	< 0.001	31,716 (28443–34504)	281.8 (252.7 -306.5)	171,805 (133188–196767)	491.7 (381.2 -563.2)	1.76 (1.58 to 1.94)	< 0.001
High-income North America	71,222 (63201–75933)	306.7 (272.2–327.0)	112,718 (96353–122019)	260.3 (222.5 -281.7)	-0.57 (-0.69 to -0.45)	< 0.001	413,986 (371112–443576)	1782.7 (1598.1 -1910.2)	536,078 (458638–586483)	1237.8 (1059.0 -1354.2)	-1.21 (-1.42 to -1.01)	< 0.001
North Africa and Middle East	1784 (1619–1966)	24.7 (22.4–27.2)	18,299 (16244–20405)	90.0 (79.9 -100.3)	4.25 (4.07 to 4.44)	< 0.001	20,359 (18612–22362)	281.9 (257.7 -309.7)	119,295 (105554–133481)	586.7 (519.1 -656.4)	2.38 (2.14 to 2.62)	< 0.001
Oceania	47 (39–57)	45.5 (37.4–54.6)	153 (130–179)	55.4 (47.0 -64.7)	0.64 (0.57 to 0.71)	< 0.001	758 (621–923)	729.4 (597.1 -887.6)	2331 (1969–2753)	845.1 (713.6 -997.9)	0.47 (0.4 to 0.54)	< 0.001
South Asia	4590 (3857–5315)	19.5 (16.4–22.6)	28,682 (24907–33035)	39.2 (34.0 -45.1)	2.28 (1.89 to 2.67)	< 0.001	75,880 (63392–87789)	323.1 (269.9 -373.8)	390,166 (340709–447666)	532.9 (465.4 -611.4)	1.64 (1.19 to 2.08)	< 0.001
Southeast Asia	3511 (2980–4066)	32.2 (27.3–37.2)	18,071 (15257–21307)	60.1 (50.7–70.8)	2.02 (1.95 to 2.09)	< 0.001	56,975 (48250–66678)	521.9 (442.0 -610.8)	232,533 (195753–275809)	773.1 (650.8–917.0)	1.27 (1.17 to 1.36)	< 0.001
Southern Latin America	3402 (3104–3706)	129.1 (117.8 -140.6)	7404 (6427–8310)	134.7 (116.9 -151.2)	0.14 (-0.12 to 0.41)	0.286	44,701 (40875–48382)	1696.3 (1551.2–1836.0)	75,152 (65741–83604)	1367.0 (1195.9 -1520.8)	-0.71 (-0.96 to -0.46)	< 0.001
Southern Sub-Saharan Africa	842 (659–1035)	64.9 (50.7–79.7)	3023 (2717–3322)	113.4 (101.9 -124.6)	1.8 (1.43 to 2.17)	< 0.001	12,254 (9642–15079)	944.0 (742.7 -1161.6)	40,189 (36538–44142)	1506.9 (1370.1 -1655.2)	1.55 (1.2 to 1.91)	< 0.001
Tropical Latin America	2686 (2451–2856)	61.5 (56.1–65.4)	11,838 (10237–12846)	82.4 (71.3–89.4)	1.04 (0.91 to 1.16)	< 0.001	35,473 (32453–37572)	812.4 (743.3 -860.5)	122,487 (106354–132378)	852.8 (740.5 -921.6)	0.22 (0.1 to 0.34)	< 0.001
Western Europe	75,870 (68544–80103)	203.2 (183.5 -214.5)	136,430 (111076–149967)	207.4 (168.8 -227.9)	0.07 (-0.06 to 0.21)	0.284	683,844 (623648–725547)	1831.1 (1669.9 -1942.8)	885,128 (732728–976456)	1345.2 (1113.6 -1484.1)	-0.99 (-1.16 to -0.83)	< 0.001
Western Sub-Saharan Africa	2046 (1691–2387)	50.9 (42.1–59.4)	6475 (5454–7704)	79.4 (66.9–94.5)	1.43 (1.32 to 1.53)	< 0.001	33,703 (28031–39264)	838.6 (697.5–977.0)	95,935 (80688–113954)	1177.2 (990.1 -1398.3)	1.08 (0.89 to 1.28)	< 0.001

