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EFFECTIVENESS OF A COMMUNITY-BASED HEALTH EDUCATION INTERVENTION ON BREAST CANCER AWARENESS AND SCREENING UPTAKE AMONG WOMEN IN RIVERS STATE, NIGERIA: A QUASI-EXPERIMENTAL STUDY

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ABSTRACT

Background: Breast cancer remains a leading cause of cancer morbidity and mortality among women worldwide, with disproportionately poor outcomes in sub-Saharan Africa due to late-stage presentation and limited screening uptake. In Nigeria, the awareness-practice gap persists, with low participation in breast cancer screening despite increasing awareness campaigns. This study evaluated the effectiveness of a community-based health education intervention on breast cancer awareness and screening uptake among women in Rivers State, Nigeria.

Methods: A quasi-experimental, two-group pretest-posttest design was conducted from February to May 2025 in two urban communities in Rivers State. A total of 340 women aged 30–69 years were enrolled (170 per group). The intervention group received a structured six-week breast cancer health education delivered in Pidgin English, while the comparison group received routine health information. Outcomes included breast cancer awareness (≥70% knowledge score), screening uptake (clinical breast examination and mammography), health beliefs, and behavioural intentions. Data were analysed using descriptive statistics, difference-in-differences analysis, and multivariable logistic regression.

Results: The mean age of participants was 42.3 ± 10.7 years, with most women married (81.8%), having at least secondary education (70.6%), and employed (65.9%). Good breast cancer awareness increased from 24.7% to 78.8% in the intervention group compared to 23.5% to 28.2% in the comparison group (difference-in-differences [DiD]: +49.4%; $p < 0.001$). Clinical breast examination uptake improved from 10.6% to 57.6% (DiD: +44.1%; $p < 0.001$), mammography from 2.4% to 18.8% (DiD: +15.3%; $p < 0.001$), and any screening from 11.8% to 60.0% (DiD: +45.3%; $p < 0.001$). Knowledge of risk factors, symptoms, and early detection methods, as well as health beliefs and behavioural intentions, improved significantly ($p < 0.001$). Exposure to the intervention was the strongest predictor of screening uptake (AOR = 6.23; 95% CI: 3.45–11.27; $p < 0.001$), with other significant predictors including higher education (AOR = 2.45; $p = 0.010$), good awareness (AOR = 3.89; $p < 0.001$), family history (AOR = 2.89; $p = 0.014$), prior breast cancer

information (AOR = 2.12; p = 0.029), high perceived benefits (AOR = 2.56; p = 0.013), and low perceived barriers (AOR = 2.89; p = 0.004). Sensitivity analyses confirmed the robustness of findings across alternative thresholds and analytical approaches.

Conclusion: A structured community-based health education intervention significantly improved breast cancer awareness, knowledge, health beliefs, and screening uptake among women in Rivers State, Nigeria. Community-based, culturally tailored health education can effectively address the awareness-practice gap and should be integrated into primary healthcare and cancer control frameworks. The intervention model has potential for scale-up across Nigeria and other resource-limited settings.

Keywords: Breast Cancer; Community-Based Intervention; Health Education; Screening Uptake; Awareness; Quasi-Experimental Study; Nigeria

1 INTRODUCTION

Breast cancer constitutes a major global public health challenge and remains the most commonly diagnosed cancer among women worldwide. Recent Global Cancer Observatory (GLOBOCAN) estimates indicate that female breast cancer accounted for approximately 11.8% of all newly diagnosed cancers globally in 2024 and 7.1% of cancer deaths, establishing it as both a primary cause of morbidity and a leading contributor to cancer mortality among women. The global burden is projected to increase substantially over the coming decades, with the greatest proportional increases expected in countries with lower levels of human development, where health systems often possess limited capacity for cancer prevention, early detection and treatment [1]. The Global Burden of Disease Study similarly demonstrated a substantial increase in breast cancer incidence over recent decades, while disparities in mortality persist between high- and low-resource settings [2]. These inequalities underscore the importance of interventions that promote early recognition of breast cancer and appropriate utilisation of available screening and diagnostic services.

The burden of breast cancer is particularly pronounced in low- and middle-income countries, where improvements in survival have generally lagged behind those observed in high-income settings. In sub-Saharan Africa (SSA), breast cancer is characterised by relatively young age at diagnosis, substantial late-stage presentation and poor survival. A 2026 systematic review involving 42,689 women with staged breast cancer found that 63.1% were diagnosed at late stage (stage III–IV), with the proportion reaching 71% in Western Africa [3]. Such advanced presentation reflects interacting patient, community, and health-system factors, including inadequate knowledge, fear, misconceptions, financial constraints, and delays in accessing appropriate diagnostic services. A systematic review of cancer-care delays in SSA further shows that socioeconomic barriers, difficulties reaching health facilities and weaknesses in referral pathways contribute substantially to delayed diagnosis and treatment [4].

Limited uptake of breast cancer screening represents another important challenge in SSA. A 2024 multilevel analysis of Demographic and Health Survey data from sub-Saharan African countries estimated the weighted prevalence of clinical breast cancer screening at only 14.23%. Screening uptake was higher among women with greater educational attainment, higher household wealth, urban residence and recent contact with health services [5]. These findings indicate that screening behaviour is shaped not only by individual knowledge but also by socioeconomic circumstances and access to health services. Consequently, improving breast cancer outcomes in SSA requires interventions that combine accurate health information with strategies that facilitate appropriate preventive and early-detection practices.

West Africa carries a substantial share of this burden. The high proportion of late-stage disease reported in West Africa suggests persistent gaps in population-level early detection [3]. Nigeria, Ghana and other countries in the subregion continue to face challenges related to cancer awareness, screening infrastructure and timely access to diagnosis. Educational interventions may provide an important mechanism for addressing modifiable barriers. Evidence from Ghana demonstrates that a structured breast cancer educational intervention significantly improved knowledge of breast cancer, its symptoms, risk factors and screening among high-school students, supporting the potential value of contextually appropriate health education in West African populations [6]. A 2026 systematic review protocol further highlights that evidence on the effectiveness of health education interventions for improving breast cancer literacy and screening uptake in SSA remains fragmented, particularly across different delivery approaches and cultural contexts [7].

Nigeria has one of the largest breast cancer burdens in Africa, with breast cancer representing the leading malignancy among Nigerian women. Recent Nigerian studies demonstrate that awareness of breast cancer does not necessarily translate into appropriate preventive behaviour. Among female undergraduates in southwestern Nigeria, 90.3% had poor knowledge of breast cancer and screening, while only 4.6% had undergone clinical breast examination [8]. Similarly, a national study of women working in the informal sector identified gaps in breast cancer awareness and

participation in screening, illustrating the persistence of barriers across different population groups [9]. These findings are important because health education should not be evaluated solely by its ability to increase awareness; its public health value ultimately depends on whether improved knowledge translates into appropriate screening and early-detection practices.

