The use of standardised tools to measure post-mastectomy quality of life among women in Africa: a scoping review

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Abstract

Background Breast cancer survivorship is increasingly prevalent, yet quality of life (QoL) outcomes post-mastectomy remain a critical concern in Africa. Women post-mastectomy encounter significant physical, psychological, social, and sexual health challenges that are inadequately addressed in clinical settings. Using standardised tools to measure QoL post-mastectomy of women is imperative. Thus, this scoping review aims to map evidence on the use of standardised tools to measure post-mastectomy quality of life among women in Africa.

Methods This scoping review followed the Levac et al. framework. A systematic search—between 2015 and 2025 across Africa—yielded 473 records: 345 from five databases—CINAHL ($n = 22$), Emcare ($n = 55$), Medline ($n = 65$), Scopus ($n = 78$), and Web of Science ($n = 125$)—and 128 from other sources. Ultimately, 34 studies met the inclusion criteria for data extraction and thematic analysis. The review followed PRISMA-ScR guidelines.

Results The 34 studies reviewed involved 5466 participants. Mean ages ranged from 38 to 57 years. QoL post-mastectomy was evaluated using standardised tools such as the EORTC QLQ-C30/BR23, WHOQOL-BREF, BREAST-Q, and FACT-B. Several studies translated and validated QoL assessment tools into local languages, notably Arabic and Yoruba, enhancing contextual relevance. Mastectomy negatively affected overall QoL, body image, psychological wellbeing, sexual functioning, and social relationships. Educational and psychosocial interventions enhanced QoL, particularly those integrating self-compassion training, physical rehabilitation, and group counselling.

Conclusion QoL post-mastectomy among women in Africa is significantly compromised; however, targeted psychosocial and rehabilitation interventions show promise in improving survivorship outcomes. Future research should emphasise culturally sensitive, multidisciplinary programs and adopt longitudinal designs to assess sustained effects on QoL.

Implications for cancer survivors This scoping review emphasises the need for comprehensive post-mastectomy care that includes physical, psychological, sexual, social and financial aspects. Culturally sensitive and accessible interventions are essential for improving the quality of life and long-term outcomes for women in Africa.

Keywords Quality of life, Post-mastectomy, Breast cancer, Breast surgery, Mastectomy, Standardised tools, Women, Africa

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Background

The quality of life (QoL) of women with breast cancer following mastectomy is markedly diminished due to disease-related symptoms and the side effects associated with treatment interventions [1–3]. Furthermore, factors impacting the QoL for women post-mastectomy include cultural and religious beliefs, economic constraints, low health literacy, prevalent misinformation, and restricted access to healthcare services [4–6]. Over the past decade, researchers have used standardised tools to measure the QoL after mastectomy, including the BREAST-Q, the European Organisation for Research and Treatment of Cancer Quality of Life instruments (EORTC QLQ-C30, BR23, and BR45), the Functional Assessment of Cancer Therapy–Breast (FACT-B), the Body Image Scale (BIS), and the World Health Organisation Quality of Life tools (WHOQOL-100, WHOQOL-BREF) [7–11]. Those standardised instruments assess different dimensions of QoL in breast cancer patients and post-mastectomy, and ensure consistent, reliable, and valid outcomes. Furthermore, these instruments help to identify patient needs, inform interventions, and support evidence-based clinical and policy decisions.

The rising incidence of breast cancer underscores the growing importance of addressing QoL among affected individuals. Healthcare systems are increasingly burdened with the demands of breast cancer screening, treatment, and survivorship care, necessitating strong infrastructure, effective resource allocation, and targeted responses to the unmet needs of patients to enhance their overall QoL [12–14]. The World Health Organisation [15] reported that breast cancer is the most prevalent cancer among women and the second most common overall, with an estimated 2.3 million new cases and 670,000 related deaths globally in 2022. The incidence and mortality of breast cancer are unevenly distributed across regions [15]. A study conducted by Lima et al. [16] found that the highest incidence rise was among women under 50, with rates escalating by 1.55% per year, followed by 1.28% for those aged 50–69 years, and 1.51% for individuals aged 70 years and above. Additionally, the global breast cancer mortality rate rose by 0.23% annually since 1990, with marked increases in the under 50 years (0.09% per year) and 70 and over (0.66% per year) age groups [16]. In female patients aged 10–19 years, breast cancer is exceedingly rare, with incidence rates around 0.08 per 100,000 [17]. Historical data indicate that individuals under 20 represent approximately 0.09% of breast cancer fatalities [17]. Furthermore, Murthy et al. [17] reported that breast cancer in children represents less than 0.1% of all breast cancer cases and less than 1% of pediatric malignancies. In Africa, breast cancer remains a major public health concern across Africa, with rising incidence rates [18]. In 2018, there were approximately 168,690 new breast cancer cases and 74,072 related deaths in Africa [19].

Mastectomy is an increasingly common surgical intervention for breast cancer [20–22], particularly in Africa, due to late diagnosis and limited access to surgeries that preserve the breast [3, 23, 24]. A study by Twahir et al. [25] identified that most patients with breast cancer underwent a mastectomy, with 64–67% of them choosing this option, while 15–26% opted for breast-conserving surgery. Late diagnosis and delayed screening of breast cancer adversely affect patient management and QoL. Research indicates that women who seek early consultation upon the onset of symptoms and receive timely treatment exhibit higher QoL scores [26]. Enhanced screening protocols and early diagnosis have led to improved prognosis and survival rates, with a 5-year survival rate now approximating 90% [27]. In Africa, many patients are diagnosed at a late stage of breast cancer, with 54% seeking medical help more than 90 days after noticing symptoms [24]. This delay is due to limited access to screening and diagnostic services; in some countries, mammography or ultrasound is below 45% [25]. The time it took to receive important procedures, such as pathology results, surgery, and systemic therapy, varied widely, ranging from 1 to 5 months [25]. Furthermore, studies show that the rates of breast cancer screening are low, ranging from 5.2% in Ivory Coast to 23.1% in Namibia [28]. Breast self-examination is also low in Africa, with only 44.0% of women ever having practised it and just 17.9% doing so regularly [29]. Financial challenges also play a significant role in delayed breast cancer screening and treatment [25]. A study conducted by Montazeri et al. [30] found that delayed diagnosis of breast cancer and the predominance of mastectomy (82.6% of patients) over breast-conserving surgery adversely affect patients' QoL. The scarcity of conservative surgical options exacerbates long-term challenges in functioning and QoL; thus, timely detection and initiation of treatment are critical for improving prognosis and QoL among breast cancer patients [30, 31].

While mastectomy can improve survival outcomes, it often brings serious physical, psychological, and social challenges that significantly affect a woman's QoL [32, 33]. Post-mastectomy, patients may experience diminished feelings of femininity, emotional distress, physical discomfort, and altered body image [34–36]. Approximately 28.2% report post-mastectomy pain syndrome [37], and up to 19% experience phantom breast pain or sensations [38]. Mastectomy can also negatively impact sexual wellbeing, intimate relationships, and mental health, often leading to issues such as low self-esteem, anxiety, depression, marital strain, and social isolation [39–41]. Younger women and those undergoing modified radical mastectomy are particularly vulnerable to

body image concerns [42]. Despite the complexity of these challenges, most interventions remain focused on medical care, with limited emphasis on psychosocial support, self-management education, or culturally appropriate care [43, 44]. Moreover, standardised QoL assessment tools are often developed in English and require translation and cultural adaptation for use in diverse populations.

In light of the above, this study aims to map evidence on the use of standardised tools to measure QoL post-mastectomy among women in Africa.

Methods

This scoping review adhered to the framework established by Levac et al. [45]. The following steps were followed: formulating research questions and study identification. Study selections, data charting and results collation, summarisation and reporting. Furthermore, the review followed PRISMA-ScR guidelines.

Research questions

The review addressed the following questions:

1. How prevalent is mastectomy among women in Africa?
2. Which standardised measurement tools are employed to assess the QoL post-mastectomy among women in Africa?
3. How is the overall QoL post-mastectomy among women in Africa?
4. Which factors predict the QoL post-mastectomy among women in Africa?
5. Which strategies are implemented to enhance the QoL post-mastectomy outcomes among women in Africa?

Study identification

A comprehensive literature search was conducted on 25 March 2025, 29 March 2025, and 1 April 2025 across five databases, covering publications from 2015 to 2025: CINAHL, Emcare, Medline, Scopus, and Web of Science. Other sources, including grey literature, were manually searched via Google and Google Scholar. The search strategy integrated keywords and subject headings and was customised for each database. To improve search result accuracy and relevance, advanced techniques were implemented. Boolean operators (AND, OR, NOT) facilitated systematic keyword combination and exclusion, while parentheses grouped search terms to optimise logical structuring. Quotation marks (" ") identified exact phrases for precise source retrieval. Wildcards and truncation symbols, such as the asterisk (*) and question mark (?), accommodated variations in word forms and spellings. Below are examples of the keyword combinations employed:

– **Search 1**: wom? n OR female*.

– **Search 2**: mastectom* OR "breast surg*" OR "breast remov*" OR postmastectomy OR "post-mastectom*".

– **Search 3**: physical* OR emotion* OR psychosocial* OR psychologic* OR mental* OR "quality of life" OR well-being OR wellbeing OR outcome* OR impact*.

– **Search 4**: measure* OR assess* OR evaluat* OR instrument* OR scale* OR tool* OR intervention* OR strateg* OR program* OR method*.

– **Search 5**: Africa*.

– **Search 6**: Search 1 AND Search 2 AND Search 3 AND Search 4 AND Search 5.