Data in parentheses are 95% uncertainty intervals for cases, incidence, and DALYs and 95% CIs for AAPCs. DALYs = disability-adjusted life-years. UI = uncertainty interval. NA = not available. AAPC = average annual percentage change

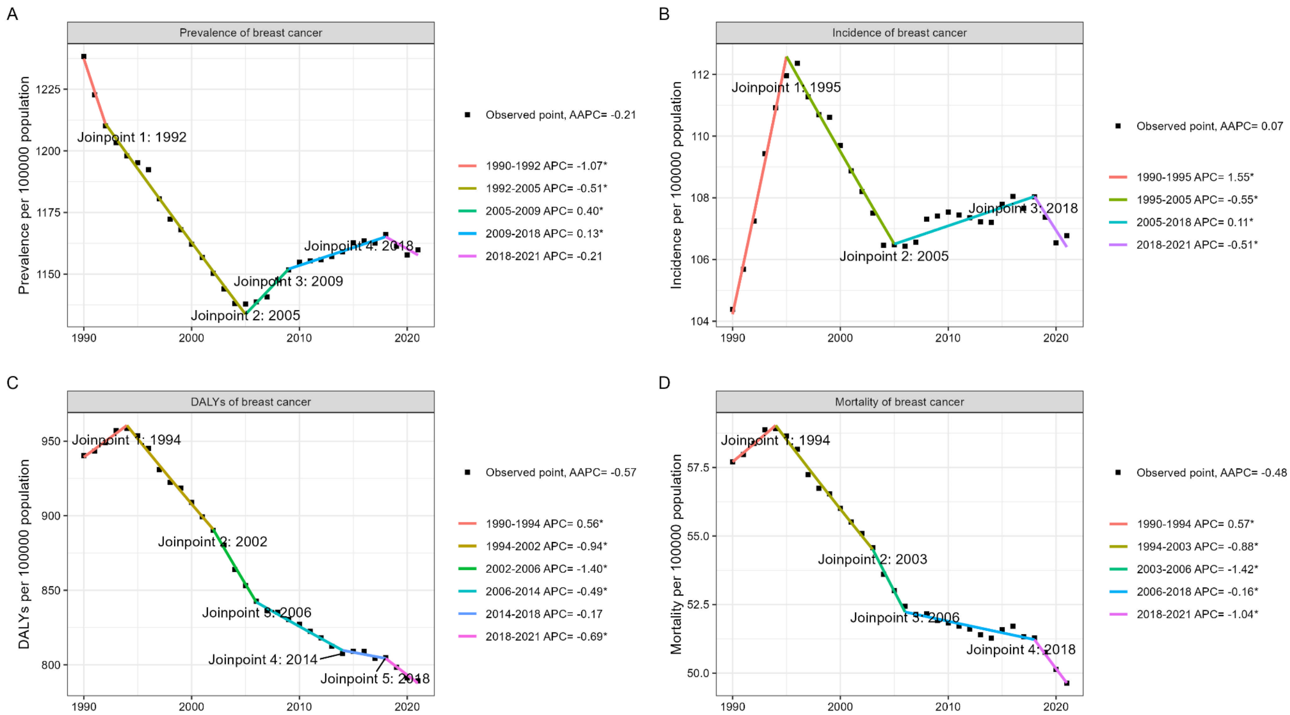

Fig. 1 Joinpoint regression analysis of breast cancer prevalence (**A**), incidence (**B**), DALYs (**C**), and mortality (**D**) in individuals aged 70 years and older from 1990 to 2021. APC = annual percentage change. DALYs = disability-adjusted life-years

Global trends by sex

There were global increases in breast cancer incidence from 1990 to 2021 in both males and females. In males, the AAPC was 0.07 (95% CI 0.01 to 0.12), with rates rising from 3.2 per 100,000 population (95% UI 2.9–3.7) in 1990 to 5.3 per 100,000 population (95% UI 3.8–6.3) in 2021. In females, incidence rates increased from 174.5 per 100,000 population (95% UI 158.7–183.2) to 306 per 100,000 population (95% UI 269–352). Notably, during this 32-year observation period, the DALYs for male breast cancer showed an upward trend with an AAPC of 0.66 (95% CI 0.48 to 0.85), whereas the DALYs for female breast cancer consistently declined with an AAPC of -0.42 (95% CI -0.50 to -0.34) (Table 2).