Evidence from intervention research in Nigeria supports the potential effectiveness of educational approaches. A 2025 quasi-experimental study conducted in southeastern Nigeria found that a breast cancer awareness intervention was associated with improvement in overall awareness and breast self-examination knowledge over 12 months [10]. These findings suggest that sustained, well-designed educational interventions can influence breast health knowledge and preventive practices. However, evidence from community-based adult women remains comparatively limited, particularly in southern Nigeria and the Niger Delta.

Rivers State provides an important setting for evaluating such an intervention. Recent studies from Port Harcourt have identified substantial gaps in breast cancer knowledge and screening behaviour. In a community-based study among women in Port Harcourt City, 62% did not know the symptoms of breast cancer and 89.2% had never undergone any form of breast cancer screening [11]. Studies among women attending antenatal services at the Rivers State University Teaching Hospital have similarly reported high general awareness but considerably lower uptake of specific preventive practices, including mammography [12]. These findings demonstrate a critical awareness–practice gap within the local population and suggest that information alone may be insufficient without structured, community-oriented health education that addresses misconceptions, perceived barriers and practical knowledge about screening.

Despite increasing attention to breast cancer awareness in Rivers State, there is limited empirical evidence evaluating whether a structured community-based health education intervention can produce measurable improvements in both breast cancer awareness and screening uptake among adult women. This study therefore addresses this gap by evaluating the effectiveness of a community-based health education intervention among women in Rivers State, Nigeria, using a quasi-experimental design.

1.1 Aim of the Study

The study aimed to determine the effectiveness of a community-based health education intervention on breast cancer awareness and screening uptake among women in Rivers State, Nigeria.

1.2 Research Questions

- What is the baseline level of breast cancer awareness and screening uptake among women in the study population?
- Does a community-based health education intervention significantly improve breast cancer awareness among women?
- Does the intervention significantly improve breast cancer screening uptake and related preventive practices?
- What sociodemographic and other factors are associated with breast cancer screening uptake following the intervention?

2 METHODOLOGY

2.1 Study Area

The study was conducted in Rumuolumeni (intervention community) in Obio/Akpor Local Government Area (LGA) and Woji (control community) in Port Harcourt Local Government Area, all in Rivers State, Nigeria. Rivers State is located in the Niger Delta region of southern Nigeria. Both communities have heterogeneous populations, access to primary healthcare facilities and other health services, and diverse socioeconomic and educational backgrounds. They are approximately ten kilometres apart to avoid contamination of the participants.

2.2 Study Design and Duration

A quasi-experimental, two-group pretest-posttest design was used. Women in the intervention community received structured breast cancer health education, whereas women in the comparison community received routine health information available through existing health services. Both groups underwent baseline and post-intervention assessments.

The study was conducted for four months, from February to May 2025. The first month was used for community entry, recruitment, instrument pretesting and baseline assessment; the intervention was delivered over six weeks; and post-intervention assessment was conducted approximately one month after completion of the educational programme. The

six-week intervention period was selected based on evidence that structured breast cancer health education can improve screening-related outcomes in Nigerian populations [13,14].

2.3 Study Population

The study population comprised women aged 30–69 years who were permanent residents of either community during the study period. The age range was selected to capture adult women for whom breast cancer awareness and early-detection practices are particularly relevant and to encompass women approaching or within the age range commonly targeted for breast cancer screening.

2.4 Inclusion and Exclusion Criteria

Women were eligible if they were aged 30–69 years, had lived in the selected community for at least six months, were able to communicate in pidgin English or an indigenous language, provided written informed consent and were available for baseline and post-intervention assessments.

Women were excluded if they had a previous diagnosis of breast cancer, were currently receiving treatment for breast cancer, were critically ill at recruitment, had cognitive or communication difficulties that prevented completion of the questionnaire, or planned to relocate from the study community during the follow-up period. Women who participated in another breast cancer educational programme during the intervention period were also excluded to minimise contamination.

2.5 Sample Size Determination

The sample size was calculated for the comparison of two independent proportions using the Fleiss formula, with the expected change in breast cancer screening uptake as the principal outcome. Based on previous Nigerian evidence demonstrating low baseline screening uptake and the potential of structured health education to improve screening-related practices [13,14], a baseline screening uptake of 10% was used for the comparison group, while an anticipated uptake of 25% was expected for the intervention group following the educational programme. The calculation used a two-sided significance level of 5% ($\alpha = 0.05$) and statistical power of 80% ($\beta = 0.20$).

The sample size was calculated using:

$$n = \frac{\left[Z_{\alpha/2}\sqrt{2P(1-P)} + Z_{\beta}\sqrt{P_1(1-P_1) + P_2(1-P_2)}\right]^2}{(P_2 - P_1)^2}$$

where $P_1 = 0.10$, $P_2 = 0.25$, $P = (P_1 + P_2)/2 = 0.175$, $Z_{\alpha/2} = 1.96$, and $Z_{\beta} = 0.84$.

The calculated minimum sample size was 100 women per group. To account for the clustered nature of community-based sampling, a design effect of 1.5 was applied, increasing the sample to 150 participants per group. An additional 10% allowance for non-response and loss to follow-up was incorporated, resulting in a minimum of 165 participants per group. This figure was conservatively approximated to 170 women per group, giving a total sample size of 340 women.

The adequacy of the calculated sample was further assessed against the requirements of multivariable logistic regression. Assuming a post-intervention screening uptake prevalence of approximately 25%, the expected number of outcome events in the final sample was estimated at 85 (25% of 340). This was considered sufficient for a regression model containing five independent predictors, consistent with the events-per-variable (EPV) rule of thumb, which recommends a minimum of 10 outcome events per predictor variable to ensure adequate statistical power, prevent model overfitting, and obtain stable regression coefficients [15]. The planned predictors for inclusion in the multivariable model were age, educational attainment, marital status, family history of breast cancer, and previous exposure to breast cancer information, all of which were identified in the literature as potential determinants of breast cancer screening behaviour [5,8,11].

2.6 Sampling Technique

A multistage sampling technique was used to select study participants. In the first stage, Rumuolumeni and Woji were selected by simple random sampling from a list of eligible communities within Obio/Akpor and Port Harcourt Local Government Areas. In the second stage, community enumeration was conducted to identify all households with eligible women aged 30–69 years who had resided in the community for at least six months. This enumeration provided the sampling frame for participant selection.

