Scientific Research Publishing

Advances in Breast Cancer Research, 2026, 15(2), 66-83
https://www.scirp.org/journal/abcr
ISSN Online: 2168-1597
ISSN Print: 2168-1589

Therapeutic Response to Neoadjuvant Chemotherapy and Associated Factors in Breast Cancer Patients: A Cameroon Cohort Study

Berthe Sabine Esson Mapoko[1,2*], Etienne Atenguena Okobalemba[1,2], Kenn Chi Ndi[1,3], Kareen Azemafac[1], Zainab Innapetel Abba[1], Lionel Armel Bala[1,3], Cyril Wilfried Admire Missinga[1], Lionel Tabola Fossa[4], Paul Ndom[1]

[1]Faculty of Medicine and Biomedical Sciences, University of Yaounde 1, Yaounde, Cameroon
[2]Yaounde Central Hospital, Yaounde, Cameroon
[3]Ebolowa Regional Hospital, Ebolowa, Cameroon
[4]Bafoussam Regional Hospital, Bafoussam, Cameroon
Email: *mapokob@yahoo.fr

How to cite this paper: Mapoko, B.S.E., Okobalemba, E.A., Ndi, K.C., Azemafac, K., Abba, Z.I., Bala, L.A., Missinga, C.W.A., Fossa, L.T. and Ndom, P. (2026) Therapeutic Response to Neoadjuvant Chemotherapy and Associated Factors in Breast Cancer Patients: A Cameroon Cohort Study. *Advances in Breast Cancer Research*, **15**, 66-83.
https://doi.org/10.4236/abcr.2026.152006

Received: January 16, 2026
Accepted: March 16, 2026
Published: March 19, 2026

Abstract

Introduction: Breast cancer represents a major public health concern in Cameroon, with over 70% of patients presenting at advanced stages. Neoadjuvant chemotherapy (NACT) has become a standard treatment for locally advanced breast cancer, with pathologic response serving as a potential surrogate marker for treatment efficacy. However, the factors influencing therapeutic response in sub-Saharan African populations remain poorly characterized. Understanding these determinants is crucial for optimizing treatment strategies in resource-limited settings. We sought to determine the therapeutic response to NACT and identify associated factors in breast cancer patients treated in Yaounde, Cameroon. **Methods**: We conducted a historical cohort study of non-metastatic breast cancer patients treated at Yaounde General Hospital and Yaounde Central Hospital from January 2019 to December 2023. Patients were categorized into good responders (pathologic complete response or >50% partial response) and poor responders (<50% partial response or no response) using Sataloff criteria. Clinical and pathologic responses were assessed using RECIST and Sataloff classification respectively. Bivariate correlation and ordinal logistic regression analyses were performed to identify factors associated with therapeutic response. **Results**: Among 119 female participants, good responders comprised 25.21% (pCR: 8.40%, pPR1: 16.81%) and poor responders 74.79% (pPR2: 68.91%, no response: 5.88%). Triple-negative breast cancer was the most common subtype (42.31%), with AC plus taxane being the most frequently used NACT protocol (53.78%). Clinical response showed 26.89% complete response and 57.98% partial response. Good responders had lower initial CA 15-

3 levels compared to poor responders; however, this difference did not reach statistical significance (p = 0.24) and a higher proportion of negative surgical margins (83.33% versus 56.18%, p = 0.01). In multivariable analysis, histological grade (aOR = 2.39, 95% CI: 1.35 - 4.26, p < 0.001) and surgical margin status (aOR = 2.41, 95% CI: 1.22 - 4.76, p = 0.01) were independently associated with pathologic response. **Conclusion**: This study reveals a pathologic complete response rate of 8.40% in Cameroonian breast cancer patients, lower than rates in high-resource settings, likely reflecting limited access to targeted therapies and molecular testing. While good responders demonstrated favorable clinical characteristics including lower CA 15-3 levels, although this did not reach statistical significance and negative surgical margins. In multivariable analysis, higher histological grade and surgical margin status remained independently associated with pathologic response. These findings underscore the need for improved access to personalized treatment approaches in resource-limited settings.