Global trends by age group

In the global trend analysis from 1990 to 2021, the incidence of breast cancer increased in the 70–74 and 95+age groups. The largest increase was observed in the 70–74 age group, with incidence rates rising from 86.3 per 100,000 population (95% UI 81.1–90) in 1990 to 90 per 100,000 population (95% UI 86.4–100.8) in 2021 (AAPC 0.27 [95% CI 0.17 to 0.37]). In contrast, the incidence rates decreased in other age groups, with the most significant decline observed in the 75–79 age group, from 105.2 per 100,000 population (95% UI 96.8–109.8) in 1990 to 99.5 per 100,000 population (95% UI 87.2–106.2) in 2021 (AAPC −0.21 [95% CI -0.33 to -0.08]). From 1990 to 2021, the DALYs for all age subgroups showed a downward trend. The most considerable reduction in DALYs was seen in the 75–79 age group, decreasing from 936.8 per 100,000 population (95% UI 870.0–984.2) to 722.1 per 100,000 population (95% UI 648.9–777.2) (AAPC −0.87 [95% CI -0.99 to -0.75]).

Global trends by SDI

The only decline in breast cancer incidence by SDI quintile was observed in the High SDI quintile, decreasing from 205.0 per 100,000 population (95% UI 184.2–216.3) in 1990 to 190.2 per 100,000 population (95% UI 158.9–206.3) in 2021 (AAPC −0.26 [95% CI -0.34 to -0.17]). In contrast, the incidence rates in the other four SDI quintiles increased during this period. The largest increase in breast cancer incidence by SDI quintile was observed in the Low-middle SDI quintile, rising from 24.4 per 100,000 population (95% UI 21.4–27.4) in 1990 to 47.5 per 100,000 population (95% UI 42.6–51.8) in 2021 (AAPC 2.22 [95% CI 2.04 to 2.39]). Notably, from 1990 to 2021, reductions in breast cancer DALYs were only observed in countries with High-middle SDI and High SDI, while DALYs increased in all other regions (Table 2).

Regional trends

At the regional level, between 1990 and 2021, North Africa and the Middle East observed the largest increases in breast cancer incidence (from 24.7 per 100,000 population [95% UI 22.4–27.2] in 1990 to 90.0 per 100,000 population [95% UI 79.9–100.3] in 2021; AAPC 4.25

[95% CI 4.07 to 4.44]) and the largest increase in DALYs (from 281.9 per 100,000 population [95% UI 257.7–309.7] in 1990 to 586.7 per 100,000 population [519.1–656.4] in 2021; AAPC 2.38 [95% CI 2.14 to 2.62]). High-income Asia Pacific observed the second-largest increase in breast cancer incidence (from 39.8 per 100,000 population [95% UI 34.6–43.9] to 100.0 per 100,000 population [76.9–114.3]; AAPC 3.02 [95% CI 2.66 to 3.38]). Notably, High-income North America had the highest incidence of breast cancer in both 1990 (306.7 per 100,000 population [95% UI 272.2–327.0]) and 2021 (260.3 per 100,000 population [95% UI 222.5–281.7]).

High-income North America was observed to have the highest incidence of breast cancer in both 1990 (306.7 per 100,000 population [95% UI 272.2–327.0]) and 2021 (260.3 per 100,000 population [95% UI 222.5–281.7]). Nevertheless, High-income North America and Australasia were the only regions where the incidence decreased. High-income North America observed the largest decrease in breast cancer incidence (from 306.7 per 100,000 population [95% UI 272.2–327.0] in 1990 to 260.3 per 100,000 population [95% UI 222.5–281.7] in 2021; AAPC −0.57 [95% CI -0.69 to -0.45]). Meanwhile, Australasia, High-income North America, Western Europe, Southern Latin America, and Central Asia observed a decrease in DALYs. Australasia observed the largest decrease in DALYs (from 1549.3 per 100,000 population [95% UI 1391.8–1684.2] in 1990 to 1050.5 per 100,000 population [95% UI 865.0–1210.8] in 2021; AAPC −1.28 [95% CI -1.51 to -1.06]).

