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A SYSTEMATIC ANALYSIS FOR THE GLOBAL, REGIONAL AND LOCAL TREND OF BREAST CANCER, 1990-2019

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Abstract

The goal of this work is to perform a thorough investigation of the incidence, death and disability-adjusted life-years (DALYs) rates of breast cancer (BC) in local, regional, and worldwide contexts. It examines how variations in breast cancer incidence, death rates and DALYs are caused by elements including socioeconomic position, cultural norms and beliefs. Data were extracted from the Global Burden of Disease study 2019) and were calculated to quantify temporal trends in the age-standardized rates of BC incidence, deaths, and disability-adjusted life-years (DALYs) by region. From 1990 to 2019, the BC incidence, deaths, and DALYs increased worldwide by 128%, 84%, and 77%, respectively. The global age-standardized incidence rate increased, whereas both the age-standardized death rate and age-standardized DALY rate presented downward trends. In particular, Western Europe had the largest burden of BC, and globally, BC was more frequently reported in high-middle and high SDI regions. Expanding upon this thorough examination, the article suggests a range of focused, empirically supported tactics aimed at enabling healthcare decision-makers, physicians, and community leaders. Future BC preventive strategies should therefore focus on addressing the global health challenge of breast cancer, aiming to improve survival rates globally through the three pillars of health promotion, timely presentation and diagnosis, and comprehensive treatment and supportive care.

Keywords: breast cancer, incidence, death, DALY, global rate.

1. Introduction

Among different kinds of cancers, breast cancer is one of the most important health problems around the world (Sharma R. 2019). Breast cancer remains one of the most significant health challenges worldwide, affecting millions of individuals across various demographic and geographic divides (Sung H, Ferlay J, Siegel RL. 2021). Despite advances in medical science, the disparities in breast cancer outcomes are stark, influenced by a myriad of factors including socioeconomic status, access to healthcare, cultural beliefs, and the robustness of healthcare systems. Breast cancer remains one of the leading causes of cancer-related deaths among women globally, impacting millions each year. It develops from breast tissue and is most commonly recognized by changes such as lumps in the breast, alterations in breast shape, dimpling of the skin, fluid coming from the nipple, or a red scaly patch of skin. The risk factors for breast cancer include a combination of genetic, environmental, and lifestyle influences. Early detection of breast cancer significantly improves the prognosis and survival rates. Despite advancements in treatment and detection, breast cancer remains a major public health issue, particularly in low and middle-income countries where healthcare systems may not be equipped to provide adequate care and where cultural and socio-economic barriers can limit access to screening and early treatment (Sung H, Ferlay J, Siegel RL. 2021). Research continues to evolve, focusing not only on improving treatment and detection methods but also on understanding the risk factors more deeply to aid in prevention strategies.

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2. Literature review

Overview of breast cancer as a leading cause of cancer-related mortality among women worldwide

According to WHO experts, the global cancer landscape is changing. An increasing global burden of breast cancer is unavoidable as incidence rates rise in the less developed regions of the world but poor survival does not need to be inevitable (Rivera-Franco MM, Leon-Rodriguez E. 2018). Breast cancer is now the second most commonly diagnosed cancer in the world. The most recent global cancer burden figures estimate that there were 2.26 million incident breast cancer cases in 2020 and the disease is the leading cause of cancer mortality in women worldwide. An estimated 685,000 women died from breast cancer in 2020, corresponding to 16% or 1 in every 6 cancer deaths in women. Although historically considered to be a disease of largely developed countries, over half of breast cancer diagnoses and two-thirds of breast cancer related deaths occurred in the less developed regions of the world in 2020. The incidence is strongly correlated with human development, with a large rise in cases anticipated in regions of the world that are currently undergoing economic transformation (Wilkinson L, Gathani T. 2022). Survival, however, is far less favourable in less developed regions. The disparity in breast cancer outcomes across different regions and demographics is pronounced. Women in high-income countries generally have access to advanced healthcare resources, including regular screenings and state-of-the-art treatment options, leading to higher survival rates. In contrast, women in low-income countries often face diagnoses at later stages, limited access to treatment, and consequently, higher mortality rates (Rivera-Franco MM, Leon-Rodriguez E. 2018). These disparities are compounded by socio-economic factors that can affect access to healthcare, including education level, income, and health insurance coverage. Preventative measures also play a crucial role in managing the global impact of breast cancer. Efforts to combat the global burden of breast cancer include awareness campaigns, improving access to early detection services and treatments, and ongoing research into more effective and less toxic therapies. International collaborations and policies aimed at enhancing healthcare infrastructure, especially in underserved areas, are crucial to improving outcomes for all women worldwide. The World Health Organization's new Global Breast Cancer Initiative has addressed this urgent global health challenge. It aims to improve survival across the world through three pillars: health promotion, timely diagnosis, and comprehensive treatment and supportive care. As a foundation to these efforts, a good understanding of global patterns and variation in the disease burden is vital.

