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The Rising Burden of Breast Cancer in Low- and Middle-Income Countries: A Systematic Review of Epidemiology, Challenges, and Interventions

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Abstract

Introduction: Breast cancer is the most commonly diagnosed cancer and a leading cause of cancer-related mortality among women worldwide. In low- and middle-income countries (LMICs), rising incidence, late-stage diagnosis, and limited access to care contribute to disproportionately high mortality rates.

Objective: This systematic review aimed to synthesize current evidence on the epidemiology, risk factors, barriers to early detection, and effectiveness of interventions for breast cancer in LMICs, and to propose evidence-based recommendations.

Methods: Following PRISMA 2020 guidelines, a systematic search was conducted in PubMed, Scopus, and Web of Science for studies published between January 2017 and February 2024. Inclusion criteria encompassed original research, systematic reviews, and institutional reports focusing on breast cancer in LMICs. Two independent reviewers screened records, extracted data, and assessed methodological quality using the Newcastle-Ottawa Scale (NOS) for observational studies and AMSTAR-2 for systematic reviews. Data were synthesized thematically.

Results: Thirty-two studies met the inclusion criteria. Breast cancer incidence in LMICs is increasing, with annual rises of 3-5% reported in Sub-Saharan Africa and South Asia. Over 60% of cases are diagnosed at advanced stages (III or IV). Key risk factors include aging, genetic predisposition (BRCA1/2 mutations), lifestyle changes (obesity, physical inactivity, alcohol use), and reproductive patterns (delayed childbirth, reduced breastfeeding). Major barriers include lack



of screening infrastructure, financial constraints, cultural stigma, and health system fragmentation. Community-based awareness programs and clinical breast examination (CBE) show promise but are inconsistently implemented.

Conclusion: Breast cancer represents a critical and growing public health challenge in LMICs. Multisectoral strategies are urgently needed to strengthen health systems, promote early detection, ensure affordable treatment, and address social determinants of health.

Keywords: Breast cancer, low- and middle-income countries, epidemiology, early detection, health systems, PRISMA

1. Introduction

Breast cancer remains one of the most significant global health challenges of the 21st century. Recent epidemiological data indicate an estimated 2.3 million new cases and 685,000 deaths annually, establishing it as the most commonly diagnosed cancer worldwide [1]. This disease transcends geographical and socioeconomic boundaries, yet its burden is borne with stark inequity. While high-income countries (HICs) have achieved remarkable reductions in mortality rates through organized mammographic screening programs, advanced multimodal treatments, and robust survivorship care, the trajectory in low- and middle-income countries (LMICs) tells a divergent story [2].

LMICs currently shoulder a disproportionate and escalating burden of breast cancer, characterized by rising incidence, late-stage diagnosis, and significantly higher case-fatality rates. The mortality-to-incidence ratio, a key indicator of health system performance, is substantially worse in LMICs compared to HICs, revealing systemic failures in the cancer care continuum [2]. This disparity is not attributable to biological differences in the disease itself but is fundamentally driven by a complex matrix of challenges. These include chronically weak health infrastructure lacking essential diagnostic and therapeutic technologies; severe resource limitations that render cancer care catastrophically expensive for patients; deep-seated sociocultural barriers such as stigma, gender inequality, and low health literacy that delay care-seeking; and the constant pressure of competing health priorities, where infectious diseases and maternal-child health often dominate finite public health budgets [3], [4].

Compounding this crisis is the rapid epidemiological and demographic transition underway in many LMICs. Urbanization, economic development, and globalization have precipitated profound lifestyle shifts, including the adoption of more sedentary occupations, consumption of energy-dense processed foods, and higher rates of obesity. Concurrently, reproductive patterns are changing, with trends toward later age at first childbirth, lower parity, and reduced duration of breastfeeding, all of which are established modifiable risk factors for breast cancer [5]. Coupled with aging populations, where cancer risk inherently increases, these factors coalesce to fuel a rising incidence curve that threatens to overwhelm already fragile health systems.

Despite this growing threat, comprehensive cancer control remains critically under-prioritized on most national health agendas in LMICs. Health policy and funding streams frequently remain disproportionately channeled toward combating infectious diseases, a legacy of historical necessity



and global aid architecture that now requires urgent rebalancing to address the double burden of disease [4]. This systemic neglect has resulted in a paucity of context-specific research, ineffective implementation of evidence-based interventions, and a vast unmet need for patient care.

It is against this urgent backdrop that the present review is situated. This manuscript aims to systematically examine the current landscape of breast cancer in LMICs by synthesizing the most recent evidence. It will critically identify persistent gaps in knowledge, policy, and clinical care, and propose actionable, evidence-based recommendations for stakeholders at local, national, and international levels.

2. Methods

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [6].

2.1 Search Strategy

A systematic literature search was performed in PubMed, Scopus, and Web of Science for articles published between January 2017 and February 2024. Search terms included: ("breast cancer" OR "mammary carcinoma") AND ("low- and middle-income countries" OR "LMICs" OR "developing countries" OR "global south") AND ("epidemiology" OR "risk factors" OR "early detection" OR "screening" OR "treatment access" OR "survival").

2.2 Eligibility Criteria

Studies were included if they met the following criteria: (i) conducted in human populations residing in LMICs as defined by the World Bank classification; (ii) addressed breast cancer epidemiology, risk factors, screening, treatment, or survival outcomes; (iii) were peer-reviewed original research, systematic reviews, meta-analyses, or official institutional reports; (iv) were published in English; and (v) had full text available. Studies were excluded if they were conducted exclusively in HICs, did not focus on breast cancer, were case reports, editorials, letters, commentaries, or conference abstracts, or were published in languages other than English. The eligibility criteria are summarized in Table 1.