Prevalence, incidence, mortality, and DALYs of breast cancer in 2021 and their average annual percentage changes between 1990 and 2021 in 204 countries and territories are provided in the appendix (p 1). The joinpoint analysis of breast cancer in 21 regions is detailed in the appendix (p 23).

National trends

At the national level, the most notable increase in the incidence of breast cancer between 1990 and 2021 was observed in Turkey, with rates rising from 19.3 per 100,000 population (95% UI 15.8–23.4) to 119.5 per 100,000 population (95% UI 92.6–150.3) (AAPC 6.04 [95% CI 5.33 to 6.75]). Notably, the country with the highest breast cancer incidence in 2021 was the United Arab Emirates, with an incidence rate of 418.2 per 100,000 population (95% UI 289.2–579.6). Conversely, the country with the lowest breast cancer incidence in 2021 was Bangladesh, with an incidence rate of 9.27 per 100,000 population (95% UI 6.80–12.6).

Between 1990 and 2021, the largest increase in DALYs from breast cancer was also observed in the United Arab Emirates, rising from 856.6 per 100,000 population (95% UI 632.3–1123.7) to 2826.8 per 100,000 population (95% UI 1982.2–3850.2) (AAPC 3.97 [95% CI 1.5 to 6.5]). The largest decrease in DALYs from breast cancer was observed in Guam, dropping from 85.6 per 100,000 population (95% UI 70.2–102.1) to 34.5 per 100,000 population (95% UI 23.8–48.2) (AAPC −3.45 [95% CI -4.58 to -2.31]). In 2021, the country with the highest DALYs from breast cancer was Palau, with a rate of 2956.8 per 100,000 population (95% UI 2332.4–3755.2). (Figures 2 and 3; appendix p 1).

Discussion

This study addresses a significant gap in understanding the incidence and trends of breast cancer among individuals aged 70 years and older across 204 countries from 1990 to 2021. Our findings indicate that, since 1995, the global incidence of breast cancer has been decreasing annually, a trend widely recognized worldwide. From 1990 to 2021, the overall global incidence of breast cancer showed a declining trend. Despite an increase observed between 2005 and 2018, the average annual percentage change (AAPC) during this period was only 0.11, approximately one-fourteenth of the AAPC of 1.55 observed from 1990 to 1995 in the population aged 70 years and older. In 2021, the incidence rate of breast cancer in males aged 70 years and older was about one-thirty-fifth of that in females of the same age group, and the DALYs were about one-thirty-second of those in females. This gender disparity highlights that although the incidence of male breast cancer is relatively low, its health impact remains significant when compared to female breast cancer. During the period from 1990 to 2021, an increase in breast cancer incidence was observed only in the 70–74 years and 95 years and older age groups. Notably, the largest increase in incidence among older people was seen in countries with low-middle SDI. This could be attributed to changes in population structure, allocation of medical resources, and public health policies in these countries.

The results of this study reveal a slight increase in the incidence of breast cancer among individuals aged 70 years and older in 2021, consistent with the current trend of global population aging [13] and the strong correlation between breast cancer and age [14]. Previous studies have highlighted that changes in the number of breast cancer cases are primarily driven by population growth and aging [15]. This finding aligns well with the slight increase in breast cancer incidence observed in this study among the elderly, while global DALYs have significantly decreased.

In the 1970s, the positive results of selective estrogen receptor modulators (SERM) tamoxifen in the treatment of hormone receptor-positive (HR+) advanced breast cancer garnered widespread attention, driving the development of endocrine therapy and significantly impacting the treatment of breast cancer in the elderly