Study selection

The inclusion criteria encompassed empirical (quantitative, qualitative, or mixed-methods), peer-reviewed or grey literature studies published in English between 2015 and 2025, focusing on African women who underwent mastectomy and reported on physical, emotional, or psychosocial post-surgery outcomes. Studies using standardised measurement tools or proposing strategies to enhance outcomes were included, while those lacking original empirical data, such as reviews, editorials, and opinion pieces, were excluded. The selection involved an initial screening of titles and abstracts, followed by a full-text review by two reviewers, with discrepancies resolved through consensus. The research questions and the Mixed Methods Appraisal Tool (MMAT) were used to guide the selection of relevant studies. MMAT version 2018 was chosen for its appropriateness in evaluating qualitative, quantitative, randomised controlled trials, quantitative non-randomised studies, quantitative descriptive studies, and mixed-methods studies [46]. Each study was initially categorised according to the five study design categories of the MMAT, followed by an assessment against the five corresponding methodological criteria [46]. Responses for each criterion were recorded as "Yes," "No," or "Can't tell." Although studies were not excluded based on quality, the MMAT results were utilised to provide insights into the overall strengths and limitations of the available evidence regarding QoL measurement tools in the post-mastectomy context across African settings.

As displayed in Fig. 1, the systematic search yielded 473 records: 345 from five databases — CINAHL ($n = 22$), Emcare ($n = 55$), Medline ($n = 65$), Scopus ($n = 78$), and Web of Science ($n = 125$) — and 128 from other sources. After removing 97 duplicates, 376 unique articles were screened for relevance. Of these, 305 were excluded. Seventy-one full-text articles were assessed for eligibility, with 37 excluded for not meeting the study's scope. Ultimately, 34 studies met the inclusion criteria for data
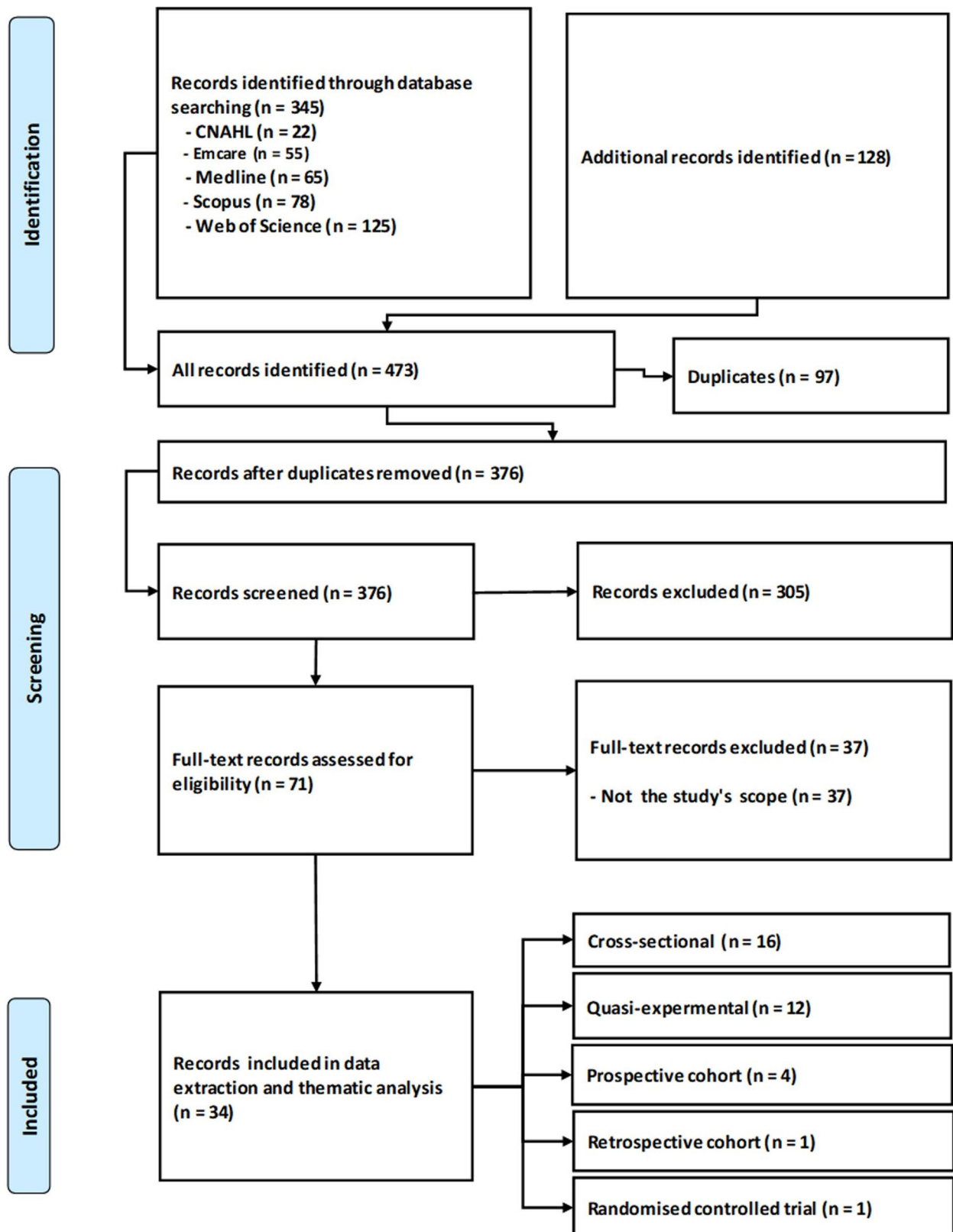
Fig. 1 PRISMA Flowchart Cancer QOL V1

extraction and thematic analysis: 16 cross-sectional, 12 quasi-experimental, four prospective cohorts, one retrospective cohort, and one randomised controlled trial. The PRISMA flow diagram illustrates the selection process (Fig. 1).

Data charting

An iterative data extraction chart was developed and piloted in several studies to ensure consistency and comprehensiveness. Extracted information included author(s), publication year, study location, design, participant characteristics, measurement tools and key findings. Charting was conducted systematically and regularly reviewed by team members for accuracy. Table 1 summarises the key findings, and Table 2 provides an overview of the standardised tools used to measure the QoL.

Results collation, summarisation, and reporting

Extracted data were synthesised descriptively to delineate the scope, nature, and distribution of literature regarding physical and emotional outcomes post-mastectomy among women in Africa. Data analysis followed a six-phase framework for thematic analysis by Braun and Clarke [72]. The initial phase, referred to as familiarisation, involved a comprehensive engagement with the data through iterative readings [72]. During the second phase, researchers developed initial codes by systematically identifying significant features within the dataset. The third phase was dedicated to thematic identification, wherein related codes were aggregated into potential overarching themes [72]. The fourth phase concentrated on reviewing and refining these themes to ensure they accurately represented the data, encompassing both coded segments and the complete dataset [72]. In the fifth phase, themes were meticulously defined and labelled to encapsulate their essence and scope [72]. Finally, the sixth phase involved the composition of the analysis, presenting a coherent narrative summary that addressed the research questions [72]. Additionally, tables were used to provide summaries of the selected studies.

Findings

Characteristics of the studies

The 34 studies reviewed involved 5466 participants (Table 1). Sample sizes varied widely, from as few as 30 participants [41] to 1,476 [32]. This variation in sample size can lead to inconsistent results across studies, complicating the comparison and synthesis of findings. It is crucial to carefully consider the sample size and design type when interpreting overall study quality and drawing conclusions from the evidence base. While smaller sample sizes are typical and sometimes appropriate for certain quantitative designs, they may limit statistical

power and affect the reliability and generalisability of results. As presented in Table 1, all 34 studies included in this review employed quantitative research designs, though these varied in type. The cross-sectional studies were the most common design, accounting for 16 of the 34 studies [3, 23, 33, 40, 49, 51, 52, 55–58, 63, 65, 66, 70, 71]. Twelve studies utilised quasi-experimental designs to assess psycho-educational, supportive, or rehabilitative interventions [41, 43, 44, 47, 50, 54, 59–61, 64, 67, 68]. Four studies employed a prospective cohort design [32, 53, 62, 69], one retrospective cohort study [2] and one a randomised controlled trial [48].

Participants' ages ranged from 18 to 85 years, with most studies focusing on women aged 30 to 60 years. The reported mean ages typically ranged from 38 to 57 years, with specific averages of 43.2 years in Ethiopia [3], 50.3 years among a multinational cohort in Namibia, Nigeria, Uganda, and Zambia [32], and 56 years in South Africa [71]. Most participants were diagnosed with late-stage breast cancer—Stage II or Stage III [2, 32, 69, 70]. The time since mastectomy also varied significantly. Some studies focused on women a few months post-surgery [51, 69], while others included participants up to five years after surgery [56, 59]. Several studies did not explicitly report the time since surgery [3, 41, 57, 67].

Geographically, the research was primarily concentrated in Egypt, which accounted for 22 studies [2, 33, 40, 41, 43, 44, 47–50, 53–56, 59–61, 64–68]. This may reflect robust research infrastructure or concentrated interest in the topic within Egypt. Two studies were exclusively from Nigeria [51, 69] and Morocco [58, 63]. Multi-country studies were conducted and included Namibia, Uganda, Nigeria and Zambia [32], Namibia, Nigeria, Uganda [52], Ghana and Ethiopia [62]. Additional study representation came from Ghana [23], Ethiopia [3], Cameroon [70], Tunisia [57] and South Africa [71]. The uneven geographical distribution of the selected studies may restrict the generalizability of findings across Africa, particularly in areas with varying health systems, cultural practices, and socioeconomic conditions.