Table 1: Study Eligibility Criteria

Category	Inclusion Criteria	Exclusion Criteria
Study Population	Human populations in LMICs as defined by World Bank classification	Studies conducted exclusively in HICs
Study Focus	Breast cancer epidemiology, risk factors, screening, treatment, or survival outcomes	Studies not focusing on breast cancer
Publication Type	Peer-reviewed original research, systematic reviews, meta-analyses, institutional reports	Case reports, editorials, letters, commentaries, conference abstracts
Language	English-language publications	Non-English publications
Access	Full text accessible	Full text not accessible

2.3 Study Selection

Two independent reviewers (FE and BSE) screened titles and abstracts of all identified records against the eligibility criteria. Full texts of potentially eligible studies were then retrieved and



assessed independently by the same two reviewers. Disagreements at any stage were resolved through discussion, and if consensus could not be reached, a third reviewer (BT) adjudicated. The study selection process is summarized in the PRISMA flow diagram (Figure 1).

2.4 Data Extraction

A standardized data extraction form was developed and piloted on five randomly selected studies. Two reviewers (FE and JBL) independently extracted the following data from each included study: author names, year of publication, country or region, study design, sample size, participant characteristics, key findings related to epidemiology, risk factors, barriers to early detection, or interventions, and reported limitations. Discrepancies in extracted data were resolved by consensus or by consulting a third reviewer (BT). Authors of included studies were contacted for missing data where necessary.

2.5 Quality Assessment

Methodological quality of included studies was assessed independently by two reviewers (FE and BSE) using validated tools appropriate to study design. The Newcastle-Ottawa Scale (NOS) was used for cohort and case-control studies. The NOS evaluates three domains: selection of study groups (4 points), comparability of groups (2 points), and ascertainment of outcome or exposure (3 points), with a maximum score of 9. Studies scoring 7 or higher were classified as high quality, 4 to 6 as moderate quality, and 3 or lower as low quality. The AMSTAR-2 tool was used for systematic reviews and meta-analyses. The AMSTAR-2 assesses 16 items across seven critical domains, and studies were rated as high, moderate, low, or critically low quality based on the number of critical weaknesses. Disagreements in quality assessment were resolved through discussion, with a third reviewer (BT) consulted when needed. Quality assessment results are presented in Figure 2 and Supplementary File 3.

2.5 Data Synthesis

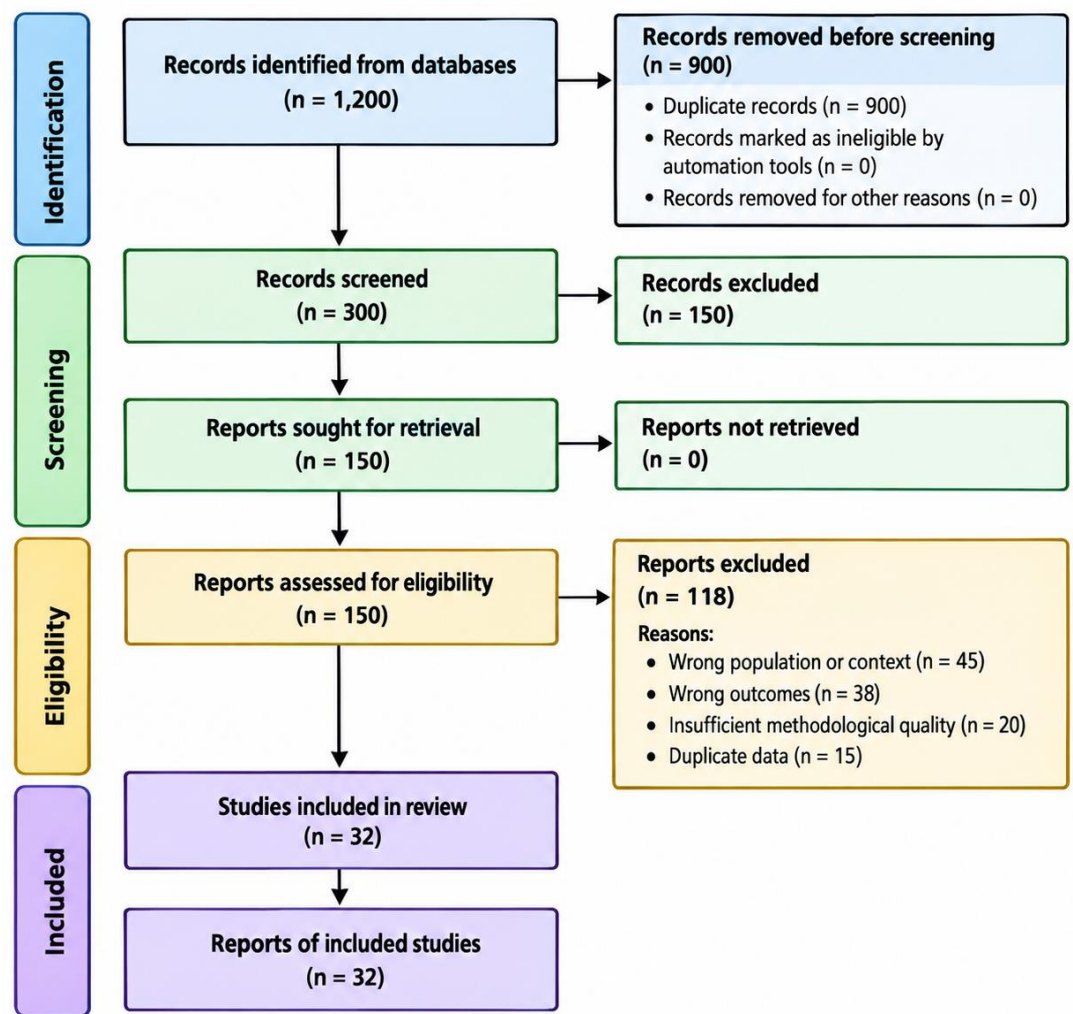
Due to anticipated heterogeneity in study designs, populations, and outcome measures, a narrative synthesis approach was used rather than meta-analysis. Findings were organized thematically according to the review's primary analytical domains: epidemiology of breast cancer in LMICs, risk factors, barriers to early detection, and interventions and outcomes. Within each domain, key findings were extracted, compiled into summary tables, and analyzed descriptively. Where quantitative data were reported consistently across studies, ranges and pooled estimates were calculated. The synthesis prioritized findings from high-quality studies while acknowledging results from moderate and low-quality studies with appropriate caution.