Keywords

Response, Neoadjuvant Chemotherapy, Breast Cancer, Cameroon

1. Introduction

Breast cancer has emerged as the most common malignancy globally, with an estimated 2.3 million new cases and 665,000 deaths reported in 2022 [1]. The burden of this disease is particularly acute in Africa, where a previously predicted steeply rising incidence has materialized with over 198,000 new breast cancer cases and above 90,000 deaths in the same year [1] [2]. In Cameroon specifically, 4207 new breast cancer cases and 2285 deaths were reported in 2022 [1]. The disease in this setting is characterized by an earlier onset, more aggressive subtypes, and notably higher mortality rates compared to that seen in developed countries [3]-[6].

Locally advanced breast cancer encompasses a diverse group of tumours characterized by extensive locoregional spread, which may be operable or inoperable without clinical or radiological evidence of metastasis [7]. Multiple Cameroonian studies have consistently revealed that over 70% of breast cancer patients present with locally advanced and metastatic disease, corresponding to stages 3 and 4 [8]-[10]. This late presentation significantly impacts treatment outcomes and necessitates aggressive therapeutic approaches.

Neoadjuvant chemotherapy has emerged as a standard treatment modality for locally advanced breast cancer, demonstrating significant clinical benefits. It can transform previously inoperable tumours into operable ones and, in operable tumours, leads to downstaging that results in a modest increase of 7% to 12% in breast conservation rates [11]. Beyond these immediate benefits, accumulating evidence suggests that patients achieving pathologic complete response (pCR) to NACT experience significantly improved overall survival and disease-free survival, particularly in triple-negative and HER2-positive breast cancers [12]. This

observation has led to the consideration of objective pathologic response (OPR) to NACT as a potential surrogate marker for disease-free survival and overall survival.

However, chemotherapy responses are influenced by a complex interplay of factors including tumour stage, histological grade, molecular subtype, and various biological markers. The impact of OPR achievement on survival outcomes varies considerably across different breast cancer subtypes and with different NACT regimens employed [13]. While the impact of lymph node OPR on survival has been demonstrated in Cameroon [10], the prognostic value of overall OPR and, critically, the factors associated with achieving this response remain unknown in our context. These factors may differ substantially from those reported in the literature given documented differences in Cameroonian breast cancer genomics [14].

In a resource-limited setting such as ours, identifying patients most likely to benefit from NACT becomes crucial for optimal resource allocation and treatment planning. Understanding the relationship between OPR and patient characteristics, tumour biology, and treatment factors specific to our context is essential for developing targeted interventions. Moreover, characterizing the pattern of therapeutic responses in our population will contribute to the global body of knowledge on NACT effectiveness across diverse populations and cancer subtypes, potentially informing treatment guidelines for similar settings. This study therefore aimed to determine the therapeutic response to neoadjuvant chemotherapy and identify associated factors in breast cancer patients in Yaounde, Cameroon.

This study provides the first comprehensive analysis of neoadjuvant chemotherapy response patterns in Cameroon, revealing unique characteristics of breast cancer treatment in sub-Saharan Africa including predominant triple-negative subtypes and limited pathologic complete response rates due to restricted access to targeted therapies.

2. Methods

2.1. Study Design and Setting

This study employed a historical cohort design to retrospectively analyze data from patients who had previously undergone NACT. Patients were categorized into two cohorts based on their therapeutic response: good responders, defined as patients exhibiting objective pathologic response to treatment (pCR or >50% partial response), and poor responders, defined as those without such response (<50% partial response or no response). This study was carried out at two major oncology treatment centres in Cameroon: the Yaounde General Hospital (YGH) and the Yaounde Central Hospital (YCH). Both institutions serve as referral hospitals located in the administrative capital and function as teaching hospitals with established oncology services. This cohort study included patients followed at both study sites from January 1, 2019, to December 31, 2023, spanning five years. Data were collected retrospectively over three months from June 1 to August 31, 2024.

2.2. Study Population

The target population comprised all patients with breast cancer in Yaounde. The source population consisted of patients managed in the medical oncology departments of YGH and YCH. This study evaluated breast cancer patients with initially non-metastatic disease who received NACT at these facilities between January 1, 2019, and December 31, 2023.

2.3. Eligibility Criteria

2.3.1. Inclusion Criteria

For good responders, all patients with histologically-confirmed breast cancer who had staging information, indication for NACT, and available data on therapeutic response showing complete, near-total, or >50% pathological response were included.

For poor responders, all patients with histologically-confirmed breast cancer who had staging information, indication for NACT, and available data on therapeutic response showing <50% pathological response or no response were included.

2.3.2. Exclusion Criteria

Patients with relative or absolute contraindications to standard chemotherapy, including pregnant patients and those with cardiac conditions contraindicating anthracycline use, were excluded from the study.