In the third stage, streets within each community served as primary sampling units (clusters). The required number of eligible women from each selected street was determined proportionately, based on the estimated number of eligible women residing on that street, using a probability-proportional-to-size approach.

In the fourth stage, systematic random sampling was used to select households within each street. The sampling interval (k) was calculated by dividing the total number of eligible households in the street by the required number of households to be sampled from that street. For example, if a street contained 850 eligible households and 170 households were required, k = 5; thus, every 5th household was selected. A random starting point was selected from the first interval (between 1 and k), and subsequent households were selected at regular intervals (every kth household) until the required number was obtained.

In the fifth stage, where a selected household contained more than one eligible woman, one woman was selected by simple balloting to avoid clustering of participants within the same household and to maintain statistical independence of observations. Recruitment continued until the target sample size of 170 participants had been enrolled in each community (340 participants overall).

2.7 Study Instrument

Data were collected using a structured interviewer-administered questionnaire adapted from established breast cancer awareness and screening instruments. The questionnaire incorporated domains from the Breast Cancer Awareness Measure and relevant breast cancer screening instruments. The Breast Cancer Awareness Measure had been subjected to psychometric evaluation, including assessment in an African setting, supporting its use as a framework for measuring breast cancer symptom awareness and breast-checking behaviour [15,16].

Additionally, the questionnaire was adapted from the Champion Health Belief Model Scale, with particular emphasis on the domains of perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy related to breast cancer screening [17,18].

2.7.1 The questionnaire consisted of six sections:

- **Section A:** Sociodemographic characteristics, including age, marital status, educational level, occupation, religion, parity and family history of breast cancer.
- **Section B:** Knowledge of breast cancer, including causes, risk factors, symptoms, complications and early detection.
- **Section C:** Awareness of breast cancer screening and early-detection methods, including breast awareness, clinical breast examination and mammography.
- **Section D:** Breast cancer screening practices, including previous clinical breast examination, mammography, breast self-awareness and healthcare-seeking behaviour.
- **Section E:** Perceived barriers and facilitators to screening.
- **Section F:** Exposure to health education and post-intervention assessment of knowledge, attitudes and screening intention.

Knowledge items were scored as correct or incorrect. Correct responses received one point, and incorrect or “don't know” responses received zero points. The total knowledge score was converted to a percentage. Participants scoring ≥70% were classified as having good breast cancer awareness, while those scoring <70% were classified as having poor awareness.

2.8 Validity and Reliability of the Instrument

The questionnaire was reviewed independently by two epidemiologists, one oncologist, one community physician and one health-education specialist to establish face and content validity. The experts assessed the relevance, clarity, comprehensiveness and cultural appropriateness of each item.

The instrument was pretested among 34 women, representing approximately 10% of the calculated final sample, in a neighbouring community not included in the study. The pretest assessed comprehension, acceptability, interview duration and consistency of responses. Ambiguous and repetitive questions were modified before the main study.

Construct validity of the multi-item awareness and health-belief scales was assessed using exploratory factor analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity were examined before factor extraction. Internal consistency was assessed using Cronbach's alpha, with a coefficient of ≥0.70 considered acceptable. The psychometric properties of breast cancer awareness instruments have been shown to vary across populations, supporting the need for local validation before implementation [16].

Interrater reliability was assessed among eight research assistants who administered the questionnaire. During the pretest phase, each research assistant independently administered the questionnaire to the same 10 participants from the neighbouring community. Agreement for categorical variables was assessed using Cohen's kappa (κ) and Fleiss' kappa, while the intraclass correlation coefficient (ICC) was used for continuous variables. Overall, Fleiss' kappa was 0.85 (95% CI: 0.82–0.88), indicating almost perfect agreement, while the ICC was 0.91 (95% CI: 0.87–0.94), indicating excellent reliability. These findings confirm consistent administration of the questionnaire across research assistants, minimising interviewer bias.

2.9 Health Education Intervention

The intervention was a structured, community-based breast cancer health education programme delivered over six weeks. It consisted of six weekly sessions, each lasting approximately 60-90 minutes.

The educational topics covered:

- The epidemiology and public health importance of breast cancer;
- Modifiable and non-modifiable breast cancer risk factors;
- Common breast cancer signs and symptoms;
- Breast awareness and recognition of abnormal breast changes;
- Breast cancer early-detection and screening approaches;
- Benefits of timely presentation and early diagnosis;
- Misconceptions, myths and fear associated with breast cancer;
- Barriers to breast cancer screening and strategies for overcoming them; and
- Appropriate healthcare-seeking and referral pathways.

The sessions were interactive lectures, illustrated presentations, demonstrations, question-and-answer sessions, small-group discussions and take-home educational materials. Demonstrations were used to improve participants' understanding of breast awareness and recognition of breast abnormalities.

The intervention was facilitated by two trained public health educators and a trained female healthcare professional. Educational materials were prepared in English and translated into pidgin English, the predominant language spoken by many residents of the study communities. Translation and back-translation were performed to preserve conceptual equivalence.

The educational content was based on established breast cancer awareness domains and health-belief constructs [15,17,18]. The intervention approach was also informed by Nigerian quasi-experimental studies demonstrating improvement in breast cancer knowledge and screening-related practices following structured education [13,14,19].

The comparison group received routine health information available through existing healthcare services but did not receive the structured intervention during the study period. After completion of the post-intervention assessment, the comparison community was offered a condensed breast cancer health education session for ethical reasons.

2.10 Primary and Secondary Outcomes

The primary outcome was change in the proportion of women with good breast cancer awareness from baseline to post-intervention assessment.

The primary effect measure was the difference in change in good awareness between the intervention and comparison groups.

The secondary outcome was breast cancer screening uptake. Screening uptake was defined as having undergone at least one recognised breast cancer screening or clinical early-detection procedure during the study period. Clinical breast examination and mammography were recorded separately, while breast cancer awareness and breast self-examination were analysed as additional early-detection practices.

Other secondary outcomes included:

- Knowledge of breast cancer risk factors;
- Recognition of breast cancer warning signs and symptoms;
- Perceived susceptibility to breast cancer;
- Perceived benefits and barriers to screening;
- Intention to undergo screening;

- Previous screening history; and
- Healthcare-seeking behaviour following identification of a breast abnormality.

2.11 Data Collection Procedure

Following community mobilisation, eight research assistants approached eligible women at their households and community meeting points. During these encounters, the research assistants provided a detailed explanation of the study's purpose, procedures, potential risks and benefits, and the voluntary nature of participation. Written informed consent was obtained from each woman before enrolment. Baseline questionnaires were administered before commencement of the intervention. Participants were assigned unique identification numbers to permit linkage of baseline and post-intervention responses without using names in the analytical dataset.