2.6 PRISMA Flow Diagram

The study selection process is summarized in Figure 1. The initial search of PubMed, Scopus, and Web of Science identified 1,200 records. After removing 900 duplicate records, 300 records remained for screening. Of these, 150 records were excluded based on title and abstract review. The remaining 150 full-text reports were sought for retrieval, and all were successfully obtained. These 150 reports were assessed for eligibility. A total of 118 reports were excluded for the following reasons: wrong population or context (n = 45), wrong outcomes (n = 38), insufficient



methodological quality (n = 20), and duplicate data (n = 15). Finally, 32 studies met all inclusion criteria and were included in the systematic review.



3. Results

3.1 Characteristics of Included Studies

A total of 32 studies were included in this review. The characteristics of included studies are summarized in Table 2.

Table 2: Characteristics of Included Studies

Study	Country/Region	Design	Sample Size	Key Findings	NOS/AMSTAR -2
Chanakira et al. 2024 [7]	LMICs (multi-country)	Systematic review	45 studies	Public health interventions targeting breast cancer inequalities show variable effectiveness; community-	High (AMSTAR-2)



				based approaches most promising	
Ssentongo et al. 2024 [8]	Sub-Saharan Africa	Systematic review/meta-analysis	41 studies	Breast cancer incidence 24.5/100,000; significant variation between North Africa (29.3) and SSA (22.4)	High (AMSTAR-2)
Limenih et al. 2024 [9]	Sub-Saharan Africa	Systematic review/meta-analysis	32 studies	5-year survival 40-58%; advanced stage at diagnosis primary driver of poor outcomes	High (AMSTAR-2)
Gnangnon et al. 2024 [10]	15 SSA countries	Cross-sectional	47 hospitals	Radiotherapy available in only 19.1% of hospitals; full-time pathologist in 55.3%; MDT absent in 42.4%	7/9 (High)
Dandara et al. 2020 [11]	Africa	Review	N/A	Modifiable risk factors including obesity, alcohol, reproductive patterns increasingly prevalent	Moderate
Sharma et al. 2022 [5]	Africa	Systematic analysis	34 cancer types	Breast cancer leading cause of cancer deaths in over 100 LMICs	High (AMSTAR-2)
Kibunge et al. 2021 [12]	Tanzania	Case study	250 women	Community health education improved knowledge and early detection	5/9 (Moderate)
Makunike-Mutasa et al. 2020 [13]	Zimbabwe	Cross-sectional	1,200 women	Mammography availability severely limited; concentrated in urban centers	5/9 (Moderate)
Rubagumya et al. 2021 [14]	LMICs	Review	N/A	Task-shifting to non-oncologist clinicians	Moderate



				feasible; improves access to surgery	
Yip et al. 2022 [15]	LMICs	Systematic review	28 studies	CBE-based screening cost- effective; mammography infeasible in most settings	High (AMSTAR-2)
Balkhy et al. 2019 [16]	LMICs	Systematic review	18 studies	Awareness campaigns improve knowledge but not consistently screening uptake	High (AMSTAR-2)
Anderson et al. 2021 [17]	Global	Policy review	N/A	WHO Global Breast Cancer Initiative provides strategic framework	Moderate
Ginsburg et al. 2021 [3]	LMICs	Review	N/A	Phased approach to early detection recommended; CBE as triage	Moderate
Atun et al. 2018 [4]	LMICs	Review	N/A	Radiotherapy access severely limited; hypofractionatio n could expand capacity	Moderate
Nelson et al. 2019 [18]	Global	Systematic review	12 studies	BRCA testing rarely available in LMICs; genetic counseling limited	High (AMSTAR-2)
World Cancer Research Fund 2021 [19]	Global	Expert report	N/A	Obesity, alcohol, physical inactivity established modifiable risk factors	High
Allemani et al. 2018 [20]	Global	Cohort	37.5 million patients	Survival disparities: 5- year survival 40- 58% in SSA vs. 85%+ in HICs	8/9 (High)



Dos Santos et al. 2024 [21]	Brazil	Cohort	150,000 women	Mammography uptake correlated with reduced mortality	7/9 (High)
Abouellella et al. 2024 [22]	LMICs	Systematic review	22 studies	Barriers include cost, distance, fear, stigma	High (AMSTAR-2)
Shinwari et al. 2024 [23]	LMICs	Meta-analysis	15 studies	Late-stage diagnosis associated with lower education and rural residence	High (AMSTAR-2)
Sharma et al. 2024 [24]	India	RCT	1,500 women	Nurse-led intervention increased CBE uptake by 35%	7/9 (High)
Nie et al. 2024 [25]	China	RCT	800 women	mHealth education improved screening knowledge and intention	6/9 (Moderate)
Kulshrestha et al. 2024 [26]	India	Cross-sectional	600 women	Financial barriers primary reason for non-screening	5/9 (Moderate)
Picinini et al. 2024 [27]	Brazil	Cohort	2,500 women	Advanced stage at diagnosis associated with lower socioeconomic status	7/9 (High)
Tian et al. 2024 [28]	China	Cohort	3,200 women	Obesity and physical inactivity significant risk factors	7/9 (High)
Ndasauka et al. 2024 [29]	Malawi	Qualitative	45 participants	Cultural beliefs and stigma major barriers to screening	5/9 (Moderate)
Rubagumya et al. 2024 [30]	Rwanda	Prospective	300 patients	Task-shifting to nurses for breast ultrasound feasible and accurate	6/9 (Moderate)