Prevalence of mastectomy

Mastectomy emerged as a highly prevalent surgical intervention among women with breast cancer across African countries, as reported in the reviewed studies. Although few articles provided direct epidemiological prevalence rates, 12 studies indicated that mastectomy was the dominant treatment modality, primarily due to late-stage diagnosis, limited access to breast-conserving options, cultural norms, and healthcare infrastructure constraints [2, 3, 32, 33, 41, 58, 60, 61, 67, 69–71]. In Cameroon, one study reported that approximately 92.6% of women with breast cancer underwent mastectomy, mainly because most cases were diagnosed at advanced stages [70]. In

Table 1 Summary of the study findings

Authors, year, country	Study title	Study Design	Participant characteristics	Key findings
Abdelhafez et al. [43], 2024, Egypt	"Effect of group counselling based on the problem-solving solution on women's sexual function, quality of life and sexual satisfaction after mastectomy."	Quasi-experimental study	Age range: <30 to >40 years Mean age: 38.24 Total sample: 50 Breast cancer stage: Stage 1, Stage 2, Stage 3 Time since mastectomy: NR	The group counselling intervention based on a problem-solving solution led to a significant improvement in the participants' sexual function, as well as their physical and mental quality of life. The study found a statistically significant increase ($p < 0.001$) in the total scores and several characteristics of sexual function, as well as a substantial rise ($p < 0.001$) in the physical component summary (PCS) and mental component summary (MCS) of the MOS SF-12 quality of life measure.
Abdel-Mordy et al. [47], 2021, Egypt	"Effect of application Roy's adaptation model on women's satisfaction and quality of life after mastectomy"	Quasi-experimental study	Age range: 25 to ≥ 50, with the majority being 45 to 55 years Mean age: 42.97 ± 10.11 years for the control group, 42.55 ± 10.05 years for study group Total sample: 100 (divided into 50 in the study group and 50 in the control group) Breast cancer stage: The majority had right-sided breast cancer, around 50–60% had metastatic disease	Highly significant improvements in women's knowledge, satisfaction, and quality of life in the group that received the educational program based on Roy's Adaptation Model compared to the control group after 2 weeks and 3 months of follow-up. Highly significant reductions in maladaptive behaviours in the study group after the program implementation, while no significant changes in the control group. Improved quality of life for post-mastectomy women in the study group after 3 months of the program implementation.
Abdelrahman et al. [2], 2025, Egypt	"Factors affecting quality of life in women post-mastectomy for breast cancer in Baheya Foundation (Egypt): A retrospective cohort study"	Retrospective cohort study	Age range: 23 to 84 years. Most people were 40 years or older (82%) Mean/median age: 54 years (IQR 43–63 years) Total sample: 318 Breast cancer stage: 35% were diagnosed with stage II Time since mastectomy: 6 months	The global quality of life score was relatively low, with a 42 out of 100 median. The most affected functional domains were role (62%) and emotional (54%), while cognitive functioning was the least affected (50% had good functioning). The most common and distressing symptoms were fatigue (65%), insomnia (61%), and pain (60%). The median scores for the FACT-B and FBSI questionnaires were 79.0 and 14.0, respectively, indicating poor overall wellbeing and quality of life. Older women (> 60 years) and those living in urban areas had poorer quality of life in certain domains.
Abebe et al. [3], 2020, Ethiopia	"Female breast cancer patients, mastectomy-related quality of life: experience from Ethiopia"	Cross-sectional study	Age range: 25 to 70 years Mean age: 43.2 Total sample: 86 Breast cancer stage: Majority stage III (81.8%) Time since mastectomy: NR (NR)	The quality of life of the female breast cancer patients who underwent mastectomy was poor, with a global health status/QoL score of 48.25 out of 100. They had a low score for future perspective (40.3 out of 100), indicating they were worried about their future health. Their sexual functioning and enjoyment were significantly affected, with mean scores of 85.3 and 71.2, respectively. However, the patients did not seem to suffer from major physical symptoms related to the mastectomy, with low scores for postoperative breast (19.1) and arm (24.5) symptoms.
Ahmed and Dawood [48], 2017, Egypt	"Effect of an educational, supportive program on mastectomy patients' satisfaction	Randomized controlled trial	Age range: 18–45 years Mean age: 30.25 ± 8.95 Total sample: 65 Breast cancer stage: 52.31% had metastatic disease Time since mastectomy: NR	The educational, supportive program had a high statistically significant positive effect on improving mastectomy patients' satisfaction in the intervention group compared to the control group, particularly in the areas of breast satisfaction, physical wellbeing, sexual wellbeing, and psychosocial wellbeing ($p < 0.001$)

Table 1 (continued)

Authors, year, country	Study title	Study Design	Participant characteristics	Key findings
Ali et al. [33], 2022, Egypt	"Assessment of quality of life in breast cancer patients"	Cross-sectional study	Age range: 25 to 45 years Mean 41, Median 42 Total sample: 200 Breast cancer stage: NR Time since mastectomy: Mean 3 years, Median 2 years	The study found that breast cancer patients had lower overall quality of life, with a global health score of 57.35 (SD = 26.27) compared to the reference value of 61.8. They also had worse functioning scales, including physical (58.26 vs. 76.4), role (58.26 vs. 76.4), emotional (58.26 vs. 76.4), and cognitive (58.26 vs. 76.4) functioning. In terms of symptoms, they had higher scores for pain (60.51), fatigue (54.44), insomnia (66.50), appetite loss (38.5), constipation (47.51), diarrhoea (19.97), and financial troubles (51.67) compared to the reference values. For the EORTC QLQ-BR23 specific to breast cancer, they had the highest functional score for sexual functioning (67.49) and the lowest for future perspective (33.33). The highest symptom score was for upset by hair loss (60.43), followed by arm symptoms (57.55). The lowest symptom score was for systemic therapy side effects (50.25).
Amin et al. [49], 2024, Egypt	"Effect of mastectomy on quality of life for elderly women"	Cross-sectional (descriptive study)	Age range: 60 to 69 years Mean age: 69.35 ± 3.49 years Total sample: 140 Breast cancer stage: More than two-fifths at stage II Time since mastectomy: 1–3 years	More than half (52.1%) of the studied older women had a moderate quality of life, one quarter (25%) had a low quality of life, and about two-fifths (40%) had a high quality of life after mastectomy. The quality of life was significantly related to the women's educational level and age.
Aquil et al. [63], 2021, Morocco	"Predictors of mental health disorders in women with breast and gynaecological cancer after radical surgery: A cross-sectional study"	Cross-sectional study	Age range: Over 18 years Mean age: 49.60 ± 1.59 years Total sample: 200 (100 breast cancer, 100 gynaeco-logical cancer) Breast cancer stage: T1-T3 Time since mastectomy: 3 weeks to 6 months	Younger women (under 50 years old) showed significantly greater mental health disorders (anxiety, depression) and body image dis-satisfaction compared to older women, regardless of cancer type. Predictors of higher anxiety, depression, and body image dissatisfac-tion included younger age, lower income, fewer children, and more advanced cancer stage. There was a strong association between mental health disorders and body image dissatisfaction in the study participants.
Araby et al. [50], 2024, Egypt	"Effect of educa-tional-supportive program about therapeutic exer-cises on women's physical, psycho-logical and marital status undergoing mastectomy"	Quasi-ex-perimental study	Age range: 20–60 years Mean age: (Control group: 40.65 ± 8.68; Study group: 41.44 ± 7.90) Total sample: 86 Breast cancer stage: NR Time since mastectomy: NR	The educational-supportive program on therapeutic exercises had a positive effect on the physical, psychological, and marital status of women undergoing mastectomy. Significantly lower scores for pain, fatigue, depression, anxiety, and stress. Significantly higher scores for shoulder function and marital satisfaction
Bioku et al. [51], 2025, Nigeria	"Psychosocial well-being of patients with breast cancer following surgical treatment in North-ern Nigeria"	Cross-sectional study	Age range: ≤30 to ≥ 51 years Mean age 45.94 ± 9.05 years Location: Northern Nigeria Total sample: 72 Breast cancer stage: NR Time since mastectomy: Median 13.5 weeks (IQR 12.0–17.0 weeks)	Over one-third (36.1%) of participants experienced psychological distress after their breast cancer surgery. 15% of participants reported poor quality of life, with the social relationship domain being the most affected. Post-surgical complications, lack of pre-surgical psychological coun-selling, and psychological distress were significant predictors of poor quality of life, explaining 70% of the variance in quality of life.
Boucheron et al. [32], 2021, Namibia, Uganda, Ni-geria, Zambia	"Self-reported arm and shoulder problems in breast cancer survivors in sub-Saharan Africa: The African breast cancer-disparities in outcomes cohort study."	Prospec-tive cohort study	Age range: 18 years and above Mean age: 50.3 ± 13.7 Total sample: 1476 Breast cancer stage: Most diagnosed with late-stage (75%) Time since mastectomy: NR	84% of women with arm pain after surgery had mastectomies; arm stiffness and swelling were 89% and 87%, respectively. Cumulative incidences of arm and shoulder problems (ASP) were 2–3 times higher after starting treatment compared to before treatment.

Table 1 (continued)