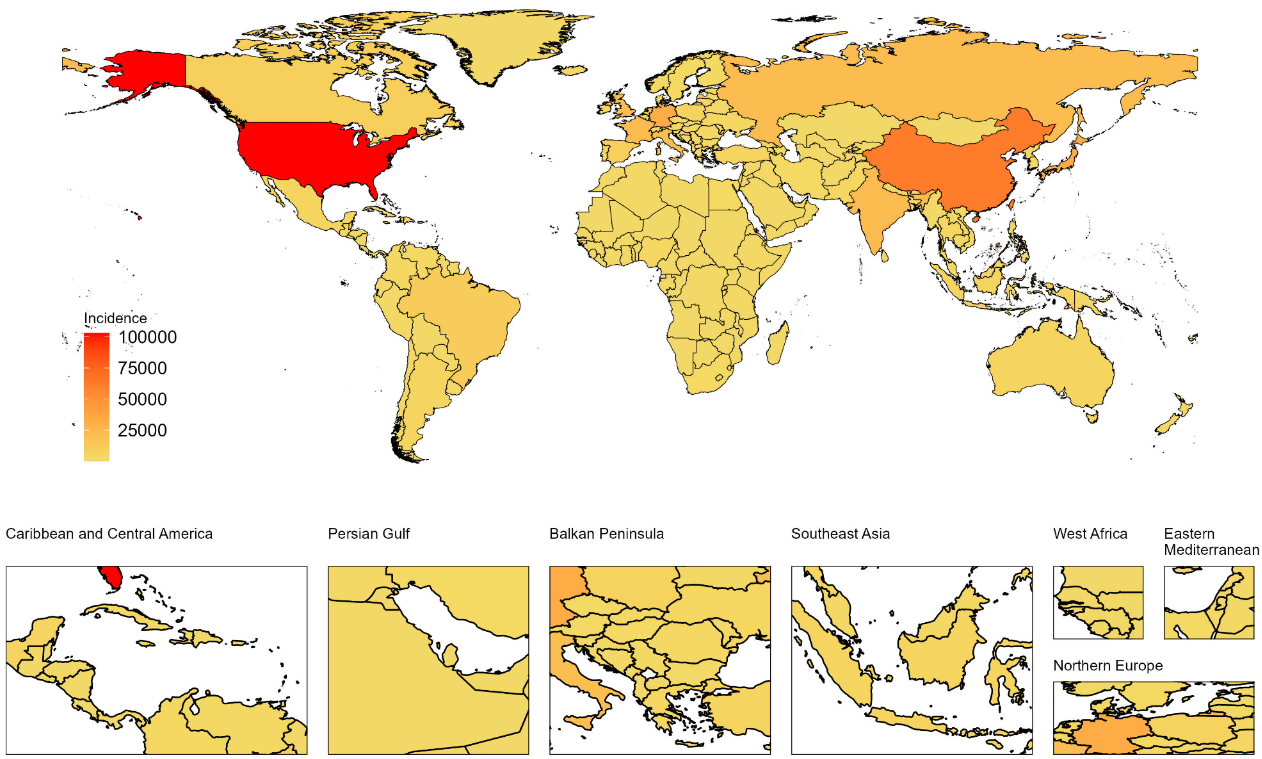

Fig. 2 Global map of 2021 incidence of breast cancer from 1990 to 2021

[16]. In September 1998, trastuzumab (Herceptin) was approved by the FDA (Food and Drug Administration), providing a new targeted therapy for HER2 (Human Epidermal Growth Factor Receptor 2) positive breast cancer [17]. Our study shows that the first significant decline in DALYs and mortality rates for breast cancer among the elderly occurred in 1994. Since then, these indicators have continued to decline, coinciding with advancements in breast cancer treatment and the widespread implementation of early screening. The development of breast cancer therapies has brought more precise and personalized treatment options, as well as improved outcomes and quality of life for elderly breast cancer patients [18].

This study highlights notable shifts in the age distribution of breast cancer incidence among individuals aged 70 years and older since 1990. In 1990, the highest incidence rate was observed in the 85–89 age group, but by 2021, this had shifted to the 95+age group. Similarly, the 95+age group recorded the highest DALYs in 1990 and 2021. A cohort study from the UK indicated that between 2010 and 2015, over 20% of women diagnosed with invasive breast cancer were aged 70 or older [19]. Given the shifting demographic structure, this proportion is expected to rise globally [3].In view of our findings, the growing incidence of breast cancer among the elderly underscores the importance of considering a patient's life expectancy and overall health when determining the most appropriate screening and treatment strategies. This personalized approach is crucial to optimizing resource allocation and improving patient outcomes.