Importance of analyzing the burden of breast cancer across different geographical and administrative levels to understand and address disparities in care and outcomes.

Analyzing the burden of breast cancer across different geographical and administrative levels is critical for understanding and effectively addressing disparities in care and outcomes. This approach enables healthcare professionals, policymakers, and researchers to identify specific areas where interventions are most needed and to tailor strategies to the unique contexts of different populations (Francies FZ, Hull R, Khanyile R, Dlamini Z. 2020).

Key Reasons for Geographical and Administrative Analysis

1.*Identifying Regional Variations*: Breast cancer incidence and mortality rates can vary significantly between countries, within countries, and even among different communities or neighborhoods. Factors contributing to these variations can include genetic predispositions, environmental exposures, socio-economic status, and access to healthcare services.
2.*Tailoring Public Health Interventions:* Different regions may require different healthcare strategies. Understanding the specific needs at each level allows for more effective allocation of resources.
3.*Evaluating Healthcare Access and Quality:* Disparities in healthcare access and quality are significant contributors to differences in breast cancer outcomes. Analyzing these factors at various administrative levels helps to pinpoint where healthcare systems may be falling short in providing adequate screening, diagnostic, treatment, follow-up care or where there may be a lack of trained healthcare professionals.
4.*Enhancing Policy Making and Resource Allocation:* Detailed geographical analysis provides lawmakers and health administrators with the data needed to make informed decisions about where to allocate resources more effectively and how to design health insurance programs that improve access to breast cancer care.
5.*Promoting Equity in Health:* This analysis helps to identify and subsequently reduce health inequities by ensuring that all women, regardless of their background or location, have access to the services they need.

3. Methodology

The annual data on BC incidence, mortality, and DALYs were collected from the Global Burden of Disease (GBD) study 2019 (https://vizhub.healthdata.org/gbd-results/). The 204 countries and territories were classified into five regions according to their sociodemographic index (SDI)—namely, low, low-middle, middle, high-middle, and high SDI. The data from countries in Europe were classified into 3 regions Central, Western, Eastern Europe. Age-standardized incidence, mortality rates and DALY were calculated per 100,000 people by European region and level of human development from 1990 to 2019 and can be visualized in tables and graphs.

4. Results

BC Worldwide

Globally, BC incidence increased from 876,992.82 (95% uncertainty interval [UI], 849,689.16–903,815.42) in 1990 to 2,002,354.13 (95% UI, 1,832,150.24–2,172,539.90) in 2019, while related deaths increased from 380,905.20 (95% UI, 364,814.62–396,713.69) in 1990 to 700,659.93 (95% UI, 647,383.81–751,555.08) in 2019 (Tables 1 and 2). BC was responsible for 20,625,312.93 DALYs (95% UI, 19,043,048.85–22,174,397.43) in 2019 (Table 3). According to these values, BC incidence, deaths, and DALYs increased by 128%, 84%, and 77%, respectively, from 1990 to 2019 (Tables 1, 2, and 3).

BC Incidence

Table 1. The incident cases and ASIR of breast cancer in 1990 and 2019 and its trends.