Authors, year, country	Study title	Study Design	Participant characteristics	Key findings
Boucheron et al. [52], 2024, Namibia, Nigeria, Uganda	"Quality of life in long-term breast cancer survivors in sub-Saharan Africa: The African breast cancer-disparities in outcomes study."	Cross-sectional study	Age range: 18 years or above Mean age: BCS: 57.5 years; CF: 55.1 years Total sample: 862 (BCS: 357; CF: 505) Breast cancer stage: NR Time since mastectomy: NR	Overall, breast cancer survivors (BCS) reported good quality of life scores, with high scores in the physical health, psychological, and social relationship domains but lower scores in the environment domain. BCS had higher quality of life scores compared to cancer-free (CF) women across most domains, with adjusted mean differences of 10.65% points for overall quality of life and 5.84% points for general health. There was no significant difference in physical health scores between BCS and CF women.
El-Adham and Elsherif [53], 2018, Egypt	"Factors affecting body image change and sexuality at mastectomy females reproductive age of women"	Cross-sectional (prospective descriptive study)	Age range: <30 to 45 years Mean/median age: NR Total sample: 78 Breast cancer stage: NR Time since mastectomy: Follow-up times include 2 weeks, 3 months, 6 months, and 12 months or more	Socioeconomic factors (age, marital status, monthly income) significantly affected women's self-consciousness regarding their body image. Residence significantly affected the women's sexuality. The type of surgery (mastectomy vs. lumpectomy) significantly affected the women's emotions, body image change, and sexuality.
El-Din et al. [40], 2021, Egypt	"Relation between self-compassion, perfectionism and body image satisfaction among women with mastectomy"	Cross-sectional study	Age range: 30 to 50 or more Mean age: 43.80 years Total sample: 100 Breast cancer stage: NR Time since mastectomy: More than 12 weeks for nearly one-third of participants	About half of the women with mastectomy had moderate self-compassion, with about a quarter having high self-compassion and a quarter having low self-compassion. Over half of the women had maladaptive perfectionism, with high levels on both the standard and discrepancy subscales. About two-thirds of the women were unhappy with their appearance, while only about a third were satisfied with their appearance. A strong positive correlation existed between self-compassion, adaptive perfectionism, and body image satisfaction. Improved self-compassion and adaptive perfectionism positively affected body image, while maladaptive perfectionism had adverse effects.
El-Rahman et al. [54], 2024, Egypt	"Effectiveness of educational guidelines on post-mastectomy women's knowledge, practices, and psychological stress regarding external breast prosthesis"	Quasi-experimental study	Age range: 21–60 years Mean/median age: NR Total sample: 50 Breast cancer stage: 40% in Stage 3 Time since mastectomy: >1 year for 56% of participants	Significantly improving post-mastectomy women's knowledge, practices, and psychological stress (depression, anxiety, and stress) regarding external breast prostheses. Reducing the severe levels of depression, anxiety, and stress among post-mastectomy women regarding external breast prostheses.
Elsoud et al. [55], 2021, Egypt	"Aspects allied with quality of life among El-Beheira governorate post-mastectomy women: a mobile-based health education"	Cross-sectional study	Age range: Less than 30 to 45 years Mean age: 36.64 ± 5.33 years Total sample: 200 Breast cancer stage: Stage I (35%), Stage II (55%), Stage III (10%) Time since mastectomy: At least one month	More than half (56%) of the post-mastectomy women had poor quality of life, with the physical domain (45.24 ± 16.07) and spiritual domain (47.28 ± 18.70) receiving the lowest scores. The overall mean QoL score was 51.27 ± 10.75, indicating a generally poor quality of life among this population. Around three-quarters (77.3%) of the women were satisfied with the mobile-based health education they received.
Eman El et al. [56], 2021, Egypt	"Perceived quality of life in a cohort of Egyptian breast cancer survivors in Alexandria as measured by EQ-5D-3 L: a cross-sectional study."	Cross-sectional study	Age range: Aged 18 years or more Mean age: 50.45 ± 9.6 Total sample: 125 Breast cancer stage: Early cancer (stage I and II), Late cancer (stage III and IV) Time since mastectomy: NR (mean follow-up time 3.72 years)	The majority (98.4%) of BCSs experienced problems in their health, with 44% reporting problems in all five dimensions of the EQ-5D-3 L. The most frequently reported problems were persistent pain (92.8%), anxiety (84%), followed by difficulties with usual activities (81.6%), mobility (70.4%), and self-care (56.8%). Younger BCSs (≤ 50 years) experienced significantly more anxiety compared to older BCSs (> 50 years). BCSs with late-stage cancer experienced significantly more problems with mobility, self-care, and anxiety compared to those with early-stage cancer.

Table 1 (continued)

Authors, year, country	Study title	Study Design	Participant characteristics	Key findings
Fekih-Rom-dhane et al. [57], 2020, Tunisia	"Hopelessness is associated with poor sleep quality after breast cancer surgery among Tunisian women."	Cross-sectional study	Age range: 18 to 65 years Mean/median age: NR Total sample: 50 Breast cancer stage: NR Time since mastectomy: NR	66% of breast cancer patients were considered poor sleepers, 30% had moderate to severe depression, and 24% had high levels of hopelessness. Sleep quality was negatively correlated with both depression and hopelessness scores, and hopelessness was a significant predictor of sleep quality even after controlling for demographic and social variables.
Fihri et al. [58], 2024, Morocco	"Perception of breast reconstruction after mastectomy for cancer. Experience of the general surgery department of the military hospital Avicenna in Marrakesh."	Cross-sectional study	Age range: NR Mean age: 49.14 ± 10.17 Total sample: 201 Breast cancer stage: NR Time since mastectomy: NR	Patients who underwent breast reconstruction after mastectomy for breast cancer were generally highly satisfied, with a mean BREAST-Q score of 79.14 out of 100. The main reasons for undergoing reconstruction were to regain femininity and feel good about themselves (100%), to feel whole and regain balance (94%), to regain a normal sexual and marital life (88%), and to forget about cancer (24%). The study also found that only 25.4% of patients underwent breast reconstruction despite it being offered to all patients.
Hamed et al. [59], 2019, Egypt	"Impact of psycho-educational program on body image concerns and mental adjustment among post-mastectomy women"	Quasi-experimental study	Age range: 20 to 60 years Mean/median age: NR Total sample: 44 Breast cancer stage: NR Time since mastectomy: 30% had mastectomy 4–5 years ago, 25% had it 1-<2 years ago	Significant improvement in body image concerns among post-mastectomy women after the psycho-educational program. Significant improvement in mental adjustment to cancer across multiple domains including reduced hopelessness/helplessness, anxious preoccupation, cognitive avoidance, and increased fighting spirit. Improvement in overall mental adjustment to cancer, with the majority of women (81.8%) having good mental adjustment after the program compared to only 34.1% before.
Hashem et al. [60], 2020, Egypt	"Effect of an educational nursing program on performance and self-efficacy of females undergoing mastectomy"	Quasi-experimental study	Age range: 20 to 65 years Mean age: 48.77 ± 9.1 Total sample: 60 Breast cancer stage: Stage II Time since mastectomy: NR	Educational nursing program had a highly statistically significant positive effect on the performance and self-efficacy of the study group compared to the control group. The study group showed significant improvements in knowledge, practice, and self-efficacy levels after the program, while the control group did not. Patient characteristics like younger age, higher education level, and employment status were positively correlated with improved self-efficacy scores.
Ibrahim [61], 2018, Egypt	"Effect of self-management guidelines on the quality of life for post-mastectomy patients"	Quasi-experimental study	Age range: 42 to 65 years Mean age: 54.1 years Total sample: 72 Breast cancer stage: NR Time since mastectomy: NR	A significant improvement in the quality of life of post-mastectomy patients. The SF-36 QOL score increased from 28.7 to 80.0 after implementing the guidelines. There was a significant positive correlation between the patient's self-management and their QOL, suggesting that the improvement in self-management contributed to the improvement in QOL.
Kennedy et al. [62], 2023, Ghana and Ethiopia	"A prospective evaluation of the quality of life and mental health implications of mastectomy alone on women in sub-Saharan Africa"	Prospective cohort study	Age range: NR Mean/median age: NR Total sample: 133 Breast cancer stage: NR - Time since mastectomy: NR	Across most BREAST-Q subscales, women from both Ghana and Ethiopia reported significantly decreased scores at 3 months postoperative. At 6 months, the combined cohort reported decreased scores for breast satisfaction (mean difference, -3.4). Women in both countries reported similar improvements in anxiety and depression scores postoperatively. Ghanaian women reported declines in most BREAST-Q measures over 6 months relative to their baseline, while Ethiopian women reported improvements, some of which improved beyond baseline levels.

Table 1 (continued)

Authors, year, country	Study title	Study Design	Participant characteristics	Key findings
Mageed et al. [64], 2024, Egypt	"The impact of the educational nursing program on quality of sexual life, body image, and self-esteem among women with breast cancer"	Quasi-experimental study	Age range: 18 to 50 years Mean age: 39.1 ± 4.9 years Total sample: 40 Breast cancer stage: More than three-fourths (80%) in the second stage 55% had a complete breast removal, while 45% had adopted radical breast removal Time since mastectomy: NR	Significant improvement in the quality of sexual life after the program implementation compared to pre-test scores ($p < 0.001$). A marked increase in self-esteem following the program ($p < 0.001$). After the program implementation, there was a significant change in every aspect of the body image subscale.
Mokhtar et al. [44], 2024, Egypt	"Acceptance and commitment training program for self-compassion and body-image among women with mastectomy"	Quasi-experimental study	Age range: 18 to 65 years Mean age: 38.14 years Total sample: 60 Breast cancer stage: More than half (58.3%) were in the second stage Time since mastectomy: NR	The acceptance and commitment training program had a positive effect on self-compassion and body image among women with mastectomy, with more than half of the women having high self-compassion and good body image after the program, compared to before the program. The proportion of women with low self-compassion decreased from 86.7–5.0%, while the proportion with high self-compassion increased from 3.3–55%. The proportion with poor body image decreased from 90.0–3.0%, while the proportion with good body image increased from 3.3–56.0%. These changes were statistically significant at $p < 0.000$.
Mokhtar et al. [65], 2024, Egypt	"Correlation between self-compassion and body-image among women with mastectomy"	Cross-sectional study	Age range: 35 to < 45 years Mean age: 38.14 ± 6.17 Total sample: 60 Breast cancer stage: NR Time since mastectomy: NR	Most women with mastectomies had low levels of self-compassion and poor levels of body image. There was a high statistically significant positive correlation between self-compassion and body image among the women with mastectomies.
Mostafa et al. [66], 2024, Egypt	"Correlation between body image, self-esteem and self-efficacy among women with mastectomy"	Cross-sectional study	Age range: 40 to 50 years Mean age: 42.30 ± 8.05 Total sample: 100 Breast cancer stage: Nearly half (45%) at the second stage Time since mastectomy: NR	Nearly two-thirds (61%) of the studied women with mastectomy had poor body image. More than half (59%) of the studied women had low self-esteem. More than half (59%) of studied women had low self-efficacy. A highly statistically significant positive correlation existed between the mean scores of total body image, total self-esteem, and total self-efficacy among the studied women.
Moussa et al. [67], 2019, Egypt	"Effect of intervention management care program on improving quality of life outcome among mastectomy women with diabetic: a comparative study"	Quasi-experimental study	Age range: 35 to more than 60 years Mean age: 50.3 ± 8.6 for the Damietta group, 48.3 ± 9.4 for Port Said group Total sample: 50 Breast cancer stage: NR Time since mastectomy: NR	Before the intervention program, most of the women had a poor quality of life across physical, psychological, emotional, social, sexual, and spiritual/moral dimensions. After the intervention program, there were significant improvements in some aspects of women's quality of life.
Nabawy et al. [41], 2024, Egypt	"Psychosocial program for women with mastectomy undergoing chemotherapy"	Quasi-experimental design	Age range: 25 to more than 55 years Mean age: 43.66 years Total sample: 30 Breast cancer stage: NR Time since mastectomy: NR (only time since disease onset is mentioned)	Significant reductions in depression, anxiety, stress, and loneliness levels Significant improvements in self-esteem, with half the women reporting high self-esteem after the intervention There was a significant increase in the proportion of women reporting low levels of loneliness, from less than two-thirds pre-intervention to three-quarters post-intervention