In our study, we found gender differences in DALYs among individuals aged 70 and older with breast cancer. Additionally, from 1990 to 2021, breast cancer incidence in men of the same age group showed a more pronounced upward trend compared to women. This trend may be attributed to biological differences in breast cancer between men and women, such as variations in tumor types, staging, and growth rates. These differences not only impact disease outcomes but also affect the quality of life for patients.

Insufficient awareness among men regarding breast cancer prevention may lead to delays in diagnosis and treatment, thereby affecting prognosis [20]. Given these findings, we recommend implementing targeted gender-specific breast cancer prevention measures, early screening programs, and health education for individuals aged 70 and older. These efforts aim to enhance patient survival quality and prognosis.

Our study demonstrates that from 1990 to 2021, DALYs among individuals aged 70 and older in High SDI and High-middle SDI regions showed a significant decline, whereas those in Middle SDI, Low-middle SDI, and Low

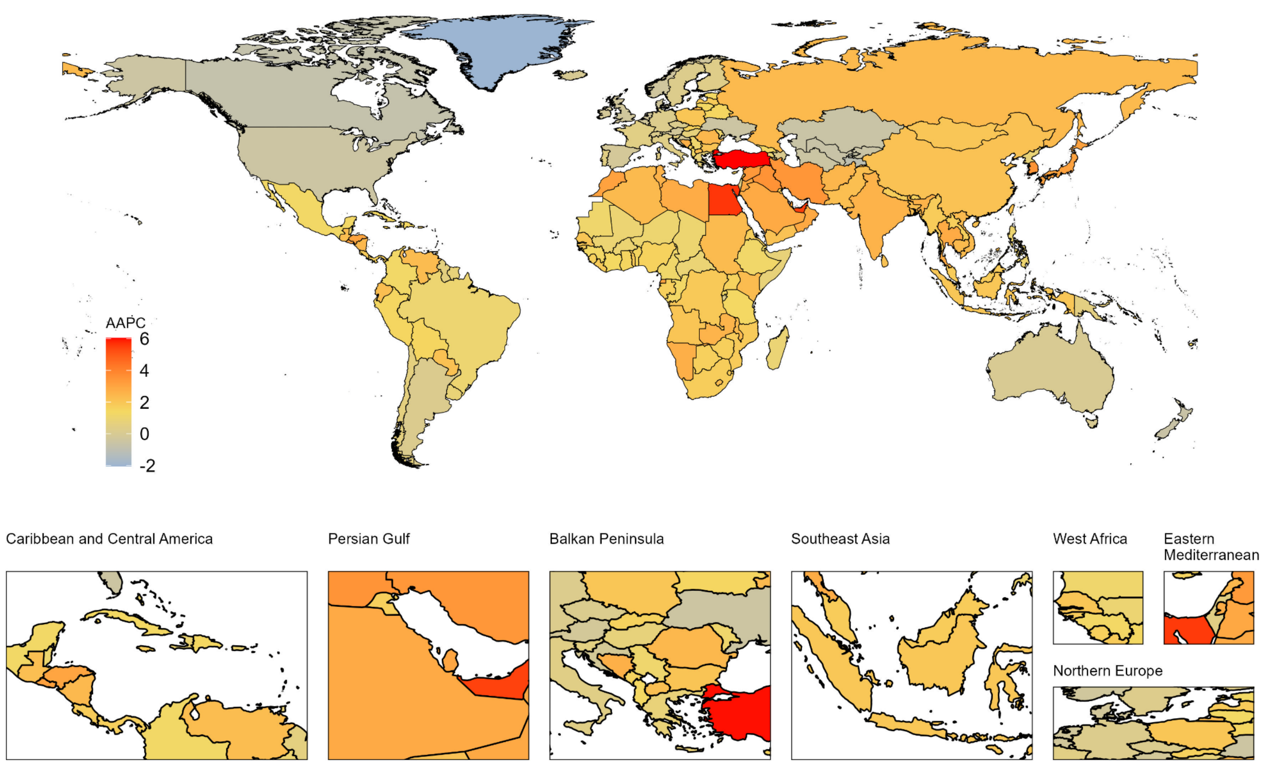

Fig. 3 Global map of 2021 average annual percentage changes in incidence of breast cancer from 1990 to 2021 AAPC = average annual percentage change

SDI regions increased. This trend may be attributed to several factors. In high-income countries, advancements in medical technology and widespread screening methods have significantly improved early detection and treatment outcomes for breast cancer. This means breast cancer can be identified early and effectively treated, reducing its impact on patient health, prolonging life expectancy, and enhancing quality of life [21]. Additionally, high-income countries generally possess more comprehensive healthcare systems and greater healthcare resources, enabling the delivery of specialized treatment and rehabilitation services [22].