The intervention group subsequently participated in six weekly health education sessions. Attendance was documented at every session. Participants who missed a session were contacted through the community mobilisation structure and encouraged to attend subsequent sessions.

One month after completion of the intervention, the same questionnaire was administered to participants in both communities. Research assistants who administered the post-intervention questionnaire were not involved in delivering the educational sessions to the control community to minimise interviewer and observer bias.

2.12 Data Safety and Management

Completed questionnaires were checked daily for completeness and consistency. Each participant was identified using a unique study identification code. Names, telephone numbers and other direct identifiers were kept separately from the analytical database.

Electronic data were entered into a password-protected database and subsequently exported to IBM SPSS Statistics version 27 for analysis. Double-checking of randomly selected records, range checks, logical consistency checks and duplicate-record checks were performed before analysis. The final analytical dataset contained no direct personal identifiers. Electronic files were stored on password-protected devices accessible only to authorised members of the research team.

2.13 Data Analysis

Data were analysed using IBM SPSS Statistics version 27. Continuous variables were summarised using means and standard deviations. Normality was assessed using graphical inspection (Quantile-Quantile Plot). Categorical variables were summarised using frequencies and percentages. Baseline characteristics of the intervention and comparison groups were compared using the chi-square test.

The intervention effect was assessed using a difference-in-differences approach, comparing the change in outcome from baseline to post-intervention between the intervention and comparison groups.

Binary logistic regression was used to identify factors associated with good breast cancer awareness and screening uptake. Candidate predictors included age, marital status, educational attainment, occupation, parity, family history of breast cancer, previous exposure to breast cancer information and study group. Variables with $p<0.20$ at bivariate analysis and variables considered clinically or theoretically important were entered into the multivariable model.

Adjusted odds ratios (AORs), 95% confidence intervals (CIs) and p-values were reported. Statistical significance was set at $p<0.05$.

Multicollinearity was assessed using tolerance statistics and variance inflation factors (VIF), with VIF values >5 considered indicative of potentially important multicollinearity. Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test and Nagelkerke R^2. Discriminatory ability was assessed using the area under the receiver operating characteristic curve (AUROC), with 0.50 indicating no discrimination and values approaching 1.00 indicating progressively better discrimination.

Sensitivity analyses were conducted by repeating the primary analysis using alternative awareness thresholds and by assessing the influence of participants lost to follow-up. A complete-case analysis was compared with an analysis incorporating participants with incomplete follow-up where appropriate.

Where more than one research assistant participated in questionnaire administration, inter-rater reliability was assessed using Cohen's kappa for categorical items and the intraclass correlation coefficient for continuous scale scores.

2.14 Handling of Missing Data

The extent and pattern of missing data were assessed before analysis. Questionnaires with substantial missing information were excluded from the relevant analysis, while isolated missing responses were treated as missing rather than assumed to represent an incorrect response. The proportion of missing observations was reported for key variables. Sensitivity analysis was performed to determine whether missing observations materially influenced the primary findings.

3 RESULTS

3.1 Participant Recruitment and Follow-up

In Figure 1, a total of 340 women were enrolled in the study, with 170 participants in the intervention community (Rumuolumeni) and 170 in the comparison community (Woji), achieving a 100% response rate at baseline. Post-intervention assessment was completed by 328 women (96.5%), with 163 (95.9%) in the intervention group and 165 (97.1%) in the comparison group. Loss to follow-up was minimal and comparable between groups (intervention: n = 7, 4.1%; comparison: n = 5, 2.9%)

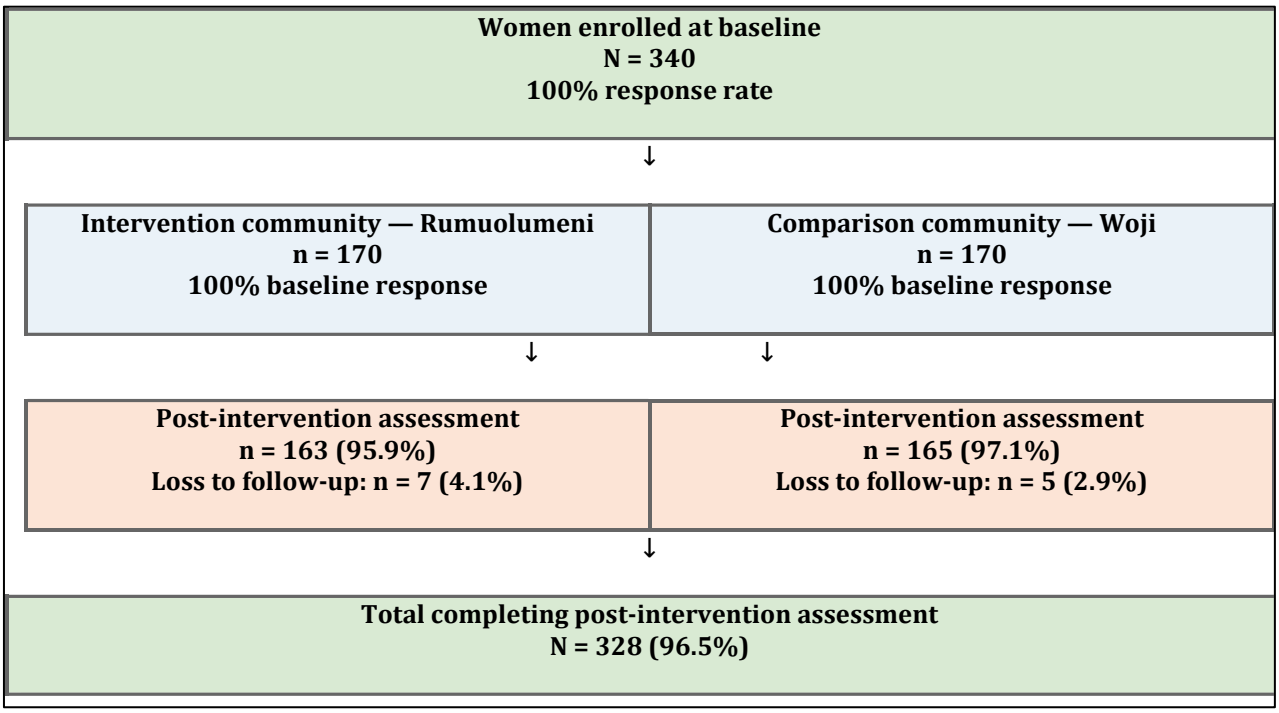


Figure 1: The participants' recruitment and follow-up

Baseline: 170 + 170 = 340 participants | Follow-up: 163 + 165 = 328 participants

3.2 Baseline Socio-demographic Characteristics of Respondents

Table 1 presents the sociodemographic characteristics of the study participants. The mean age was 42.3 ± 10.7 years, with the majority (66.5%) aged 30–49 years. Most participants were married (81.8%), had at least secondary education (70.6%), and were employed (65.9%). Parity distribution showed that 45.9% had three or more children, while 15.3% reported a family history of breast cancer. There were no statistically significant differences in sociodemographic characteristics between the intervention and comparison groups at baseline ($p > 0.05$ for all comparisons), confirming the comparability of the two groups.