Table 1 (continued)

Authors, year, country	Study title	Study Design	Participant characteristics	Key findings
Nsaful et al. [23], 2024, Ghana	"Quality of life after mastectomy with or without breast reconstruction and breast-conserving surgery in breast cancer survivors: a cross-sectional study at a tertiary hospital in Ghana"	Cross-sectional study	Age range: NR Mean/median age: NR Total sample: NR Breast cancer stage: Approximately 50% early-stage Time since mastectomy: NR	Overall, global health status (quality of life) was high and similar across the different surgery groups, with a median score of 83.3. The breast reconstruction group had significantly lower functional scores and higher symptom scores compared to the mastectomy and breast-conserving surgery groups. The breast reconstruction group had the lowest body image and future perspective scores, while the breast-conserving surgery group had the highest body image scores.
Rashwan et al. [68], 2024, Egypt	"Empowering mind-body wellness: effect of bundling seated exercises and psycho-educational rehabilitation using the teach-back approach on fatigue and coping of women post mastectomy"	Quasi-experimental, two-group, pre-posttest, longitudinal study	Age range: 40 to 60 years Mean/median age: NR Total sample: 60 Breast cancer stage: NR Time since mastectomy: NR	A significant reduction in cancer-related fatigue (CRF) in the intervention group, with fatigue scores decreasing from 136.10 ± 27.76 to 98.43 ± 25.99 ($p < 0.001$). Significant improvements in adaptive coping behaviours like fighting spirit, cognitive avoidance, and fatalism in the intervention group, along with decreases in maladaptive coping behaviours like helplessness/hopelessness and anxious preoccupation
Romanoff et al. [69], 2024, Nigeria	"Patient-reported outcomes improve following mastectomy for early-stage breast cancer in Nigeria: pilot experience using a translated and validated BREAST-Q"	Prospective cohort study	Age range: 43 to 59 years Median age: 50 Total sample: 108 Breast cancer stage: Stage I (5%), Stage II (41%), Stage III (54%) Time since mastectomy: 6 months	Patients with early-stage breast cancer, mastectomy led to significant improvements in psychosocial wellbeing, physical wellbeing of the chest, and satisfaction with breasts, but no significant change in sexual wellbeing. In contrast, for patients with late-stage breast cancer, there were no significant changes in psychosocial wellbeing, physical wellbeing of the chest, or satisfaction with breasts, but sexual wellbeing significantly decreased.
Tchente et al. [70], 2022, Cameroon	"Quality of life of women after mastectomy in two training hospitals in the city of Douala, Cameroon"	Cross-sectional study	Age range: 30 to 70 years Mean age: 48.2 ± 10 Total sample: 102 Breast cancer stage: Tumor size more than 5 cm (76.3%), lymph node involvement (89.1%), metastatic at diagnosis (16.1%) Time since mastectomy: NR	The functional domain of quality of life was severely compromised, with a score of 2.7 out of 20, indicating significant impairment in the ability to perform daily activities. The sexual quality of life score was very low at 1.2, indicating a significant impact on the women's sexuality and femininity after mastectomy. The social domain of quality of life was also severely impacted, with a score of 0.
Wilkinson and Smith [71], 2024, South Africa	"Quality of Life in Female Breast Cancer Patients and Survivors in a South African Municipality"	Cross-sectional study	Age range: 27 to 85 years Mean age: 56 years Total sample: 100 Breast cancer stage: Most common was stage II (35%), least common was stage IV (7%) Time since mastectomy: NR	The quality of life subscale with the highest score was spiritual wellbeing (6.66 ± 2.07), and the lowest was psychological wellbeing (4.91 ± 1.93). The breast cancer survivor group had higher scores on all four quality of life subscales (physical, psychological, social, and spiritual) compared to the breast cancer patient group. Participants attending private facilities had higher scores on 3 of the four quality of life subscales than those attending public facilities, except for spiritual wellbeing, which was higher in the public facility group.

Nigeria, two studies highlighted that mastectomy was recommended for the majority of non-metastatic breast cancer cases, although only 43% of eligible patients ultimately received surgery, often due to psychosocial barriers [51, 69].

Research conducted in Egypt across four studies confirmed that modified radical mastectomy remained the most frequently performed surgical procedure for breast cancer, attributed to advanced disease presentation at the time of diagnosis [2, 60, 61, 68]. In South Africa, one study found that mastectomy continued to be widely performed, particularly among historically underserved and public healthcare populations [71]. Additionally, six studies from Ethiopia, Egypt, Nigeria, and Cameroon

Table 2 Standardised tools used to measure quality of life post-mastectomy among girls and women in Africa

QoL Scales (Abbrev.)	QoL Scales (Full name)	Authors	Country	Translated	Language (Translation)
EORTC QLQ-C30	European Organisation for Research and Treatment of Cancer Quality of Life-30 items	Abdelrahman et al. [2]	Egypt	Yes	Arabic
		Abebe et al. [3]	Ethiopia	NR	NR
		Ali et al. [33]	Egypt	Yes	Arabic
		Amin et al. [49]	Egypt	NR	NR
		Nsaful et al. [23]	Ghana	Yes	Twi
EORTC QLQ-BR23	European Organisation for Research and Treatment of Cancer Quality of Life-Breast Cancer Module-23 items	Abebe et al. [3]	Ethiopia	NR	NR
		Ali et al. [33]	Egypt	Yes	Arabic
		Boucheron et al. [32]	Namibia, Uganda, Nigeria and Zambia	NR	NR
		Nsaful et al. [23]	Ghana	Yes	Twi
EORTC QLQ-BR45	European Organisation for Research and Treatment of Cancer Quality of Life-Breast Cancer module-45 items	Amin et al. [49]	Egypt	NR	NR
		Tchente et al. [70]	Cameroon	NR	NR
BREAST-Q	A patient-reported outcome measure (PROM) for measuring patient satisfaction and QoL in breast cancer patients.	Abdel-Mordy et al. [47]	Egypt	Yes	Arabic
		Ahmed and Dawood [48]	Egypt	Yes	Arabic
		Fihri et al. [58]	Morocco	NR	NR
		Kennedy et al. [62]	Ghana and Ethiopia	NR	NR
		Romanoff et al. [69]	Nigeria	Yes	Yoruba
FACT-B	Functional Assessment of Cancer Therapy–Breast	Abdelrahman et al. [2]	Egypt	Yes	Arabic
		Tchente et al. [70]	Cameroon	NR	NR
FACT-MBIS	Functional Assessment of Cancer Therapy–McGill Body Image Scale-Head and Neck	Tchente et al. [70]	Cameroon	NR	NR
WHOQOL-BREF	World Health Organisation Quality of Life Brief Version	Bioku et al. [51]	Nigeria	No	NA
		Boucheron et al. [52]	Namibia, Nigeria and Uganda	Yes	Local languages
		Moussa et al. [67]	Egypt	Yes	English
		Tchente et al. [70]	Cameroon	NR	NR
WHOQOL-100	World Health Organisation Quality of Life-100 items	Elsoud et al. [55]	Egypt	NR	NR
SF-12	Short-Form Health Survey-12-item	Abdelhafez et al. [43]	Egypt	Yes	Arabic
SF-36	Short-Form Health Survey-36-item	Ibrahim [61]	Egypt	Yes	Arabic
GHQ-12	General Health Questionnaire-12-item	Bioku et al. [51]	Nigeria	No	NA
QOL-CSV	Quality-of-Life Patient-Cancer Survivor Version	Wilkinson and Smith [71]	South Africa	No	NA
EQ-5D-3 L	EuroQol-Five Dimension-Three Level Scale	Eman El et al. [56]	Egypt	Yes	Arabic
RAM	Roy's Adaptation Model	Abdel-Mordy et al. [47]	Egypt	Yes	Arabic
DASS-21	Depression, Anxiety and Stress Scale-21 items	Araby et al. [50]	Egypt	NR	NR
		El-Rahman et al. [54]	Egypt	NR	NR
		Nabawy et al. [41]	Egypt	Yes	Arabic
PHQ-9	Patient Health Questionnaire (for screening, diagnosing, monitoring and measuring the severity of depression)	Kennedy et al. [62]	Ghana and Ethiopia	NR	NR
GAD-7	Generalised Anxiety Disorder	Kennedy et al. [62]	Ghana and Ethiopia	NR	NR
HADS	Hospital Anxiety and Depression Scale	Aquil et al. [63]	Morocco	Yes	Arabic
BDI-II	Beck Depression Inventory	Fekih-Romdhane et al. [57]	Tunisia	Yes	Arabic
BHS	Beck Hopelessness Scale	Fekih-Romdhane et al. [57]	Tunisia	Yes	Arabic
Mini-MAC	Mini-Mental Adjustment to Cancer Scale	Hamed et al. [59]	Egypt	Yes	Arabic
		Rashwan et al. [68]	Egypt	NR	NR

Table 2 (continued)