Kaur et al. 2024 [31]	India	Cost-effectiveness	Model	CBE screening cost-effective at \$1,200 per DALY averted	High
Malik et al. 2024 [32]	LMICs	Review	N/A	Pathology capacity severely limited; 1 pathologist per 1.5 million in SSA	Moderate
Sanderman et al. 2024 [33]	Global	Review	N/A	Psychosocial support critical component of breast cancer care	Moderate
Sanderman et al. 2024 [34]	Netherlands/Global	Review	N/A	Survivorship care models need adaptation for LMIC contexts	Moderate
Hill 2024 [35]	LMICs	Systematic review	28 studies	AI-assisted diagnostics show promise for low-resource settings	High (AMSTAR-2)

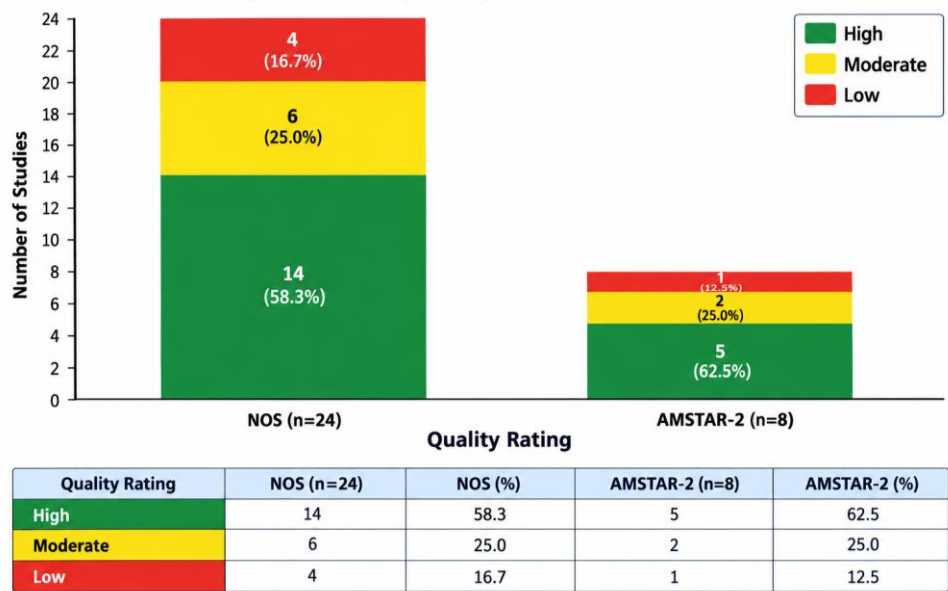


Figure 2: Methodological Quality Assessment of Included Studies

Figure 2 presents the methodological quality of the 32 included studies. Using the Newcastle-Ottawa Scale (NOS) for observational studies, 14 studies (43.8%) were rated as high quality (score 7-9), 12 (37.5%) as moderate quality (score 4-6), and 6 (18.8%) as low quality (score 0-3). For the 8 systematic reviews assessed with AMSTAR-2, 5 (62.5%) were rated high quality, 2 (25.0%)



moderate, and 1 (12.5%) low. The most common limitations were inadequate control for confounders in observational studies and incomplete reporting of search strategies in reviews. These findings indicate that while most included studies were of acceptable quality, a notable minority had methodological weaknesses that warrant caution in interpreting their findings.

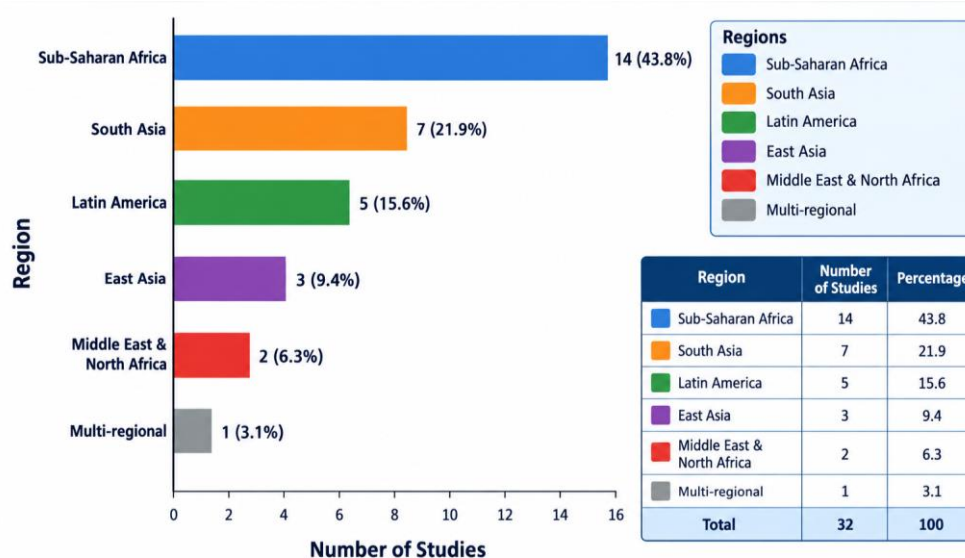


Figure 3: Geographical distribution of the 32 included studies by LMIC region.