Table 1: Sociodemographic Characteristics of Respondents

Variable	Total (N = 340)	Intervention (n = 170)	Comparison (n = 170)	χ^2	p-value
	n (%)	n (%)	n (%)		
Age Group (years)				0.24	0.625
30–49	226 (66.5)	115 (67.6)	111 (65.3)		
50–69	114 (33.5)	55 (32.4)	59 (34.7)		
Mean ± SD	42.3 ± 10.7	42.1 ± 10.5	42.5 ± 10.9		
Marital Status				0.18	0.672
Married	278 (81.8)	140 (82.4)	138 (81.2)		
Unmarried*	62 (18.2)	30 (17.6)	32 (18.8)		
Educational Attainment				0.42	0.517
≥Secondary	240 (70.6)	122 (71.8)	118 (69.4)		
≤Primary	100 (29.4)	48 (28.2)	52 (30.6)		
Occupation				0.31	0.578
Employed	224 (65.9)	114 (67.1)	110 (64.7)		
Unemployed	116 (34.1)	56 (32.9)	60 (35.3)		
Parity				0.28	0.597
≥3 children	156 (45.9)	80 (47.1)	76 (44.7)		
<3 children	184 (54.1)	90 (52.9)	94 (55.3)		
Family History of Breast Cancer				0.06	0.807
Yes	52 (15.3)	25 (14.7)	27 (15.9)		
No	288 (84.7)	145 (85.3)	143 (84.1)		

*Unmarried includes widowed, divorced, separated, and never married; SD: Standard Deviation

3.3 Baseline Knowledge, Health Beliefs, and Screening Practices

Table 2 presents baseline knowledge, health beliefs, and screening practices. Only 24.1% demonstrated good awareness (≥70% score), with knowledge of risk factors (21.8%), symptoms (25.9%), and early-detection methods (22.9%) similarly low. Health beliefs were suboptimal: perceived susceptibility (18.2%), benefits (31.8%), low barriers (15.9%), and self-efficacy (17.1%). Screening uptake was low (Clinical Breast Examination: 10.3%; mammography: 2.1%; any: 11.5%), and intentions were modest (27.6% intended screening; 30.0% breast awareness). No significant baseline differences existed between groups ($p > 0.05$).

Table 2: Baseline Knowledge, Health Beliefs, and Screening Practices

Variable	Total (N = 340)	Intervention (n = 170)	Comparison (n = 170)	χ^2	p-value
	n (%)	n (%)	n (%)		
Primary Outcome					
Good breast cancer awareness (≥70%)	82 (24.1)	42 (24.7)	40 (23.5)	0.06	0.807
Knowledge Components					
Knowledge of risk factors	74 (21.8)	38 (22.4)	36 (21.2)	0.07	0.791
Knowledge of symptoms	88 (25.9)	45 (26.5)	43 (25.3)	0.06	0.807

Knowledge of early-detection methods	78 (22.9)	40 (23.5)	38 (22.4)	0.06	0.801
Health Belief Constructs					
High perceived susceptibility	62 (18.2)	32 (18.8)	30 (17.6)	0.08	0.777
High perceived benefits	108 (31.8)	55 (32.4)	53 (31.2)	0.05	0.823
Low perceived barriers	54 (15.9)	28 (16.5)	26 (15.3)	0.09	0.764
High self-efficacy	58 (17.1)	30 (17.6)	28 (16.5)	0.08	0.777
Screening Practices					
Clinical breast examination (ever)	35 (10.3)	18 (10.6)	17 (10.0)	0.03	0.862
Mammography (ever)	7 (2.1)	4 (2.4)	3 (1.8)	0.14	0.704
Any screening procedure	39 (11.5)	20 (11.8)	19 (11.2)	0.03	0.862
Behavioural Intentions					
Intend screening (next 12 months)	94 (27.6)	48 (28.2)	46 (27.1)	0.06	0.807
Intended breast awareness practice	102 (30.0)	52 (30.6)	50 (29.4)	0.06	0.807

3.4 Post-Intervention Outcomes

Following the six-week intervention, marked improvements were observed in the intervention group, while the comparison group showed minimal change (Table 3). Good breast cancer awareness increased from 24.7% to 78.8% in the intervention group (DiD: +49.4%, $p < 0.001$), compared to a 4.7% increase in the comparison group. Screening uptake improved substantially: CBE (10.6% to 57.6%; DiD: +44.1%, $p < 0.001$), mammography (2.4% to 18.8%; DiD: +15.3%, $p < 0.001$), and any screening (11.8% to 60.0%; DiD: +45.3%, $p < 0.001$). Knowledge of risk factors (22.4% to 75.3%; DiD: +49.4%), symptoms (26.5% to 82.4%; DiD: +51.8%), and early-detection methods (23.5% to 80.0%; DiD: +53.0%) also improved significantly (all $p < 0.001$). All health belief constructs (perceived susceptibility, benefits, low barriers, self-efficacy) and behavioural intentions (intended screening, intended breast awareness) showed significant improvements (DiD: 42.3–50.7%; all $p < 0.001$).