QoL Scales (Abbrev.)	QoL Scales (Full name)	Authors	Country	Translated	Language (Translation)
BIS	Body Image Scale	Aquil et al. [63]	Morocco	Yes	Arabic
		El-Din et al. [40]	Egypt	Yes	Arabic
		Mokhtar et al. [44]	Egypt	Yes	Arabic
		Mokhtar et al. [65]	Egypt	Yes	Arabic
		Mostafa et al. [66]	Egypt	Yes	Arabic
		Hamed et al. [59]	Egypt	Yes	Arabic
		Mageed et al. [64]	Egypt	Yes	Arabic
BIMWS	Body Image of Mastectomy Women Scale	El-Adham and Elsherif [53]	Egypt	Yes	Arabic
SCS	Self Compassion Scale	El-Din et al. [40]	Egypt	Yes	Arabic
		Mokhtar et al. [44]	Egypt	Yes	Arabic
		Mokhtar et al. [65]	Egypt	Yes	Arabic
RSES	Rosenberg Self-Esteem Scale	Mageed et al. [64]	Egypt	Yes	Arabic
		Mostafa et al. [66]	Egypt	Yes	Arabic
		Nabawy et al. [41]	Egypt	Yes	Arabic
PS	Perfectionism Scale	El-Din et al. [40]	Egypt	Yes	Arabic
FSFI	Female Sexual Function Index	Abdelhafez et al. [43]	Egypt	Yes	Arabic
MWSSQ	Married Women's Sexual Satisfaction Scale	Abdelhafez et al. [43]	Egypt	Yes	Arabic
MWHO-QSLS	Modified WHO Quality of Sexual Life Scale	Mageed et al. [64]	Egypt	Yes	Arabic
ENRICH-MSS	ENRICH Marital Satisfaction Scale	Araby et al. [50]	Egypt	NR	NR
PFS	Piper Fatigue Scale	Rashwan et al. [68]	Egypt	NR	NR
MFIS	Modified Fatigue Impact Scale	Araby et al. [50]	Egypt	NR	NR
WBFPRS	Wong-Baker Faces Pain Rating Scale	Araby et al. [50]	Egypt	NR	NR
SAF	Shoulder Ability and Function	Araby et al. [50]	Egypt	Yes	Arabic
PSQI	Pittsburgh Sleep Quality Index	Fekih-Romdhane et al. [57]	Tunisia	Yes	Arabic
UCLA-LS	UCLA Loneliness Scale	Nabawy et al. [41]	Egypt	Yes	Arabic
SMS	Self-Management Scale	Ibrahim [61]	Egypt	Yes	Arabic
GSES	General Self-Efficacy Scale	Hashem et al. [60]	Egypt	NR	NR
SES	Self Efficacy Scale	Mostafa et al. [66]	Egypt	Yes	Arabic

NR: Not Reported

NA: Not Applicable

reinforced that mastectomy was often the primary surgical treatment option, typically performed after neoadjuvant chemotherapy in locally advanced cases [3, 40, 41, 50, 64, 67]. Across the reviewed literature, mastectomy rates appeared to be higher among middle-aged and older women, with age ranges predominantly between 40 and 60 years, as indicated in eight studies [41, 44, 51, 54, 56, 66, 68, 71]. Most prevalence data were inferred through hospital-based samples, retrospective audits, or treatment patterns, suggesting a critical gap in comprehensive epidemiological research.

Measurement tools used to evaluate QoL post-mastectomy

Across studies, a range of validated instruments were used to assess QoL, psychosocial wellbeing, and associated factors after mastectomy among women in Africa (Table 2). Prominent tools included the EORTC QLQ-C30, EORTC QLQ BR23, and EORTC QLQ BR45,

particularly in Egypt, Ethiopia, Ghana, and Cameroon [2, 3, 23, 32, 33, 49, 70]. Additional frequently employed instruments were the BREAST-Q [47, 48, 58, 62, 69] and WHOQOL scales [51, 52, 55, 67, 70].

Psychosocial wellbeing after mastectomy was assessed through multiple tools, including DASS-21, PHQ-9, GAD-7, HADS, BDI-II, and BHS [41, 50, 54, 57, 62, 63]. Furthermore, the BIS was used to identify body image concerns affecting the QoL [40, 44, 59, 63–66] and BIMWS [53]. Coping strategies and mental adjustment were evaluated with the Mini-MAC [59, 68] and SCS [40, 44, 65]. Additionally, Table 2 displays other tools used to assess self-esteem, sexual function, fatigue, pain, marital satisfaction, and sleep quality.

In the reviewed studies, researchers consistently justified using standardised tools to measure QoL after mastectomy for several important reasons. They highlighted the necessity for validated and reliable instruments that

can effectively capture the various ways breast cancer and its treatment impact survivors' lives [23, 69]. Tools like the BREAST-Q, EORTC QLQ-C30/BR23, and FACT-B were chosen because they systematically assess key areas such as physical health, emotional wellbeing, body image, social relationships, and sexual health — domains that are significantly affected after a mastectomy [71]. Since QoL is subjective and complex, researchers emphasised the need for validated questionnaires to detect changes over time and across different cultures [3, 52]. WHO-QOL-BREF was chosen in several studies because it can be adapted to different cultures and covers important aspects of wellbeing, including physical, psychological, social, and environmental factors. This makes it particularly useful in diverse and low-resource settings [51, 52, 67, 70]. Many studies supported their selection of specific instruments based on their clinical relevance and focus on patients' experiences. For instance, the BREAST-Q was often chosen for its modules that specifically address various aspects of breast surgery, including satisfaction with breast appearance, psychosocial health, and sexual functioning [58, 69]. The EORTC QLQ tools were favoured due to their international validation and ability to compare outcomes across different populations [23]. Researchers also pointed out the importance of capturing treatment-related side effects, such as lymphedema and fatigue, which general QoL measures might miss, making tools like the EORTC QLQ-BR23 and BR45 valuable [23, 32, 33]. Furthermore, standardised measures were used to ensure comparability and assess the effectiveness of interventions. Studies that included psychological or physical rehabilitation needed consistent outcome measures to demonstrate their impact and quantify improvements [41, 68]. Using internationally recognised tools enabled researchers to compare their findings with existing literature and apply results globally. Structured instruments were also noted to reduce bias compared to clinicians' subjective evaluations, improving objectivity and reproducibility in research.

Lastly, a few papers acknowledged limitations in the available tools but justified their choices due to the absence of better alternatives validated in local languages or cultural contexts [51, 69]. In these instances, as displayed in Table 2, several researchers adapted existing tools, translated them, and validated them before use to uphold methodological standards while addressing specific contextual needs. However, some studies did not provide information about the translation (NR = Not Reported), while others reported that the absence of translation was a limitation of the studies.

Overall QoL post-mastectomy

The review of various studies on the QoL for women after mastectomy due to breast cancer shows significant differences depending on the location and type of support available. Many studies found that women often reported low to moderate QoL scores. For instance, at the Baheya Foundation in Egypt, women had a median global QoL score of 42, much lower than what was found in similar studies in other countries [2]. In Ethiopia, women post-mastectomy had a mean QoL score of 48.25, and factors like poor psychological and social support were mentioned as reasons for this [3], while Ali et al. [33] noted a lower mean score of 57.3 in Egypt, suggesting substantial impairment. In South Africa, survivors reported varying QoL scores, with the highest score being spiritual wellbeing and the lowest being psychological wellbeing [71]. In Northern Nigeria, the average QoL score was 50.91, and approximately 15% of participants reported poor QoL, and social relationships were notably affected [51]. In another study from El-Beheira Governorate, 56% of women reported poor QoL, with an average score of 51.27 [48].

Boucheron et al. [52] reported poor to moderate QoL scores among long-term breast cancer survivors across several African countries, with mean scores below global norms. Factors contributing to reduced QoL included physical symptoms (pain, fatigue, arm morbidity), emotional distress (anxiety, depression, hopelessness), body image dissatisfaction, impaired sexual functioning, social isolation, and limited access to healthcare and psychosocial support [33, 41, 68, 69, 71]. Financial constraints, transportation barriers, and low access to information and skills further exacerbated these challenges, negatively impacting QoL outcomes [51, 62, 67].

On the other hand, some studies reported higher QoL scores. In Ghana, breast cancer survivors had a median global health status score of 83.3 out of 100, with satisfaction regarding breast appearance positively affecting their QoL [23]. Similarly, women who underwent breast reconstruction in Marrakesh had a mean QoL score of 79.14 out of 100 [58]. Long-term survivors in Sub-Saharan Africa showed promising results, achieving an overall QoL score of about 80%, which was better than that of cancer-free individuals [52].

Measured outcomes of QoL post-mastectomy

The standardised tools used yielded significant outcomes affecting the QoL after mastectomy among women in Africa. These outcomes are grouped into physical, psychological, social, sexual functioning, financial and access to healthcare services dimensions.

Physical outcomes

A broad range of physical outcomes was frequently documented among women who underwent mastectomy in the included African studies. Pain consistently emerged as one of the most reported physical symptoms

post-mastectomy, with approximately 43–92.8% of patients experiencing moderate to severe post-operative pain, particularly in the arm, shoulder, and chest areas [2, 32, 33, 56, 69, 71]. Arm and shoulder morbidity was especially pronounced, with studies reporting high rates of lymphedema, arm swelling, stiffness, and significant arm pain [32, 33]. A study conducted by Ali et al. [33] reported a mean symptom score for arm morbidity of 57.55 out of 100 on the EORTC QLQ-BR23, indicating significant physical impairment. Additionally, fatigue was prevalent, affecting between 54% and 65% of participants across multiple studies [2, 33, 68], severely impacting daily functioning and overall QoL.