2.4. Sample Size Determination

Sample size was determined using the Fleiss formula ($n = [Z\alpha/2 + Z\beta]^2 \times [p1(1 - p1) + p2(1 - p2)]/(p1 - p2)^2$ [15], appropriate for comparing two proportions. Assuming expected proportions of good responders (80%) and poor responders (20%) [13], with 80% power and 95% confidence, the calculation yielded 55 patients per group, giving a total minimum sample size of 110 patients.

2.5. Data Collection Procedures

Following protocol validation and ethical approval, qualifying patient files were systematically explored.

Patient demographics including age, sex, marital status, profession, and region of origin were collected. Dates of first symptoms and diagnosis were documented. Cancer diagnosis was confirmed through pathological reports signed by consultant oncologists or from histopathological records.

Histopathological characteristics including tumour grade, hormone receptor status, Ki67, and human epidermal growth factor receptor 2 (HER2) status were recorded where available.

Staging was determined based on imaging studies including chest and abdominopelvic CT scans or chest radiography with abdominopelvic ultrasound, using the Tumour Node Metastasis (TNM) staging method.

Tumour location, mode of presentation, patient comorbidities, gynecologic his-

tory, and lifestyle factors were documented. Pre-treatment CA 15-3 levels were collected when available.

Details of chemotherapy regimens used prior to surgery were recorded, including number of cycles received, documented side effects, and dose intensity (treatment dose and schedule adherence).

Post-operative pathological reports were examined for pathological response using Sataloff classification and surgical margin status.

The occurrence of events (progression, relapse, or death) and their dates were noted, along with the date of last contact.

Data were entered into Microsoft Excel 2013 spreadsheets using validated questionnaires.

2.6. Definition and Measurement of Variables

2.6.1. Clinical Response Assessment

Clinical response was assessed using the Response Evaluation Criteria in Solid Tumors (RECIST) criteria [16] by measuring tumour and node size after NACT.

RECIST classifications include:

- complete response (CR) - primary tumour disappearance
- partial response (PR) - ≥30% decrease in longest diameter
- progressive disease (PD) - ≥20% increase in longest diameter
- stable disease (SD) - insufficient change to qualify as PR or PD.

2.6.2. Pathological Response Assessment

The Sataloff Classification was used to evaluate pathologic response based on primary carcinoma and lymph node responses.

The Sataloff tumour (T) classification includes:

- T-A (total or near-total therapeutic effect)
- T-B (>50% effect)
- T-C (<50% effect)
- T-D (no therapeutic effect).

The Sataloff nodal (N) classification includes:

- N-A (node negative with evidence of therapeutic effect)
- N-B (node negative without evidence of effect)
- N-C (node positive with evidence of effect)
- N-D (node positive with no evidence of therapeutic effect) [17].

2.6.3. Definition of Therapeutic Response Groups

Pathologic complete response (pCR) was defined as TANA.

Pathologic partial response was categorized into:

- pPR1 (>50%: TANB, TBNA, TBNB)
- pPR2 (<50%: TCNA, TCNB, TANC, TBNC, TCNC, TDNA, TDNB, TDNC, TAND, TBND, TCND).

Pathologic no response (pNR) was defined as TDND.

Patients classified as pCR and pPR1 constituted the good responders group,

while those with pPR2 and pNR were classified as poor responders.

2.7. Data Quality Considerations

Although dose intensity and treatment schedule adherence were initially recorded, incomplete documentation in a substantial proportion of files prevented reliable statistical analysis of these variables. Initial visual checking for obvious errors and inconsistencies was performed on the Excel data.

2.8. Statistical Analysis

Descriptive statistics were employed to summarize demographic characteristics (age, marital status, profession, breastfeeding status, menopausal status), clinical characteristics (stage and subtype), and pathological characteristics (receptor status and histological grade). Means, medians, and standard deviations were calculated for continuous variables, while frequencies and percentages were calculated for categorical variables. Inferential statistics were applied to examine relationships between variables. Chi-square tests and Fisher's exact tests were conducted to compare categorical variables such as tumour subtype and receptor status between patients with OPR and those without. Independent samples t-tests were used to compare continuous variables including age, CA 15-3, and Ki67 levels between groups. Spearman's rank correlation coefficient was used to evaluate relationships between patient clinicopathologic and treatment characteristics and therapeutic response. Bivariate correlation and ordinal logistic regression analyses were performed to assess factors associated with therapeutic response, with results adjusted for potential confounding factors. Analysis was conducted using IBM SPSS version 23, with statistical significance set at two-sided p-value < 0.05. Results were presented in figures and tables generated by Microsoft Excel 2013.