Conversely, in low-income countries, although breast cancer incidence may be higher, many cases are diagnosed at advanced stages due to inadequate screening, diagnostic, and treatment facilities. Advanced-stage breast cancer is more challenging to treat and often has poorer outcomes, significantly affecting patient health and life expectancy. Moreover, limited healthcare resources and potentially lower levels of medical expertise and service capacity in low-income countries further impact treatment outcomes for breast cancer patients [23]. Furthermore, only regions in the High SDI quintile experienced a decrease in breast cancer incidence among individuals aged 70 and older, possibly due to improved overall education levels and increasing health awareness, which have somewhat constrained the growth of breast cancer, consistent with previous study findings [24].

Our study findings indicate that from 1990 to 2021, North Africa and the Middle East exhibited the most significant increase in breast cancer incidence among individuals aged 70 and older, while the high-income North American region consistently maintained the highest breast cancer incidence rates in both 1990 and 2021. This finding aligns with previous research [25], suggesting a continued rise in breast cancer risk among individuals aged 70 and older in regions with lower sociodemographic indices (SDI) as socioeconomic development and increased life expectancy prevail. Among the 21 regions analyzed, the high-income Asia Pacific region observed the second-highest increase in breast cancer incidence. According to the World Health Organization's Global Status Report on Noncommunicable Diseases, 2010, some women in the Asia Pacific region lack physical activity or suffer from obesity [26], factors that may contribute to increased breast cancer risk [27]. Therefore, addressing these modifiable risk factors to reduce breast cancer incidence among individuals aged 70 and older could be crucial in alleviating the global burden of breast cancer.

On a global scale, our attention must not only focus on countries where individuals aged 70 and older bear the heaviest burden of breast cancer but also on those where the burden is increasing most rapidly. In our study, from 1990 to 2021, Turkey exhibited the most significant increase in breast cancer incidence rates. Addressing this trend requires public health strategies that enhance breast health awareness among elderly women, promote breast screening, optimize lifestyle choices, and monitor and manage environmental risk factors. Simultaneously, there is a need to expand access to cancer genetic counseling to assist women carrying genetic risk factors with early intervention and monitoring. Policymakers, healthcare providers, and researchers must collaborate to continuously monitor breast cancer epidemiological trends and adjust prevention, diagnosis, and treatment strategies based on the latest scientific evidence, aiming to reduce the burden of breast cancer on both national and individual health.

At the regional level, our findings underscore the urgent need for targeted interventions in regions such as North Africa, the Middle East, and the High-income Asia Pacific, where breast cancer incidence and DALYs have seen the most pronounced increases. Public health strategies in these areas should prioritize expanding access to early detection programs, bolstering healthcare infrastructure, and addressing region-specific risk factors such as environmental exposures and lifestyle factors. In regions like High-income North America and Australasia, where incidence and DALYs have declined, continued investment in and adaptation of existing programmes are vital to ensure they remain responsive to challenges such as ageing populations and shifting risk profiles. At the national level, Turkey exhibited the greatest increase in breast cancer incidence, highlighting an immediate need for national policies focused on promoting breast health awareness and screening in older women. In contrast, countries like the United Arab Emirates, where both incidence and DALYs are alarmingly high, must prioritize the accessibility of advanced therapeutic options and develop comprehensive care pathways to alleviate the burden on healthcare systems. These regional and national findings are aligned with global strategies to reduce breast cancer mortality but emphasize the importance of continual reassessment and adaptation of policies to the evolving epidemiological landscape.