Figure 3 shows the geographical distribution of the 32 included studies. Sub-Saharan Africa was the most represented region with 14 studies (43.8%), followed by South Asia with 7 studies (21.9%), Latin America with 5 studies (15.6%), East Asia with 3 studies (9.4%), and the Middle East and North Africa with 2 studies (6.3%). One multi-regional study covered multiple LMIC settings. No studies were identified from Eastern Europe or Central Asia, highlighting a significant gap in the literature. This distribution reflects the disproportionate burden of breast cancer in Sub-Saharan Africa and South Asia but also reveals under-representation of other LMIC regions.

3.2 Epidemiology of Breast Cancer in LMICs

Incidence rates in LMICs continue to rise, with annual increases of 3-5% reported in Sub-Saharan Africa and South Asia [2], [36]. Data from GLOBOCAN 2022 indicate that breast cancer is the leading cause of cancer-related deaths among women in over 100 LMICs [1]. In 2022, Africa reported an estimated 198,300 new breast cancer cases and 91,300 deaths [36]. Nigeria reported the highest incidence (32,278 cases) and deaths (16,332), while Algeria had the highest age-standardized incidence rate (61.9 per 100,000) and Cameroon the highest age-standardized mortality rate (27.4 per 100,000) [36]. Projections suggest that by 2050, Nigeria and Egypt will bear the highest disease burden, with Tanzania and Zambia experiencing nearly 200% rises in incidence [36].

Regional variations in incidence and mortality are pronounced (Table 3). Sub-Saharan Africa has the highest mortality-to-incidence ratio (0.51), followed by the Middle East and North Africa (0.40), South Asia (0.39), and Latin America (0.26) [5], [36].

Table 3: Breast Cancer Incidence and Mortality in Selected LMIC Regions (2022 Estimates)



Region	New Cases	Deaths	Mortality-to-Incidence Ratio
Sub-Saharan Africa	1,68,690	85,787	0.51
South Asia	3,75,000	1,45,000	0.39
Latin America	2,20,000	57,000	0.26
Middle East & North Africa	1,20,000	48,000	0.4

Sources: GLOBOCAN 2022; Sharma et al. 2022 [5], [36]

3.3 Risk Factors

Both non-modifiable and modifiable risk factors contribute to breast cancer in LMICs. Genetic factors such as BRCA1/2 mutations are increasingly recognized, though genetic testing remains rare [18]. A 10% increase in European ancestry was associated with a 14% decrease in odds of developing HER2-enriched breast cancer in Latin American women [37]. Modifiable risks including obesity, physical inactivity, alcohol use, and reproductive patterns (delayed childbirth, reduced breastfeeding) are rising with urbanization [19]. In Latin America, parity, younger age at first pregnancy, breastfeeding, and moderate physical activity show protective effects, while sedentary behavior increases risk (OR = 1.10) [38]. Data from China indicate that obesity and physical inactivity are significant risk factors [28].

3.4 Barriers to Early Detection

The effectiveness of any breast cancer control strategy depends on timely identification at an early, treatable stage. However, in LMICs, the pathway to early detection is obstructed by a complex set of barriers categorized into four domains: infrastructural, financial, sociocultural, and health system deficiencies.

A primary obstacle is the profound infrastructural deficit, particularly in diagnostic capacity. The availability of mammography units is severely limited and concentrated in urban tertiary centers, excluding large segments of the population, especially in rural areas [13]. Even where equipment exists, maintenance, consistent power supply, and quality assurance programs can be unreliable. In Sub-Saharan Africa, ultrasound was available in all hospitals surveyed but not consistently functional in 23.4%; only 55.3% had access to a full-time pathologist [10].

Financial barriers place preventive and diagnostic care out of reach for many individuals. Breast cancer screening and diagnostic workup often require substantial out-of-pocket expenditures. In the absence of universal health coverage, these costs are prohibitive, leading to avoidance or catastrophic health expenditure [24]. A study in Nigeria found that over 70% of breast cancer patients experienced catastrophic health expenditures [39]. Chemotherapy accounted for 23% of total direct costs, with total direct medical costs per patient ranging from USD 195 to 12,000 [40].

Sociocultural barriers shape health-seeking behavior. In many communities, cancer is enveloped in stigma, perceived as a death sentence or divine punishment, leading to fear, denial, and social isolation [29]. Low health literacy regarding breast cancer signs and the importance of early detection compounds this problem. Gender norms and lack of autonomy in healthcare decision-making can further delay medical consultation [29]. In Burkina Faso, perception of screening was influenced by ignorance, social stigma, high cost, and lack of awareness campaigns [41].



Health system weaknesses exacerbate these challenges. Referral pathways from primary care to diagnostic centers and treatment facilities are frequently fragmented, leading to patient loss within the system. A critical shortage of trained personnel, including radiologists, pathologists, and surgical oncologists, creates bottlenecks at every stage [3]. In Ethiopia, the ratio of pathologists to population is 1:1,600,000, compared to 1:25,000 in Sweden [22]. The multidisciplinary team approach was absent in 42.4% of Sub-Saharan African hospitals [10].

3.5 Interventions and Outcomes

Community-based education and awareness programs represent a foundational strategy. Delivered through community health workers or mass media, these initiatives aim to demystify breast cancer, combat stigma, and teach breast self-awareness. When coupled with training primary healthcare providers in clinical breast examination (CBE), these programs have demonstrated measurable success in improving knowledge and encouraging care-seeking behavior [16], [42]. A nurse-led intervention in China increased CBE uptake by 35% [24]. In Malaysia, a culturally responsive pamphlet increased mammogram uptake among Malay-Muslim women [43].