Post-mastectomy, women frequently reported decreased physical functioning and a reduced ability to perform daily activities, with functional impairment scores reflecting significant deterioration post-surgery [2, 56, 70]. A study conducted in Egypt by Eman El et al. [56] reported reduced mobility (70.4%), challenges in self-care (56.8%), and limitations in activities (81.6%). Similarly, Abdelrahman et al. [2] highlighted that 62% of their Egyptian cohort had impaired role functioning, while Ali et al. [33] found similar low mean scores of 58.26 out of 100 for physical functioning on the EORTC QLQ-C30. In Cameroon, Tchente et al. [70] reported severe functional limitations, scoring just 2.7 out of a possible 20, indicating profound difficulty in routine physical tasks, and approximately at least 41.2% have their physical outcomes altered to some extent. Sleep disturbances were another prevalent physical symptom reported post-surgery. Abdelrahman et al. [2] and Ali et al. [33] reported insomnia rates of approximately 61% and 66.5%, respectively, while Fekih-Romdhane et al. [57] found that 66% of Tunisian post-mastectomy patients suffered from poor sleep quality. Across studies that stratified outcomes by stage, those with more advanced disease stages (Stage III/IV) often reported worse physical outcomes than those with early-stage disease [2, 56, 69]. Moreover, time since mastectomy influenced physical symptomatology, with symptoms such as lymphedema, pain, and fatigue persisting years after surgery in some cohorts [59, 67].

Psychological outcomes

Psychological outcomes of post-mastectomy included body image disturbance and emotional distress. Body image disturbance was frequently reported and identified as a key psychological outcome in eight studies [40, 44, 53, 58, 59, 65, 66, 69]. A study conducted by Nsaful et al. [23] found that the body image scores were notably lowest for the BRS group, with an average score of 83.3 (ranging from 68.8 to 91.7), while the BCS group reported the highest average score of 100 (with a range of 91.7 to 100).

Emotional distress, which includes anxiety, depression, hopelessness, and psychological stress, was a significant finding across nine studies [41, 49, 51, 54–57, 63, 68]. Anxiety was a prevalent mental health issue among women after mastectomy in Africa, with numerous studies indicating varied levels of anxiety, often moderate to severe, before intervention. Anxiety was explicitly measured in 12 studies [41, 44, 50, 51, 54, 56, 59, 62, 63, 68, 69]. Standardised tools, primarily the Depression, Anxiety, and Stress Scale (DASS-21), were utilised for anxiety assessment [50, 54, 68]. Kennedy et al. [62] employed the Generalised Anxiety Disorder scale (GAD-7) in Ghana and Ethiopia, finding baseline mild anxiety (mean = 5.3) significantly decreased at six months post-mastectomy (mean = 1.6), underscoring the effectiveness of supportive care. Bioku et al. [51] reported a 36.1% prevalence of psychological distress using the 12-item General Health Questionnaire (GHQ-12), indicating substantial anxiety concerns. Eman El et al. [56] found an alarming 84% anxiety prevalence with the EQ-5D-3 L tool, particularly among younger survivors, highlighting age as a critical factor in anxiety severity.

Clinically meaningful improvements in anxiety were reported following structured psycho-educational, psychosocial, and psychological interventions. Mokhtar et al. [44] noted significant anxiety reductions through Acceptance and Commitment Therapy (ACT), illustrating the efficacy of mindfulness-based approaches. Similarly, psychosocial interventions assessed by Araby et al. [50] and Rashwan et al. [68] showed substantial reductions in DASS-21 scores post-intervention, with Rashwan et al. [68] documenting a shift from severe to mild anxiety levels. Hamed et al. [59] corroborated these results, evidencing significant anxiety reductions alongside broader mental adjustment improvements post-intervention. Romanoff et al. [69] acknowledged anxiety as a significant dimension of emotional distress impacting psychosocial adjustment and QoL in breast cancer survivors. These findings confirm that anxiety is a significant concern for African women post-mastectomy, with strong evidence supporting structured psychological and psychosocial interventions as effective strategies for anxiety reduction and psychosocial enhancement.

Depressive symptoms represent significant psychological consequences after mastectomy, as evidenced by multiple studies employing standardised assessment tools. DASS-21 was prominently utilised to evaluate various dimensions of depression [41, 50, 54, 68]. For example, El-Rahman et al. [54] reported elevated pre-intervention depressive scores (mean = 26.60 ± 2.52), which decreased post-intervention (mean = 13.45 ± 1.43), indicating substantial improvement following structured interventions. Similarly, Araby et al. [50] observed baseline depressive scores (mean = 17.33 ± 2.67) improve markedly at

one-month post-intervention (mean = 9.91 ± 2.38), showcasing the effectiveness of educational-supportive programs. Additional specialised tools were employed to evaluate depressive severity, such as PHQ-9, BDI-II and HADS [57, 62, 63]. Kennedy et al. [62] found a significant improvement in depressive scores among women at three- and six-month post-mastectomy—using PHQ-9. Fekih-Romdhane et al. [57] used both BDI-II and DASS-21, revealing high severity of depressive symptoms linked to hopelessness and diminished QoL. Aquil et al. [63] applied the Hospital Anxiety and Depression Scale (HADS), identifying substantial depressive symptoms correlated with younger age, lower socioeconomic status, and later stages of breast cancer, underscoring the role of demographic factors as predictors of post-mastectomy depression.

Social outcomes

Social relationships, particularly the ability to form and maintain interpersonal connections, were significantly impaired after mastectomy, according to 10 studies [32, 33, 41, 59, 65–67, 69–71]. Studies reported that women had moderate to severe difficulties in maintaining existing relationships or initiating new ones, primarily due to physical changes, emotional distress, and decreased self-esteem [65, 66, 71]. Social roles—including responsibilities within families, workplaces, and communities—were significantly impacted following mastectomy, as reported in 8 studies [23, 32, 49, 51, 62, 69–71]. Results indicated a reduced ability or inability of women after mastectomy to fulfil their previous social roles effectively, particularly in areas related to family care, work tasks, and community involvement [69–71]. Participation in social activities and the adaptation to these activities following mastectomy were discussed in 7 studies [23, 32, 33, 51, 67, 70, 71].

A common trend was reduced participation or withdrawal from social activities mainly due to physical discomfort, fear of stigma, and negative body image perceptions [33, 51, 71]. For instance, Ali et al. [33] reported significant limitations in social functioning scores on the EORTC QLQ-C30. Furthermore, social isolation emerged as a notable and frequent outcome following mastectomy, documented in 9 studies [41, 51, 59, 65–67, 69–71]. Three studies indicated that women experienced moderate to severe social isolation, worsened by stigma, diminished self-confidence, and avoidance behaviours [65, 67, 71].

The social stigma associated with breast loss, perceptions of femininity, and cancer diagnoses was explicitly reported in 7 studies [32, 65–67, 69–71]. Studies by Mokhtar et al. [65] and Wilkinson and Smith [71] found that women faced stigma and discrimination from their communities, families, or social groups, leading to emotional distress, self-isolation, and reduced social interaction [65, 71].

Post-mastectomy communication, especially regarding emotional expression, support-seeking, and disease discussions, was markedly impaired in 6 studies [41, 65–67, 69, 71]. Women reported significant challenges in openly communicating their feelings and concerns, often due to fears of rejection or being a burden to family members [66, 71]. Community and religious support played a significant role in social functioning and coping mechanisms, as documented in 4 studies underscoring the positive influence of cultural and spiritual contexts [41, 67, 69, 71].

Sexual functioning outcomes

Research indicates that many African women experience impaired sexual functioning and intimacy issues following mastectomy [33, 43, 66, 69]. A study by Ali et al. [33] reported a mean sexual functioning score of 67.49 out of 100, while a study in Cameroun by Tchente et al. [70] found severe sexual impairment (mean score = 1.2 out of 4), with a significant percentage reporting alteration of sexual life 88.3% (slightly altered = 36.3%, occasionally altered = 36.3% and quite altered = 15.6%). The Female Sexual Function Index (FSFI) is a primary instrument for evaluating sexual dysfunction across several areas, including arousal, lubrication, orgasm, satisfaction, and pain [3, 33, 43]. Ali et al. [33] used the FSFI alongside the EORTC QLQ-BR23 and found significant impairments in sexual desire and arousal post-mastectomy. Abdelhafez et al. [43] also employed the FSFI to assess sexual dysfunction before and after group counselling interventions, reporting substantial improvements in sexual function, with scores rising from a pre-intervention average of 41.88 to 88.30 afterwards, reflecting substantial clinical enhancement. Abebe et al. [3] used FSFI along with EORTC QLQ-BR23, documenting high baseline sexual functioning scores but persistent sexual enjoyment impairment post-mastectomy, with mean sexual functioning at 85.3 and sexual enjoyment at 71.2, highlighting continued challenges despite relatively higher functioning scores. Similarly, Abebe et al. [3] found that while baseline sexual functioning scores were relatively high, there remained persistent issues with sexual enjoyment post-mastectomy, highlighting ongoing challenges despite better functioning scores.

Studies by Amin et al. [49] and Nsaful et al. [23] used the EORTC QLQ-BR23 to document declines in sexual functioning and enjoyment, correlating these declines with negative body image and psychological distress after surgery. Romanoff et al. [69] employed the BREAST-Q tool and reported a significant drop in sexual wellbeing, with average scores decreasing from 42 before surgery to 25 afterwards, indicating clinically meaningful

reductions in sexual functioning and satisfaction. Additional research using the Modified WHO Quality of Sexual Life Scale by Mageed et al. [64] and the Body Image and Marital Wellbeing Scale (BIMWS) by El-Adham and Elsherif [53] confirmed that sexual dysfunction is closely linked to decreased marital satisfaction and negative self-perceptions regarding femininity and sexual attractiveness. Though infrequently assessed, marital satisfaction post-mastectomy is a critical dimension affected by breast cancer treatment, as highlighted in 2 studies [65, 66]. Marital satisfaction was associated with alterations in sexual functioning, intimacy, emotional connectivity, and overall relationship quality following mastectomy—common outcomes following mastectomy [52, 67, 70].

Financial impact

Financial challenges were prominently identified in 11 studies — reporting economic hardship as a significant concern for women after mastectomy [2, 3, 23, 32, 33, 51, 52, 62, 67, 69, 71]. These financial difficulties primarily stemmed from insufficient income, treatment costs, follow-up care expenses, loss of income due to an inability to work, and a lack of financial support mechanisms [23, 33, 49, 50, 52, 53, 55, 58, 66].