Table 3: Comparison of Breast Cancer Awareness and Screening Uptake at Baseline and Post-Intervention

Variable	**Intervention (n = 170)**			**Comparison (n = 170)**			**DiD**	
	Baseline	**Post**	**Δ%**	**Baseline**	**Post**	**Δ%**	**Δ%**	**p**
	n (%)	n (%)		n (%)	n (%)			
Primary Outcome								
Good awareness (≥70%)	42 (24.7)	134 (78.8)	+54.1	40 (23.5)	48 (28.2)	+4.7	+49.4	<0.001
Screening Uptake								
CBE (ever)	18 (10.6)	98 (57.6)	+47.0	17 (10.0)	22 (12.9)	+2.9	+44.1	<0.001
Mammography (ever)	4 (2.4)	32 (18.8)	+16.4	3 (1.8)	5 (2.9)	+1.1	+15.3	<0.001
Any screening	20 (11.8)	102 (60.0)	+48.2	19 (11.2)	24 (14.1)	+2.9	+45.3	<0.001
Knowledge Components								
Risk factors	38 (22.4)	128 (75.3)	+52.9	36 (21.2)	42 (24.7)	+3.5	+49.4	<0.001

Symptoms	45 (26.5)	140 (82.4)	+55.9	43 (25.3)	50 (29.4)	+4.1	+51.8	<0.001
Early detection	40 (23.5)	136 (80.0)	+56.5	38 (22.4)	44 (25.9)	+3.5	+53.0	<0.001
Health Beliefs								
Perceived susceptibility	32 (18.8)	110 (64.7)	+45.9	30 (17.6)	36 (21.2)	+3.6	+42.3	<0.001
Perceived benefits	55 (32.4)	145 (85.3)	+52.9	53 (31.2)	58 (34.1)	+2.9	+50.0	<0.001
Low barriers	28 (16.5)	118 (69.4)	+52.9	26 (15.3)	32 (18.8)	+3.5	+49.4	<0.001
Self-efficacy	30 (17.6)	120 (70.6)	+53.0	28 (16.5)	34 (20.0)	+3.5	+49.5	<0.001
Behavioural Intentions								
Intend screening (12 months)	48 (28.2)	140 (82.4)	+54.2	46 (27.1)	52 (30.6)	+3.5	+50.7	<0.001
Intended breast awareness	52 (30.6)	142 (83.5)	+52.9	50 (29.4)	56 (32.9)	+3.5	+49.4	<0.001

CBE: Clinical Breast Examination; DiD: Difference-in-Differences.

3.5 Predictors of Breast Cancer Screening Uptake

Table 4 presents predictors of screening uptake. Five factors were independently associated: intervention exposure (AOR = 6.23; p < 0.001), good awareness (AOR = 3.89; p < 0.001), family history (AOR = 2.89; p = 0.014), higher education (AOR = 2.45; p = 0.010), and prior breast cancer information (AOR = 2.12; p = 0.029). Among health beliefs, high perceived benefits (AOR = 2.56; p = 0.013) and low barriers (AOR = 2.89; p = 0.004) were significant; perceived susceptibility and self-efficacy were not. Sociodemographic factors (age, marital status, occupation, parity) were not significant (p > 0.05).

Table 4: Predictors of Breast Cancer Screening Uptake Post-Intervention

Predictor	Unadj. OR (95% CI)	p	Adj. OR (95% CI)	p
Study Group				
Intervention (vs. Comparison)	8.94 (5.12–15.61)	<0.001	**6.23 (3.45–11.27)**	**<0.001**
Sociodemographic				
Age ≥50 years	1.34 (0.78–2.30)	0.292	1.18 (0.65–2.14)	0.586
≥Secondary education	3.12 (1.67–5.83)	<0.001	**2.45 (1.24–4.84)**	**0.010**
Married	1.08 (0.62–1.88)	0.789	0.94 (0.51–1.73)	0.843
Employed	1.45 (0.84–2.50)	0.184	1.28 (0.70–2.34)	0.422
Parity ≥3 children	0.92 (0.53–1.60)	0.769	0.88 (0.48–1.61)	0.679
Clinical Factors				
Family history of BC	3.45 (1.58–7.53)	0.002	**2.89 (1.24–6.74)**	**0.014**
Knowledge/Beliefs				
Good awareness (≥70%)	5.67 (3.12–10.31)	<0.001	**3.89 (2.01–7.52)**	**<0.001**
Prior BC information	2.89 (1.56–5.35)	<0.001	**2.12 (1.08–4.16)**	**0.029**
High susceptibility	2.34 (1.28–4.28)	0.006	1.78 (0.92–3.44)	0.087
High benefits	3.89 (1.98–7.64)	<0.001	**2.56 (1.22–5.37)**	**0.013**

Low barriers	4.12 (2.14–7.93)	<0.001	**2.89 (1.41–5.92)**	**0.004**
High self-efficacy	3.45 (1.82–6.54)	<0.001	1.89 (0.94–3.80)	0.073

BC: Breast Cancer; Adj.: Adjusted; Unadj.: Unadjusted; OR: Odds Ratio; CI: Confidence Interval

3.6 Model Diagnostics and Goodness-of-Fit

The logistic regression model demonstrated good fit and discriminative ability. The Hosmer-Lemeshow goodness-of-fit test yielded a χ^2 value of 7.24 ($p = 0.512$), indicating that the model adequately fitted the data and there was no evidence of poor calibration. The Nagelkerke R^2 value of 0.42 indicated that the independent variables collectively explained approximately 42% of the variance in screening uptake. The area under the receiver operating characteristic curve (AUC) was 0.84 (95% CI: 0.79–0.89), indicating excellent discriminative ability; the model correctly distinguished between women who underwent screening and those who did not in 84% of cases. Multicollinearity assessment using variance inflation factors (VIF) revealed values ranging from 1.12 to 2.45, all well below the threshold of 5, indicating no significant multicollinearity among the predictor variables. The overall model was statistically significant ($\chi^2 = 78.45$, $p < 0.001$).

3.7 Sensitivity Analysis

To assess the robustness of the primary findings, several sensitivity analyses were conducted, including alternative thresholds for good awareness (≥60% and ≥80%), intention-to-treat analysis, complete-case versus multiple imputation, adjustment for baseline differences, and exclusion of participants with prior screening history. The intervention effect remained statistically significant across all sensitivity analyses, indicating that the primary findings were robust and not attributable to analytical assumptions, missing data, or attrition. An evidence-value (E-value) analysis for unmeasured confounding (E-value = 5.12) further suggested that unmeasured confounding was unlikely to explain the observed intervention effect.

4 DISCUSSION

4.1 Baseline Breast Cancer Awareness and Screening Practices

This study demonstrated substantial deficits in breast cancer awareness and screening practices at baseline. Only 24.1% of women had good breast cancer awareness, while knowledge of risk factors, symptoms and early-detection methods was similarly low. Screening uptake was particularly limited, with only 11.5% reporting any previous breast cancer screening, 10.3% having undergone clinical breast examination (CBE), and 2.1% having undergone mammography. These findings are consistent with the broader pattern of inadequate breast cancer screening in low- and middle-income countries. A systematic review of more than 78 million women found that screening uptake remains lowest in Africa and among women with lower educational and socioeconomic status, while pooled estimates for mammography and CBE in LMICs remained only 22.7% and 23.1%, respectively [20,21].