Our study offers critical insights that can inform future research trajectories. Aligned with the World Health Organization's Global Action Plan for the Prevention and Control of Non-Communicable Diseases (NCDs) and the United Nations Sustainable Development Goals, which prioritize reducing premature mortality, our core objective is to decrease early death [25]. The NCD Countdown 2030 report highlights that globally, the mortality rates of several cancers, including lung, colorectal, and liver cancers, have declined too slowly and, in many countries, have even worsened. Nonetheless, the global target of reducing premature mortality from NCDs by one-third by 2030 remains achievable. While specific clinical interventions vary by country and region, policies aimed at reducing behavioral risk factors—such as smoking, excessive alcohol consumption, and high sodium intake—account for nearly two-thirds of the health benefits of tailored NCD strategies [28]. These approaches are also highly applicable to improving breast cancer prevention and treatment outcomes.

A 2021 study evaluated trends in female breast cancer from 1990 to 2017 and explored the association between demographic shifts and female breast cancer risk [29]. Our study utilized the latest GBD data, specifically focusing on male and female breast cancer patients aged 70 and older. In line with the World Health Organization's objective to reduce premature mortality, our analysis of this cohort provides critical insights into the burden of breast cancer among the elderly. It is important to recognize, however, that breast cancer screening guidelines are progressively lowering the recommended starting age, with screening now often initiated at age 40 or even earlier for those at high risk [30]. This shift reflects an increasing recognition of the rising incidence of breast cancer among younger age groups, where early detection can significantly improve prognosis and reduce mortality. By lowering the age threshold for screening, these programs aim to detect breast cancer at an earlier and more treatable stage, thus enhancing survival outcomes. In contrast, our study's focus on patients aged 70 and older means that it does not account for the rising incidence occurring in younger women. Changes in screening practices are likely influencing the observed epidemiological trends, as breast cancer is being detected earlier in younger populations.

Several key limitations must be addressed. Firstly, the GBD database, despite its global reach, varies in data quality, with significant gaps in low- and middle-income countries that may affect the robustness and generalizability of our findings. Secondly, our analysis is restricted to individuals aged 70 years and older. Future research should include younger cohorts to provide a more comprehensive understanding of the evolving dynamics of breast cancer. Thirdly, while we focused on temporal trends, the study did not account for key risk factors such as lifestyle changes, environmental exposures, and genetic predispositions, which are likely to have significant implications for breast cancer risk. Finally, the exclusive reliance on GBD data may have constrained the scope of our findings. Future work should incorporate a wider range of data sources and consider additional factors to improve the depth and accuracy of the analysis.

From 1990 to 2021, there has been a slight increase in breast cancer incidence among the global population aged 70 and above. However, in contrast, the DALYs due to breast cancer have shown a significant downward trend. This phenomenon is closely linked to rapid advancements in multiple treatment modalities, including endocrine and targeted therapy. Given the unique physiological, pathological, and therapeutic responses of individuals aged 70 and above, there is an urgent need for more effective breast cancer screening in this population. Additionally, it is crucial to develop more personalized treatment strategies tailored to the needs of these patients aged 70 and above.

Conclusion

This study reveals global trends in breast cancer among individuals aged 70 and older from 1990 to 2021. While high-income regions saw declines in incidence and disability-adjusted life years (DALYs), lower-income regions experienced increases, especially in North Africa and the Middle East. Gender disparities were observed, with a sharper rise in male breast cancer. The findings underscore the need for age-specific strategies in prevention, early detection, and treatment to address the growing burden in elderly populations.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13690-024-01404-3.

Supplementary Material 1

Acknowledgements
This work was supported by Beijing Medical Award Foundation(YXJL-2021-0424-0382) 2021-2023 and the Harbin Medical University Cancer Hospital Haiyan Scientific Research Fund (JJZD2022-14)2022-2024.

Author contributions
Liu Shaochun was the principal investigator, leading the research design, data analysis, and manuscript writing. Tang Yuhuan and Li Jiajie contributed equally to the research, with Tang Yuhuan responsible for data collection and initial analysis and Li Jiajie responsible for literature review and study validation. Zhao Wenhui provided strategic guidance, supervised the research, and contributed to interpreting results. All authors contributed to the revision of the manuscript and approved the final version for submission.

Funding
This work was supported by the Beijing Medical Award Foundation(YXJL-2021-0424-0382) 2021–2023 and the Harbin Medical University Cancer Hospital Haiyan Scientific Research Fund (JJZD2022-14)2022–2024.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 29 July 2024 / Accepted: 21 September 2024
Published online: 30 September 2024

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