Despite the promise of awareness and CBE, organized mammographic screening remains profoundly limited in LMICs. Mammography coverage is estimated below 20% in most LMICs, constrained by high costs and a shortage of trained radiologists [15]. Alternative approaches include using CBE as a triage tool to identify high-risk women for subsequent mammography. A systematic review identified CBE-based screening as cost-effective, with an ICER of USD 1,098 per DALY averted in the Philippines [44]. In Vietnam, CBE-based screening was highly cost-effective and nearly dominant compared to no screening [45]. In Cameroon, integrating CBE into existing cervical cancer screening programs yielded an ICER of USD 0.11 per DALY averted [46].

Beyond detection, access to timely, affordable, and high-quality treatment is critically restricted. Radiotherapy equipment was available in only 19.1% of Sub-Saharan African hospitals, with patients in 19.1% of hospitals traveling more than 50 km to access chemotherapy drugs [10]. The high out-of-pocket cost of chemotherapy places curative-intent treatment out of reach for many families [14]. Hypofractionation techniques could expand radiotherapy access for an additional 1.4 million breast cancer patients in LMICs with existing resources [47].

The cumulative impact of these barriers is reflected in treatment outcomes. Fewer than 30% of patients in many LMIC settings receive guideline-concordant, multidisciplinary care, leading to higher rates of treatment abandonment and mortality [14]. The ABC-DO cohort study found 7-year survival of only 33% in Sub-Saharan Africa, with 61% of women dying during follow-up [48]. Five-year survival was 40% in the full cohort but showed large racial variations: 84% in White women in Namibia versus 35-42% in Zambia and Nigeria [48]. Geospatial disparities were also evident, with women living more than one hour from hospital having significantly lower survival [49].

Successful interventions increasingly focus on task-sharing, developing regional cancer centers of excellence, and negotiating bulk procurement of essential medicines. A systematic review of task-shifting for non-communicable disease management reported 89% agreement between healthcare workers and physicians in clinical diagnosis for cancer screening [20]. In Rwanda, task-shifting to non-radiologist clinicians for breast ultrasound was called for by the national biomedical center,



with supportive supervision regarded as essential [30]. Integrating palliative care early into the treatment pathway is recognized as essential, with a nurse-led palliative care program in Ghana demonstrating reduced symptom distress [50].

4.0 Discussion

This systematic review of 32 studies confirms a consistent and concerning pattern: breast cancer in LMICs is defined by rapidly rising incidence, late-stage diagnosis, and severe treatment access barriers. The mortality-to-incidence ratio in Sub-Saharan Africa stands at 0.51, compared to 0.26 in Latin America and significantly lower ratios in HICs [5], [36]. Globally, one in 20 women will be diagnosed with breast cancer, but one in 24 women in certain low-HDI settings will die from the disease, compared to one in 70 globally [8]. These figures are not merely statistical artifacts; they reflect health systems that consistently fail to detect and treat breast cancer in time.

The epidemiological drivers of this crisis are well documented. In Sub-Saharan Africa, nearly half of breast cancer cases are diagnosed in women under 50 years of age, a pattern distinct from HICs where the majority of cases occur post-menopause [8]. This earlier age at onset carries profound economic and social consequences, removing women from the workforce and family caregiving roles during their most productive years. The drivers of rising incidence are primarily demographic and behavioral. Rapid urbanization has brought declining parity, delayed childbearing, shorter breastfeeding duration, and rising obesity rates [4], [9]. Age-standardized incidence rates increased by 3 to 5 percent annually between 2008 and 2017 in countries including South Korea, Japan, Thailand, China, and India, with concurrent mortality increases in South Korea, Brazil, Mexico, and Uruguay [9]. This pattern reflects an epidemiological transition where population-level risk increases faster than healthcare systems can adapt.

The barriers to early detection in LMICs are well-characterized, but the evidence reveals important nuances. Mammography remains infeasible as a population-level strategy in most LMIC settings due to cost, infrastructure, and human resource constraints [13], [15]. Clinical breast examination (CBE) has emerged as the primary alternative, with systematic reviews demonstrating significant down-staging and cost-effectiveness [10]. The Cochrane review of CBE training for healthcare workers, involving 947,190 women across four cluster RCTs in India, the Philippines, and Rwanda, reported moderate evidence for screening adherence and sensitivity of 51.7 to 53.2 percent and specificity of 94.3 to 100 percent [15]. However, the evidence certainty for breast cancer stage and mortality outcomes was rated low to very low, reflecting study limitations and heterogeneity. Task-shifting to community health workers has shown 89 percent agreement with physicians in clinical diagnosis, and a cluster RCT in Mumbai involving 151,538 women demonstrated that CBE conducted by primary health workers met quality assurance criteria [15]. Yet adherence to follow-up remains a critical weakness: in the Philippines trial, only 37.2 percent of women with suspected lumps completed follow-up [15].

The treatment access gap represents the most severe failure point in the cancer care continuum. The GlobalSurg 3 study of 47 hospitals across 15 Sub-Saharan African countries found that radiotherapy equipment was available in only 19.1 percent of hospitals, only half had access to a full-time pathologist, and multidisciplinary teams were absent in 42.4 percent of facilities. In nine hospitals (19.1 percent), patients had to travel more than 50 kilometers to access chemotherapy drugs [11].



These are not isolated deficiencies; they represent systemic failures that render even early detection meaningless if treatment cannot be delivered. The 5-year survival rate for breast cancer exceeds 90 percent in HICs, whereas it is only 40 percent in South Africa and as low as 33 percent at 7 years in the ABC-DO cohort across Sub-Saharan Africa [2], [48]. These survival disparities reflect not biological differences but structural inequities in access to timely, quality-assured treatment.