The particularly low baseline uptake observed in this study is also consistent with evidence from sub-Saharan Africa. A recent meta-analysis estimated pooled CBE uptake at only 13%, with educational attainment, household wealth, health insurance and recent contact with health services positively associated with screening [22]. Similarly, the multilevel analysis of six sub-Saharan African countries reported a clinical breast screening prevalence of 14.23%, indicating that the baseline screening level observed in the present study reflects a wider regional problem rather than an isolated community phenomenon [23].

Within Nigeria, the findings reinforce evidence of a persistent awareness–practice gap. Studies among Nigerian women have repeatedly documented inadequate knowledge and low participation in breast cancer screening, particularly mammography. In rural communities in Enugu State, only 11.4% of women demonstrated good breast cancer knowledge, while financial constraints and inadequate knowledge were prominent barriers to mammography [24]. The low baseline awareness and screening observed in the present study therefore provide an important justification for community-level interventions that move beyond passive dissemination of information.

4.2 Effect of Community-Based Health Education on Breast Cancer Awareness

The major finding of this study was the substantial improvement in breast cancer awareness following the six-week community-based intervention. Good awareness increased from 24.7% to 78.8% in the intervention group, compared with only a modest increase from 23.5% to 28.2% in the comparison group, producing a difference-in-differences of 49.4 percentage points. Improvements were also observed across knowledge of risk factors, symptoms and early-detection methods, with all intervention effects statistically significant.

This magnitude of improvement is consistent with evidence that structured health education can substantially increase breast cancer knowledge when interventions are interactive, repeated and contextually adapted. A quasi-experimental Nigerian study among nursing students in Plateau State reported significant improvement in breast cancer screening uptake following six weeks of health education [25]. Similarly, an intervention among female university students in Southern Nigeria demonstrated significant improvements in knowledge, attitudes and breast self-examination practices following educational exposure [26]. The present study extends these findings by demonstrating effectiveness among community-dwelling adult women rather than predominantly student populations.

The observed improvement may partly reflect the structure and intensity of the intervention. The programme incorporated interactive lectures, demonstrations, discussions, question-and-answer sessions and take-home materials, while information was delivered in Pidgin English. Such approaches are likely to enhance comprehension, reinforce key messages and allow participants to address misconceptions directly. Evidence from sub-Saharan Africa indicates that screening interventions involving extensive education and community engagement tend to achieve higher participation than interventions relying solely on screening availability [27]. The current findings therefore support the importance of combining information provision with participatory community education.

4.3 Effect on Breast Cancer Screening Uptake

The intervention produced a pronounced improvement in screening behaviour. Any screening uptake increased from 11.8% to 60.0% in the intervention group, compared with only 11.2% to 14.1% in the comparison group, yielding a difference-in-differences of 45.3 percentage points. CBE increased by 47.0 percentage points, whereas mammography increased by 16.4 percentage points. These findings indicate that the intervention influenced not only knowledge but also movement towards preventive action.

The larger increase in CBE than mammography is plausible within the Nigerian and sub-Saharan African context. CBE is generally more accessible and requires less specialised infrastructure than mammography, making it more feasible in community-oriented early-detection programmes. Evidence from SSA similarly identifies CBE as a comparatively feasible early-detection strategy in resource-constrained settings, although sustained linkage to diagnostic and treatment services remains essential [22,27]. The increase in mammography, although smaller, is nevertheless important because baseline mammography uptake was extremely low. The finding suggests that appropriate education may reduce informational barriers to utilisation of more specialised screening services, but education alone may not fully overcome financial, geographic and health-system constraints.

A systematic review of interventions to increase mammography use in LMICs found that group education, small and mass media, client reminders, reduction of structural and financial barriers, and engagement of community health workers were effective, particularly when interventions were multicomponent [28]. The present intervention was predominantly educational and nevertheless achieved a substantial increase in mammography uptake, suggesting that knowledge and perceived need may represent important proximal barriers in this population. However, the remaining gap between CBE and mammography uptake indicates that future community programmes may require stronger service-linkage and navigation components.

4.4 Changes in Health Beliefs and Behavioural Intentions

The intervention produced significant improvements in perceived susceptibility, perceived benefits, perceived barriers and self-efficacy. Perceived benefits increased from 32.4% to 85.3%, while the proportion reporting low perceived barriers increased from 16.5% to 69.4%. These changes are particularly relevant because screening behaviour is influenced by both knowledge and perceptions concerning risk, benefits, barriers and personal capability. A systematic review applying the Health Belief Model to breast cancer screening found that constructs including knowledge, perceived susceptibility, perceived benefits, perceived barriers and self-efficacy are important determinants of screening-related behaviour [29].

The improvement in behavioural intentions was also substantial. Intention to undergo screening within 12 months increased from 28.2% to 82.4%, while intention to practise breast awareness increased from 30.6% to 83.5%. These changes suggest that the intervention successfully altered participants' readiness to engage in preventive behaviour. However, the difference between intention and actual screening uptake remains important: 82.4% intended to undergo screening, whereas 60.0% actually reported screening. This indicates that intention is an important intermediate outcome but does not guarantee completion of screening. Practical barriers, including cost, availability, transport and health-system access, may continue to constrain translation of intention into action.

4.5 Independent Predictors of Screening Uptake

The multivariable analysis provides further evidence of the intervention effect. Exposure to the community-based education programme was the strongest independent predictor of screening uptake, with women in the intervention

group more than six times as likely to undergo screening as those in the comparison group. This association remained substantial after adjustment for educational attainment, family history, prior information exposure, awareness and health-belief variables, suggesting that the intervention contributed an effect beyond individual sociodemographic characteristics.

Good breast cancer awareness was independently associated with nearly fourfold higher odds of screening. Higher educational attainment was also significant, consistent with evidence from SSA showing that women with greater educational attainment are more likely to participate in screening [23]. Education may facilitate comprehension of health messages, interpretation of risk information and navigation of healthcare services. Nigerian evidence similarly demonstrates that educational disparities influence breast cancer knowledge and the capacity to translate knowledge into preventive behaviour [30].

Family history was another independent predictor of screening uptake. Women with a family history may perceive themselves as being at greater risk and therefore have stronger motivation to seek early detection. Prior exposure to breast cancer information was also independently associated with screening, supporting the importance of repeated exposure to accurate information rather than relying on a single educational encounter.

Interestingly, perceived benefits and low perceived barriers remained significant predictors, whereas perceived susceptibility and self-efficacy did not retain statistical significance after adjustment. This suggests that women may be more likely to act when they perceive screening as useful and feasible than simply because they perceive themselves to be susceptible or confident. The finding reinforces the importance of addressing practical and perceptual barriers alongside knowledge acquisition.