Access to healthcare services

Limited access to health and social care services emerged as a critical concern post-mastectomy, as reported by 13 studies [2, 3, 23, 32, 33, 51, 52, 62, 67–71]. Accessibility issues included inadequate follow-up care, limited rehabilitation facilities, insufficient psychosocial support, and significant barriers due to distance from healthcare providers [51, 71]. Inadequate access to reliable information about mastectomy, breast cancer management, rehabilitation resources, and coping skills was prominently reported in 9 studies [2, 32, 50, 51, 62, 67–69, 71]. Results from this study reported significant unmet needs for accessible information on post-surgical care, symptom management, rehabilitation exercises, psychological coping strategies, and community support systems [62, 69, 71]. The influence of media, particularly concerning the portrayal of femininity, breast cancer, and survivorship narratives, was less explored, appearing in 2 studies — indicating that media portrayals often exacerbated feelings of inadequacy, anxiety, and social withdrawal due to unrealistic body image representations and survivorship narratives [65, 66].

Interventions to improve QoL post-mastectomy

Interventions to improve QoL, psychological wellbeing, and coping strategies for post-mastectomy women have included educational and supportive programs that enhance knowledge, self-efficacy, and health-related behaviours. Notably, integrated programs incorporating education, psycho-educational training, and structured exercise have significantly improved QoL. For instance, an Egyptian study implementing self-management guidelines reported an increase in the SF-36 QoL score from 28.7 to 80.0 [61]. Furthermore, quasi-experimental and randomised studies [48, 50, 60] have significantly improved physical functioning, self-care, marital satisfaction, and psychological adjustment. These interventions often included components such as post-operative care, therapeutic exercises, and health education, contributing to both physical rehabilitation and emotional resilience.

Psycho-social and psycho-educational interventions have also been effective in alleviating psychological distress and enhancing adaptive functioning. Specifically, interventions targeting emotional challenges — such as depression, anxiety, stress, and loneliness — have improved self-esteem and body image [41, 59]. Group counselling, often based on cognitive or problem-solving methodologies, improved sexual health, emotional wellbeing, and overall QoL [43]. Acceptance and commitment training [44] significantly enhanced self-compassion and body image perception associated with mastectomy experience, thereby mitigating its psychological consequences [44].

The application of theoretical models, including Roy's Adaptation Model and self-management frameworks, has shown promise in facilitating structured behavioural change, self-monitoring, and emotional regulation, leading to improved patient satisfaction, adaptive functioning, and long-term QoL [47, 61]. Innovative delivery methods — such as mobile-based health education [55] and combined mind-body interventions featuring seated exercises and psychoeducation [68] — have broadened access to support, particularly in resource-limited settings. These multimodal strategies effectively addressed both physical symptoms (fatigue and pain) and psychological outcomes (helplessness and coping difficulties).

Discussion

This scoping review found that overall, the QoL was lower among women after mastectomy and related treatments. Mastectomy significantly affects various aspects of women's lives, including their QoL, body image, emotional health, marital relationships, and coping strategies [3, 40, 41, 44, 50, 60–63, 65, 66]. Most studies indicated that mastectomy negatively impacts women's body image, leading to lower self-esteem, increased feelings of depression and anxiety, sexual difficulties, and dissatisfaction in marriage [48, 58, 59]. In this study, assessment tools such as BREAST-Q, EORTC QLQ-C30/BR23, FACT-B, and WHOQOL-BREF showed significant declines in physical, emotional, and social functioning after surgery. The use of various standardised tools to measure QoL after mastectomy has been documented

in the literature [22, 73–75]. Studies have shown that mastectomy can significantly affect the QoL for breast cancer survivors, particularly in areas such as emotional wellbeing, physical health, and sexual function [22, 74, 76]. Many survivors who undergo breast reconstruction, especially if it is done right after the mastectomy, report better QoL, improved body image, and enhanced sexual functioning [74, 77]. Issues such as depression, chronic health conditions, and abdominal obesity can have a detrimental effect on the QoL after mastectomy and among cancer survivors [78]. Sexual health is also a significant area of concern, with many studies reporting low satisfaction levels [39, 73].

Evidence from this review highlighted the importance of various interventions, including educational support programs, psycho-educational rehabilitation, group counselling focused on positive psychology, self-compassion training, and structured therapeutic exercises, on improving post-mastectomy outcomes for women [41, 43, 68]. Participants in these programs reported reductions in pain, fatigue, depression, anxiety, and stress, along with improvements in shoulder mobility, body image satisfaction, sexual health, coping skills, and overall QoL [40, 63, 64]. Programs that combined physical rehabilitation with psychological training, such as mindfulness and problem-solving, were particularly effective in promoting comprehensive recovery [48, 68]. Moreover, strong self-compassion, self-efficacy, and supportive marital relationships were associated with better psychological adjustment [44, 50]. Evidence from studies conducted in various countries, including Egypt, Nigeria, Ghana, South Africa, Tunisia, and Morocco, indicated some contextual differences; however, the overall findings were consistent: non-pharmacological, multi-faceted interventions tailored to women's physical and emotional needs significantly reduced the negative effects of mastectomy and improved long-term survivorship [57, 69, 71]. Nevertheless, only a few studies thoroughly examined sexual health recovery, and many emphasised the necessity for longer follow-up periods to assess sustained improvements [60, 62, 67].

Limitations
Despite the valuable insights gained from the research, several limitations were identified. One major issue is the heavy reliance on quasi-experimental and cross-sectional study designs, which complicates determining clear cause-and-effect relationships between interventions and outcomes. Many studies also employed convenience sampling within a single hospital, limiting the ability to apply findings to broader populations. All 34 studies included in this review used a variety of quantitative designs, and the sample size ranged from 30 to 1,476 participants. This could affect study reliability and generalisability. Smaller samples risk reduced statistical power, bias, and imprecise estimates, while larger samples offer more robust and generalisable findings. This variability complicates comparisons between studies and must be considered when interpreting and synthesising research results. The geographical distribution of studies indicates a significant concentration in Egypt, comprising 22 studies, which suggests regional dominance and potential geographical bias, thereby limiting the generalizability of findings to other African contexts. While the diversity of contexts offers opportunities for comparative analysis, it complicates the synthesis of results due to inherent heterogeneity. Furthermore, the lack of data on breast cancer in females under 18 limits this study. While rare, missing data on this age group limits a comprehensive understanding of breast cancer's burden among girls.

Additionally, cultural factors affecting perceptions of body image, coping strategies, and marital satisfaction were often inadequately explored, particularly in African contexts where the stigma associated with breast cancer may differ from that in Western countries. Moreover, the lack of long-term follow-up in most interventions raises questions about the lasting nature of any observed improvements. Another significant gap is the limited focus on sexual health outcomes following mastectomy despite evidence of ongoing difficulties in this area. Finally, inconsistencies in the measurement tools and incomplete reporting of their reliability and validity have hindered the comparison and synthesis of results across different studies.

Implications
The study's findings have critical implications for clinical practice, research, and health policy, emphasising the necessity of integrated, multidisciplinary rehabilitation for post-mastectomy women. This includes the combination of physical therapy, psychological support, self-management education, and counselling on marriage or sexual health. Healthcare providers must implement culturally sensitive, holistic interventions addressing body image, self-esteem, pain management, sexual health, and mental wellbeing as vital components of care for breast cancer survivors. From a research perspective, future studies should employ robust methodologies, such as randomised controlled trials and standardised measurement tools such as EORTC QLQ (C30, BR23, and BR45), BREAST-Q, FACT-B and WHOQOL-BREF, along with long-term follow-up assessments to enhance evidence quality. Interventions should also account for socio-cultural factors, including breast cancer stigma, access to reconstruction options, and family support dynamics. Furthermore, to enrich understanding and provide deeper contextual insights into QoL after mastectomy, future research should consider incorporating qualitative

and mixed-methods approaches, which can complement quantitative findings by exploring participants' lived experiences, perceptions, and underlying mechanisms. Policymakers should advocate for the integration of psycho-social rehabilitation services in national breast cancer management guidelines to improve the overall QoL for survivors, particularly after mastectomy.

Furthermore, the observed disparity in the geographical distribution of research studies underscores the imperative to promote North-South and intra-African research collaborations. Such collaborations are essential for enhancing research capacity and generating more equitable, contextually relevant evidence to inform policy and practice across diverse African regions. Due to the small sample sizes observed in some of the included studies, future quantitative studies should utilise larger and more consistent sample sizes to enhance reliability and generalizability. Standardising sample size calculations via power analysis is critical for ensuring adequate statistical power and reducing bias. Furthermore, the paucity of data from numerous African countries emphasises the necessity for more inclusive research that captures a wider array of African environments, especially in sub-Saharan Africa, rural or resource-limited settings. Additionally, future research should specifically investigate the prevalence and characteristics of breast cancer in individuals under 18 to provide a more comprehensive understanding of the disease across all age groups.

Conclusion
This scoping review analysed 34 studies on QoL, psychological adjustment, body image, sexual health, and coping strategies among women after mastectomy. Findings indicate that breast cancer treatments, particularly mastectomies, significantly impact survivors' physical, emotional, and social wellbeing. Effective interventions include educational programs, therapeutic exercises, cognitive-behavioural therapies, and self-compassion training. The review noted limitations, such as differences in samples sizes, research methods, tool variability, disparity in the geographical distribution of studies, lack of long-term studies, and insufficient consideration of cultural factors, underscoring the need for more high-quality, long-term research. Incorporating comprehensive rehabilitation programs into standard breast cancer care after mastectomy, especially in low- and middle-income countries, is essential to address survivors' broader needs. Future research should focus on standardised measurement tools, cultural sensitivity, and underexplored areas like sexual health and relationship dynamics to improve the QoL for women after treatment worldwide.

Declarations

Human ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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