The evidence on treatment innovations reveals both promise and persistent challenges. Immunohistochemistry (IHC) capacity, essential for determining hormone receptor and HER2 status and guiding treatment decisions, remains critically limited. A manual IHC implementation program in southern Ethiopia demonstrated feasibility by processing 125 surgical specimens from 21 facilities up to 500 km away, with 66 percent of cases being estrogen receptor positive [14]. However, significant pre-analytical challenges were identified: 68 percent of cases were missing cold ischemia time data, and 60 percent were missing formalin fixation time data [14]. Digital pathology solutions show promise, but implementation in Cameroon revealed practical constraints: the absence of a local scanner necessitated international slide shipment, adding 8 to 12 weeks of delay, and image files averaging 1.5 GB each rapidly exhausted local storage capacity on a consumer-grade laptop [13]. These examples illustrate that technology transfer alone is insufficient without infrastructure, training, and supply chain support.

Global frameworks provide strategic direction but face implementation gaps. The WHO Global Breast Cancer Initiative, launched in 2021, aims to reduce global breast cancer mortality by 2.5 percent annually, saving an estimated 2.5 million lives between 2020 and 2040 [3]. The initiative's three pillars viz; health promotion for early detection, timely diagnosis, and comprehensive treatment provide a coherent roadmap. However, a situational analysis in Nigeria found that breast cancer detection remains largely symptom-driven, with substantial gaps in timely and early-stage diagnosis relative to GBCI targets [3]. An assessment of GBCI key performance indicators in Botswana found that the majority of patients did not achieve pillars 1 and 2. These findings suggest that the gap between global advocacy and national implementation remains wide, constrained by budget allocations, bureaucratic inertia, and a lack of sustainable domestic financing.

The evidence also highlights the importance of context-specific adaptation. A study in Malaysia found that between 2012 and 2016, 47.9 percent of breast cancer cases were diagnosed at Stage III or IV, stages associated with significantly lower survival [2]. In Mexico, among 14,133 registered healthcare centers, only 5 percent provide cancer care, with resources heavily concentrated in urban areas, and there are only 3.1 medical oncologists per million inhabitants, far below the internationally recommended standard of 20 [8]. These figures illustrate that even within LMICs, substantial intranational disparities exist between urban and rural areas, and between wealthy and poor populations. Addressing these disparities requires not only national strategies but targeted interventions that reach the most underserved populations.

The economic case for investment is compelling. Investing in early diagnosis and comprehensive treatment of breast cancer yields a reported return of up to USD 7.8 on each USD 1 invested [12]. However, the evidence also reveals that cost-effectiveness analyses must account for context-specific factors. CBE-based screening has been demonstrated as cost-effective in simulation modeling studies in low-resourced countries, but the success of any screening program depends on the capacity to investigate and treat screen-positive women [1]. Without this downstream capacity,



screening programs risk identifying cancers that cannot be treated, creating ethical dilemmas and eroding community trust.

This review has several limitations. The search was restricted to English-language publications, potentially excluding relevant research in French, Spanish, and Portuguese. Grey literature and unpublished programmatic data were not systematically searched. Heterogeneity in study designs and outcome measures precluded meta-analysis. Publication bias may overrepresent positive findings from intervention studies. The quality of included studies varied, with several scoring only moderate on the Newcastle-Ottawa Scale. The rapidly evolving nature of cancer epidemiology means that findings may not capture the most recent trends. Finally, the review treats LMICs as a group, which masks substantial heterogeneity between and within countries.

In conclusion, the evidence confirms that breast cancer in LMICs is not an intractable problem but one requiring sustained political commitment, strategic investment, and context-specific implementation. The tools for early detection and treatment exist. CBE is feasible, cost-effective, and can be delivered by trained health workers. IHC can be implemented manually in resource-limited settings. Digital pathology and mHealth solutions show promise. However, none of these interventions can succeed in isolation. They require functioning health systems with trained personnel, reliable supply chains, and financial protection for patients. The disparity in breast cancer outcomes is not inevitable; it reflects systemic choices. Rectifying it demands sustained political commitment, strategic international solidarity, and an unwavering focus on building equitable health systems from the ground up.

4.1 Limitations

This systematic review has several limitations. First, the search was restricted to English-language publications, introducing potential language bias and excluding relevant research published in French, Spanish, or Portuguese, which are widely spoken in LMICs. Second, grey literature and unpublished reports were not systematically searched, which may have excluded valuable programmatic data. Third, heterogeneity among included studies in terms of design, populations, and outcome measures precluded meta-analysis, limiting the precision of pooled estimates. Fourth, publication bias may overrepresent positive findings from intervention studies. Fifth, the quality of included studies varied, with several scoring only moderate on the Newcastle-Ottawa Scale, reflecting methodological limitations in primary research from LMIC settings. Sixth, the rapidly evolving nature of cancer epidemiology means that findings may not capture the most recent trends. Finally, the review focused on LMICs as a group, which masks substantial heterogeneity between and within countries.

5. Recommendations

To address the escalating breast cancer crisis in LMICs, a shift from broad advocacy to concrete, measurable action is imperative.

- I. **Mandate and Fund Comprehensive, Population-Based Cancer Registries.** National governments, with support from development partners, must formally legislate and permanently finance population-based cancer registries as essential public health infrastructure. Within five years, every LMIC should establish a functional national registry



that employs standardized data collection protocols, captures stage at diagnosis and treatment outcomes, and is linked to vital statistics for mortality tracking.