Overall, the findings support community-based health education as an effective component of breast cancer early-detection strategies among women in Rivers State. The consistency of the intervention effect across alternative awareness thresholds, follow-up assumptions and sensitivity analyses further strengthens the inference that the observed improvements were associated with the intervention rather than analytical assumptions or differential attrition.

4.6 Strengths and Limitations of the Study

4.6.1 Strengths

This study has several notable strengths:

- **Rigorous design:** Quasi-experimental design with comparison group, pre-post assessments, and difference-in-differences analysis.
- **Validated instrument:** Culturally adapted tool incorporating the Breast Cancer Awareness Measure and Champion Health Belief Model Scale, psychometrically evaluated in African settings.
- **Community-based approach:** Training local educators, using Pidgin English, and delivering sessions in accessible settings, contributing to high retention.
- **Comprehensive intervention:** Covered epidemiology, risk factors, symptoms, screening methods, misconceptions and barriers, addressing multiple behavioural determinants.
- **Theoretical grounding:** Inclusion of health belief constructs as outcomes and predictors enabled identification of mechanisms of change.
- **Robust findings:** Sensitivity analyses (alternative thresholds, intention-to-treat, E-value analysis) confirmed robustness across analytical approaches.

4.6.2 Limitations

Several limitations should be considered:

- **Design:** Quasi-experimental design limits causal inference; however, E-value analysis suggested unmeasured confounding was unlikely.
- **Measurement:** Self-reported screening may be subject to recall and social desirability bias; objective verification is needed.
- **Follow-up:** One-month post-intervention follow-up limits assessment of long-term sustainability.
- **Generalisability:** Urban setting may limit generalisability to rural populations, though communities were representative of peri-urban Rivers State.
- **Scalability:** Delivery by public health educators rather than community health workers may affect scalability; materials were designed to be transferable.

5 CONCLUSION

This study demonstrated that a structured community-based health education intervention significantly improved breast cancer awareness, knowledge, health beliefs, and screening uptake among women aged 30–69 years in Rivers State, Nigeria. Good awareness increased from 24.7% to 78.8%, CBE uptake from 10.6% to 57.6%, and mammography uptake from 2.4% to 18.8%. Intervention exposure was the strongest predictor of screening uptake, with other significant predictors including higher education, good awareness, family history, prior breast cancer information, high perceived benefits, and low perceived barriers. These findings provide strong evidence that community-based, culturally tailored education can effectively address the awareness-practice gap in Nigerian populations. By enabling early symptom recognition, understanding of screening importance, and barrier reduction, the intervention contributes to earlier detection and reduced breast cancer morbidity and mortality. Aligned with Nigeria's National Cancer Control Plan and the WHO Global Breast Cancer Initiative, the intervention model supports integration into primary healthcare and cancer control frameworks, with potential for scale-up across Nigeria and other resource-limited settings.

Recommendations

The effectiveness of this community-based health education intervention supports its integration into primary healthcare and cancer control frameworks. Health education should be prioritised to reduce late-stage disease burden. Materials should be developed in indigenous languages, with translation and back-translation serving as a replicable model. Programmes must address misconceptions, fears, and barriers while enhancing self-efficacy and leveraging social support, with interventions tailored to reach women with lower education and no family history of breast cancer.

At the systemic level, integration into Nigeria's National Cancer Control Programme and National Breast Cancer Control Programme should include training community health extension workers; developing national guidelines; allocating resources for training, materials, and monitoring; strengthening referral pathways; and establishing routine monitoring and evaluation systems.

Future investigations should include longitudinal studies; scale-up and implementation studies across multiple regions; cost-effectiveness analysis; comparative effectiveness studies on delivery approaches; qualitative studies on mechanisms of behaviour change; and studies on integrating breast cancer education with other health programmes.

Contributions to Knowledge

- **For Practice:** This study demonstrates that community-based, culturally tailored health education can significantly improve breast cancer awareness and screening uptake among women in resource-limited settings. By operationalising a structured six-week educational programme using local language and culturally relevant content, the findings show that trust-based community engagement is an effective alternative to conventional facility-based health education. Improved recognition of symptoms, knowledge of risk factors, and timely screening uptake at the household level indicate that such models can strengthen frontline breast cancer control in rural and peri-urban settings.
- **For Research:** The study provides epidemiological evidence that behaviour change interventions can impact key determinants of breast cancer screening, improving scientific understanding of household-level preventive practices. By focusing on urban communities in Rivers State, the study broadens local breast cancer epidemiology and emphasises the need for more context-specific research in hard-to-reach populations. The identification of education, awareness, family history, prior information exposure, perceived benefits, and low perceived barriers as independent predictors of screening uptake offers a foundation for developing predictive models and guiding future community intervention trials.
- **For Policy:** Field evidence from this study supports integrating community-based educational approaches into Nigeria's cancer control strategies. The intervention aligns with the National Cancer Control Plan and the WHO Global Breast Cancer Initiative, reinforcing the value of people-centred interventions in cancer prevention and early detection. Scaling up structured community education can contribute to achieving Sustainable Development Goal 3 by reducing preventable breast cancer morbidity and mortality through strengthened household-level awareness and screening practices.
- **Specific Innovation:** This study contributes a validated, culturally adapted community-based educational intervention model that can be replicated in similar settings across Nigeria and sub-Saharan Africa. The intervention's integration of Health Belief Model constructs, use of local language, and sustained six-week delivery format represents an innovative approach to addressing the awareness-practice gap in breast cancer control.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

Ethical approval was obtained from the Rivers State Health Research Ethics Committee. Administrative permission was obtained from the Rivers State Primary Health Care Management Board, LGA health authorities, heads of PHCs, and community leadership.

Statement of informed consent

Written informed consent was obtained from every participant after an explanation of the study purpose, procedures, potential benefits, possible risks, confidentiality arrangements, and the voluntary nature of participation. Participants were informed that refusal to participate, or withdrawal from the study, would not affect their access to healthcare.

Participants who reported breast symptoms or identified a breast abnormality during the study were counselled and referred to an appropriate health facility for clinical evaluation. The intervention was educational and did not replace professional breast cancer diagnosis or treatment. All data were anonymised using unique study identification codes, and confidentiality was maintained throughout the study. Electronic files were stored on password-protected devices accessible only to authorised members of the research team.

Authors' Contributions

Briggs NCT conceptualised and designed the study, supervised the data analyses, interpreted the data, and wrote the initial manuscript. Nwadiuto IC developed the study instrument, conducted the literature review, supervised data collection and collation, and wrote part of the manuscript. Both authors read and approved the final manuscript.

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