Characteristics	1990	2019	1990–2019
	ASIR (per 100,000)	ASIR (per 100,000)	Change in No. (%)
	No. (95% UI)	No. (95% UI)	
Overall	21.44 (20.65,22.10)	24.17 (22.11,26.24)	1.28 (1.09,147)
Sociodemographic index	–	–	–
Low	9.24 (7.66,10.79)	13.51 (11.93,15.22)	2.27 (1.7,2.97)
Low-middle	9.58 (8.39,10.74)	15.38 (13.54,17.27)	2.49 (1.94,3.13)
Middle	10.66 (9.87,11.48)	18.52 (16.43,20.76)	2.91 (2.39,3.48)
High-middle	20.93 (20.23,21.63)	26.00 (23.34,28.88)	1.26 (1.03,1.52)
High	43.20 (41.83,44.11)	41.22 (36.88, 45.65)	0.57 (0.41,0.74)
Region	–	–	–
Central Europe	25.4 (24.63,26.07)	32.49 (28.13,37.48)	0.69 (0.48,0.92)
Eastern Europe	23.15 (22.49,24.04)	29.83 (25.53,35.06)	0.51 (0.3,0.76)
Western Europe	44.1 (42.79,45.11)	45.15 (38.99,51.84)	0.48 (0.3,0.7)
Albania	9.51 (8.71,10.38)	20.73 (15.07-28)	2.38 (1.44,3.66)

ASIR, age-standardized incidence rate

At a global level, from 1990 to 2019, the age-standardized incidence rate of BC in most countries presented an upward trend (Table 1). The region with the largest number change in BC incidence during 1990–2019 was Central Europe (0.69), whereas that with the smallest number change was Western Europe (0.48) (Table 1).

As for various SDI quintiles, the largest number change in the age-standardized incidence rate of BC during 1990–2019 was observed in the middle SDI quintile (2.91) (Table 1). High SDI countries had the highest age-standardized incidence rate (43.20 in 1990 and 41.62 in 2019), whereas low SDI countries had the lowest age-standardized incidence rate (9.24 in 1990 and 13.51 in 2019) (Table 1). The age-standardized incidence rates in the following SDI quintiles (high-middle, middle, low-middle, and low) continued to increase over time.

However in Albania, was the largest number change in the age-standardized incidence rate of BC from 1990 to 2019, as demonstrated in Table 1 (2.38). The age -standardized incidence rate was 9.51 in 1990 and 20.73 in 2019.

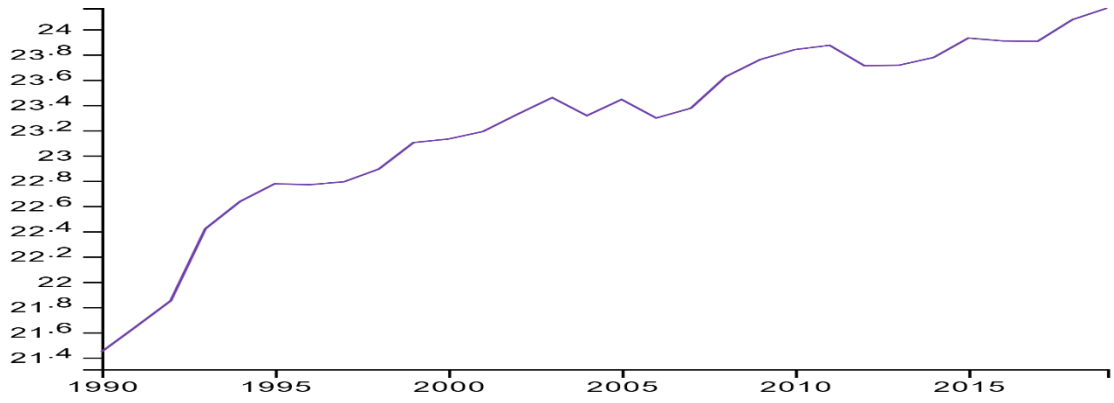

Figure 1 Global Incidence, rate per 100k.

The graph above shows the rate of incidence over a 30-year period from 1990 to 2019. The values are given as rate per 100 000 people. If we look at this trend we can see that the global incidence rate is increased noticeably in this period.

BC RELATED DEATHS

Table 2. The death cases and ASDR of breast cancer in 1990 and 2019 and its trends.