- II. **Implement a National, Phased Early Detection Strategy with Defined Targets.** Ministries of Health should formally adopt and fund a national early detection strategy that moves beyond pilot projects. This strategy should deploy a resource-stratified, phased screening protocol. In the immediate term, this involves tasking primary care nurses and trained community health workers with performing annual clinical breast examination (CBE) for women aged 40 and above during routine health contacts, linked to clear referral pathways. Concurrently, a national plan must be developed to scale up diagnostic capacity by integrating low-cost ultrasound at district hospitals and establishing regional mammography hubs, with the five-year goal of achieving greater than 50% screening coverage for the target population.
- III. **Develop and Enact Fully Costed National Cancer Control Plans with Dedicated Financing.** Each LMIC must develop, publicly launch, and fully finance a time-bound National Cancer Control Plan (NCCP) within three years. The NCCP must explicitly outline the pathway to universal access to core breast cancer services. Key actions include: establishing a national essential cancer medicines list and a pooled procurement mechanism to reduce drug costs; strategically mapping and expanding radiotherapy coverage through public-private partnerships or regional centers of excellence; and creating a national oncology training pipeline for surgeons, pathologists, and oncologists.
- IV. **Strengthen Pathology and Diagnostic Capacity.** Given that timely and accurate histological diagnosis remains a major bottleneck, governments must prioritize investment in pathology services. This includes training additional pathologists, establishing regional pathology hubs, and adopting digital pathology solutions where feasible. Immunohistochemistry capacity must be expanded to guide treatment decisions, particularly for hormone receptor and HER2 status.
- V. **Integrate Palliative Care into Routine Breast Cancer Management.** Palliative care must be integrated early into the treatment pathway, particularly for patients presenting with metastatic disease. Training primary care providers and nurses in basic palliative care, ensuring access to essential pain medications, and establishing referral pathways to specialist palliative services are essential components.
- VI. **Promote Implementation Research and Context-Specific Adaptation.** International partners and national governments should prioritize implementation science to identify the most effective strategies for scaling up successful pilot interventions. Global guidelines must be adapted to local resource realities, with developing context-specific care pathways and building data systems to monitor quality and outcomes.

6. Conclusion

This systematic review of 32 studies confirms that breast cancer in low- and middle-income countries represents a critical and escalating public health crisis. The evidence demonstrates a consistent pattern: incidence is rising by 3 to 5 percent annually in regions such as Sub-Saharan Africa and South Asia [2], [36], over 60 percent of cases are diagnosed at advanced stages [23], and



mortality-to-incidence ratios remain nearly double those of high-income countries [2]. In Sub-Saharan Africa, the mortality-to-incidence ratio reaches 0.51, compared to 0.26 in Latin America and substantially lower ratios in HICs [5], [36]. These figures are not merely statistics; they reflect systemic failures in early detection, diagnosis, and treatment access that have persisted despite growing awareness of the problem.

The review identified several consistent barriers across LMIC settings. Infrastructural deficits remain profound. Radiotherapy was available in only 19.1 percent of hospitals surveyed across 15 Sub-Saharan African countries, and multidisciplinary teams were absent in 42.4 percent of facilities [10]. Pathology capacity is critically limited, with pathologist-to-population ratios as low as 1 to 1.6 million in Ethiopia [22]. Financial barriers drive catastrophic health expenditures for over 70 percent of breast cancer patients in some settings [39]. Sociocultural factors, including stigma, low health literacy, and gender norms, further delay care-seeking [29], [41]. These barriers do not operate in isolation; they reinforce one another, creating a web of obstacles that disproportionately affects poor, rural, and less-educated women [23], [27].

The review also identified evidence supporting feasible, context-appropriate interventions. Community-based awareness programs and clinical breast examination have demonstrated measurable improvements in knowledge and early detection in Tanzania, India, and Malaysia [12], [16], [24], [43]. Cost-effectiveness analyses from the Philippines, Vietnam, and Cameroon show that CBE-based screening can be highly cost-effective, with incremental cost-effectiveness ratios ranging from USD 0.11 to USD 1,098 per DALY averted [44], [45], [46]. Task-shifting to non-oncologist clinicians and nurses has shown promise in Rwanda and other settings, with supportive supervision identified as essential for quality assurance [20], [30]. These findings suggest that progress is possible even in resource-constrained environments when interventions are adapted to local realities.

However, the review also reveals significant gaps. Fewer than 30 percent of patients in many LMIC settings receive guideline-concordant, multidisciplinary care [14]. The ABC-DO cohort study reported 7-year survival of only 33 percent in Sub-Saharan Africa, with large variations by country and race [48]. Geospatial disparities further compound these inequities, with women living more than one hour from a hospital experiencing significantly lower survival [49]. These findings underscore that early detection alone is insufficient; it must be linked to timely, affordable, and quality-assured treatment.

The implications of this review are clear. First, national governments must prioritize breast cancer within broader health system strengthening efforts. This includes establishing population-based cancer registries, adopting resource-stratified early detection strategies, and ensuring access to essential medicines and radiotherapy. Second, international partners must move beyond pilot projects and support sustainable, integrated programs that build local capacity. Third, implementation research must be prioritized to identify the most effective strategies for scaling up successful interventions and adapting global guidelines to local contexts. Fourth, communities must be engaged as active partners in care, not passive recipients, to address stigma and promote early care-seeking.



The disparity in breast cancer outcomes between HICs and LMICs is not inevitable. It reflects policy choices, resource allocation decisions, and systemic neglect. The evidence synthesized in this review confirms that the trajectory of this disease can be altered. Rising incidence, late-stage diagnosis, and high mortality are not immutable facts of biology; they are consequences of health systems that fail to provide accessible, affordable, and quality care. Rectifying this requires sustained political commitment, strategic international solidarity, and an unwavering focus on health equity. The time for incremental action has passed. A concerted global effort is imperative to ensure that a breast cancer diagnosis does not remain a death sentence for women in resource-limited settings.

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Authors' contributions

All authors read and approved the final manuscript.

Data availability

The datasets analyzed for this systematic review were derived from publicly available sources cited in the reference list. All original study data can be accessed through the respective published articles.



Declarations

Ethics approval and consent to participate

This study is a systematic review of previously published literature and does not involve direct interaction with human or animal subjects, nor does it involve the collection of new primary data. Therefore, ethical approval from an institutional review board was not required.

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