Characteristics	1990	2019	1990–2019
	ASDR (per 100,000)	ASDR (per 100,000)	Change in No. (%)
	No. (95% UI)	No. (95% UI)	
Overall	9.80 (9.30,10.21)	8.62 (7.95,9.25)	0.84 (0.7,0.97)
Sociodemographic index	–	–	–
Low	7.79 (6.47,9.3)	9.83 (8.59,11.12)	1.79 (1.27,2.35)
Low-middle	7.23 (6.24,8.14)	8.94 (7.77,10.16)	1.74 (1.25,2.31)
Middle	6.67 (6.2,7.17)	7.3 (6.6,8.12)	1.54 (1.24,1.86)
High-middle	9.98 (9.58,10.35)	8.31 (7.63,9)	0.59 (0.48,0.72)
High	13.55 (12.9,13.88)	9.05 (8.36,9.47)	0.22 (0.16,0.27)
Region	–	–	–
Central Europe	12.39 (11.95,12.72)	11.32 (9.86,12.93)	0.33 (0.16,0.5)
Eastern Europe	11 10.68,11.36)	10.59 (9.17,12.27)	0.18 (0.03,0.36)
Western Europe	16.21 (15.43,16.59)	10.9 (10.01,11.45)	0.11 (0.04,0.16)
Albania	5.14 (4.72,5.59)	6.5 (4.83,8.68)	1.28 (0.68,2.06)

ASDR, age-standardized death rate;

From 1990 to 2019, high SDI regions had the highest age-standardized death rates (13.55 in 1990 and 9.05 in 2019), while middle SDI regions had the lowest age-standardized death rates (6.67 in 1990 and 7.33 in 2019). The largest number change in age-standardized death rate was in the low SDI quintile (1.79) while the lowest number change in age-standardized death rate was in the high SDI quintile (0.22).

As presented in Table 2, the European region with the highest age-standardized death rate in 2019 was Central Europe (11.32), followed by Western Europe with 10.9 highest age-standardized death rate. The lowest age-standardized death rate was Eastern Europe (10.59). Among regions, the largest number change in BC incidence during 1990–2019 was in Central Europe (0.33) and the lowest in Western Europe (0.11)

In addition, in Albania, the age-standardized death rate was 5.14 in 1990 and 6.5 in 2019 similar with the trends in low, low-middle and middle counties. The number change in BC incidence during 1990-2019 was 1.28.

The graph below shows the rate of deaths over a 30-year period from 1990 to 2019. The values are given as rate per 100 000 people. If we look at this trend we can see that the global deaths rate followed a downward trend.

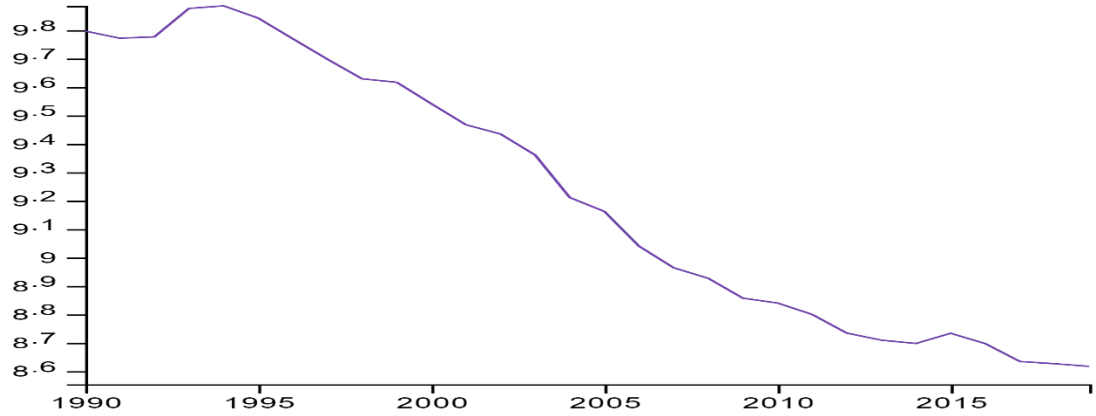

Figure 2. Global Deaths, rate per 100k.

BC-DALY

Table 3. The DALY and age-standardized DALY rate of breast cancer in 1990 and 2019 and its trends.

Characteristics	1990	2019	1990–2019
	Age-standardized DALY rate (per 100,000)	Age-standardized DALY rate (per 100,000)	Change in No.(%)
	No. (95% UI)	No. (95% UI)	
Overall	275.32 (263.24,288.77)	247.63 (228.68,266.08)	0.77 (0.62,0.89)
Sociodemographic index	–	–	–
Low	228.74 (192.19,266.75)	283.77 (248.24,323.37)	1.76 (1.26,2.32)
Low-middle	220.23 (193.29,247.91)	271.67 (235.41,309.31)	1.59 (1.14,2.11)
Middle	202.41 (188.65,218.93)	219.85 (197.35,243.15)	1.36 (1.07,1.65)
High-middle	286.35 (275.39,298.36)	230.43 (212.17,249.87)	0.44 (0.33,0.57)
High	377.54 (364.84,390.67)	252.68 (237.71,269.32)	0.1 (0.05,0.14)
Region	–	–	–
Central Europe	350.79 (340.79,360.44)	298.04 (257.73,344.01)	0.11 (-0.03,0.27)
Eastern Europe	335.31 (325.36,348.04)	303.9 (263.08,354.02)	0.06 (-0.07,0.22)
Western Europe	445.3 (430.56,459.14)	290.47 (272.68,311.07)	–0.04 (–0.09,0)
Albania	155.53 (143.02,169.01)	199.56 (145.58,271.4)	0.94 (0.41,164)

DALY, Disability-Adjusted Life Years

The highest age-standardized DALY rates of BC were observed in high SDI regions in 1990 (377.54) and in low SDI regions in 2019 (356.65). The lowest age-standardized DALY rates remained in the middle SDI quintile in this period (202.41 in 1990 and 219.85 in 2019) (Table 3). The largest number change in age-standardized DALY-s rate was in the low SDI quintile (1.76) while the lowest number change in age-standardized DALY rate was in the high SDI quintile (0.1).

As shown in Table 3, women in Eastern Europe had the highest DALYs in 2019 (303.9) compared with Central Europe (298.04) and Western Europe (290.47). The region with the largest number change in DALY rate of BC during 1990–2019 was Central Europe (0.11).
In addition, in Albania, the age-standardized DALY rate was 155.53 in 1990 and 199.56 in 2019 similar with the trends in low, low-middle and middle counties. The number change in BC incidence during 1990-2019 was 0.94.
The graph below shows the rate of DALY's over a 30-year period from 1990 to 2019. The values are given as rate per 100 000 people. If we look at this trend we can see that the global DALY's rate is noticeably decreased in this period.

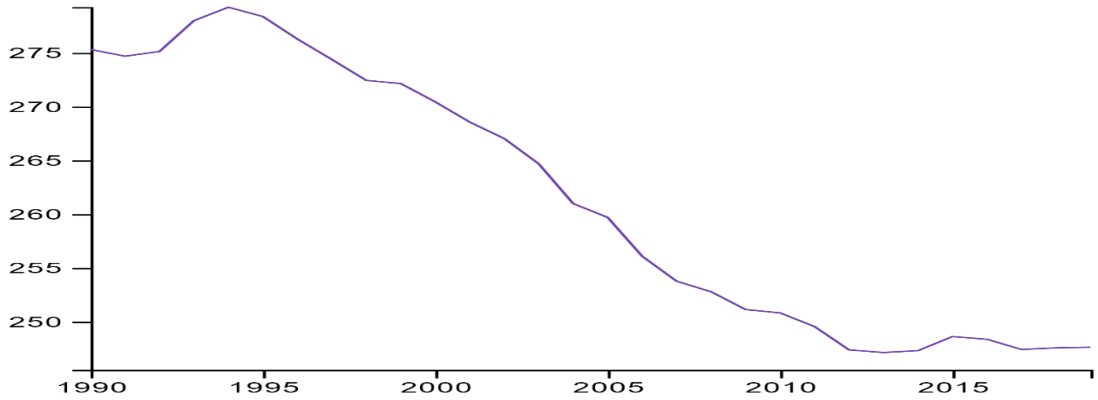

Figure 3. Global DALYs (Disability-Adjusted Life Years), rate per 100k.

From 1990 to 2019, the age-standardized incidence rate of BC showed an upward trend worldwide (EAPC, 0.13; 95% CI, 0.04–0.22), whereas the age-standardized death rate (EAPC, −0.12; 95% CI, −0.18 to −0.06) and age-standardized DALY rate (EAPC, −0.10; 95% CI, −0.17 to −0.03) presented a downward trend.

Table 4. EAPC of breast cancer from 1990 to 2019.

Age-standardized rate (1990-2019)	EAPC No. (95% CI)
Incidence	0.13 (0.04–0.22)
Deaths	–0.12 (–0.18–0.06)
DALYs (Disability-Adjusted Life Years)	–0.1 (–0.17–0.03)

EAPC, estimated annual percentage change

5. Discussion

Breast cancer represents a true global health challenge with considerable unmet medical need (Wilkinson L, Gathani T. 2022). There are a multitude of factors behind disparities in the global survival rates, including delays in diagnosis and lack of access to effective treatment. In this study, we analyzed the changing trends in BC incidence, deaths, and DALYs at global, regional, and local levels by age and SDI from 1990 to 2019 based on data from the GBD study 2019. Breast cancer incidence is highly correlated with human development (WHO). By comparing and contrasting these elements across diverse contexts, the research sheds light on the critical role of socioeconomic factors, including income levels, education, and cultural practices, in shaping the epidemiology of breast cancer. It emphasizes the importance of understanding these underlying determinants to address the disparities in disease incidence, treatment success, and patient well-being effectively. The human development index is a

composite measure of life expectancy, education and wealth and is a more useful comparator between countries than income alone (Dasic B, Devic Z, Denic N. 2020). Countries with the highest levels of human development have the highest incidences of breast cancer. Although the relative incidence of breast cancer is highest in the most developed regions of the world, much larger populations in less developed regions mean that over half of all breast cancer cases are diagnosed in low- and middle-income countries, creating a significant burden of disease (Wilkinson L, Gathani T. 2022). The observed global variations in the incidence of breast cancer need to be considered in the context of the known risk factors for the disease. Age is the most important risk factor and the highest age-specific incidence rates are observed in the oldest females. In less developed countries, by contrast, over half of breast cancer occurs in females under the age of 50. A younger population and a decade shorter life expectancy is the main driver of the average younger age at presentation in less developed countries (Heer E. 2020). As life expectancy increases alongside economic development in these regions, we can expect to see an increase in breast cancer incidence. Regarding to breast cancer deaths we can see that almost half of those deaths were recorded in less-developed regions. The observed survival advantage for patients diagnosed with breast cancer in more developed countries can be largely attributed to a combination of early detection strategies, access to early diagnosis and better access to effective treatments. By contrast, delayed presentation is more common in less developed regions of the world (Wilkinson L, Gathani T. 2022). The burden of breast cancer is not uniformly distributed, and neither should the solutions be. By undertaking detailed analyses of how breast cancer impacts various populations differently, health systems can move towards more personalized and equitable health care strategies. This approach not only helps in optimizing healthcare delivery but also ensures that advancements in breast cancer prevention, treatment, and care benefit all segments of society.

6. Conclusions

Despite worldwide decreases in the age-standardized death rate and age-standardized DALY rate of BC from 1990 to 2019, the values of these measures remained high during the study period in high-middle and middle SDI regions. In particular, Western Europe had the largest burden of BC, and globally, BC was more frequently reported in high-middle and high SDI regions. Future BC preventive strategies should therefore focus on addressing the global health challenge of breast cancer, aiming to improve survival rates globally through the three pillars of health promotion, timely presentation and diagnosis, and comprehensive treatment and supportive care (WHO). Furthermore, this article proposes targeted, evidence-based strategies to empower healthcare policymakers, practitioners, and communities to bridge gaps in care and outcomes, advocating for a more equitable global health system that improves breast cancer survivability and prognosis for all.

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