2.9. Ethical Considerations

The protocol and questionnaire forms were submitted to and approved by the Ethical Committee of the Faculty of Medicine and Biomedical Sciences of the University of Yaounde I. Administrative authorization was obtained from both study sites. Questionnaires were coded to ensure no link between patient records and study data. Patient identity and personal details were kept strictly confidential, accessible only to the investigator. Information collected was used solely for study purposes. All patient files were examined within institutional archives without modification of their contents. This study was conducted in accordance with the principles of the Declaration of Helsinki (as revised in 2013) [18].

3. Results

During the five-year study period from January 1, 2019, to December 31, 2023, a total of 1,061 cases of breast cancer were identified from case registers and medical records at both study sites. Following application of inclusion and exclusion criteria, several groups were not included in the final analysis: participants with met-

astatic disease at diagnosis (225 cases, 21.21%), those without staging data (113 cases, 10.65%), patients who underwent upfront surgery without NACT (132 cases, 12.44%), those who had no surgery (292 cases, 27.52%), and patients with contraindications to anthracyclines (12 cases, 1.13%). Additionally, patients whose surgical specimen histology reports lacked therapeutic effect analysis (170 cases, 16.02%) were excluded. This selection process resulted in 119 participants (11.34% of initial cases) retained for final analysis.

3.1. Sociodemographic Characteristics

The study retained 119 female participants, categorized into 30 good responders (25.21%), comprising 10 with pCR (8.40%) and 20 with pPR1 (16.81%), and 89 poor responders (74.79%), comprising 82 with pPR2 (68.91%) and 7 with no response (5.88%). The median age of participants was 47.00 ± 11.44 years with a range of 28 to 80 years. The peak age group was 45 to 54 years, representing 32.77% of the cohort. The majority of participants (79, 66.39%) were aged 40 - 64 years, with 31 (26.05%) under 40 years and only 9 (7.56%) aged 65 years or older. When comparing mean age between subgroups, good responders were on average one year older than poor responders (48 ± 12 versus 47 ± 11.26 years), though this difference was not statistically significant ($p = 0.75$).

Among participants with available civil status data (n = 102), the majority were married (63, 61.67%), followed by single (33, 32.35%) and widowed (6, 5.88%). There was no significant difference in civil status distribution between good and poor responders ($p = 0.82$). Regarding professional status (n = 80), 48 participants (60.00%) were employed or students, while 32 (40.00%) were unemployed, with no significant difference between response groups ($p = 0.51$).

Regarding reproductive characteristics, 75 participants (63.03%) were pre-menopausal and 44 (36.97%) were post-menopausal, with no significant difference between response groups ($p = 0.81$). The average age at menarche was 13.34 ± 2.17 years (range 9 - 18 years), while the average age at menopause was 50.41 ± 3.72 years (range 42 - 59 years). Among participants with available breastfeeding data (n = 80), 64 (80.00%) had breastfed, with no significant difference between good and poor responders ($p = 0.60$).

3.2. Comorbidities and Risk Factors

Thirty-nine participants (32.77%) reported a family history of cancer. The majority of participants (88, 73.94%) had at least one comorbidity or risk factor. Among all documented comorbidities and risk factors (n = 83 total occurrences), the most common was alcohol consumption (54, 32.53%), followed by use of oral contraceptive pills (35, 21.08%) and obesity (32, 19.28%). Hypertension was present in 27 participants (16.27%), while diabetes was documented in 6 (3.61%). HIV infection was present in 7 participants (4.22%), hepatitis in 2 (1.20%), and smoking in 3 (1.81%). None of these comorbidities or risk factors showed statistically significant differences in distribution between good and poor responders (all $p > 0.05$).

3.3. Clinical and Pathobiologic Characteristics

The pre-treatment level of the biologic marker CA 15-3 was available in 69 cases, with a mean value of 41.44 ± 66.47 UI/L (range 1.00 - 406.00 UI/L) and median of 16.30 UI/L. When comparing mean CA 15-3 levels between subgroups, good responders had lower levels than poor responders, although this did not reach statistical significance (Figure 1).

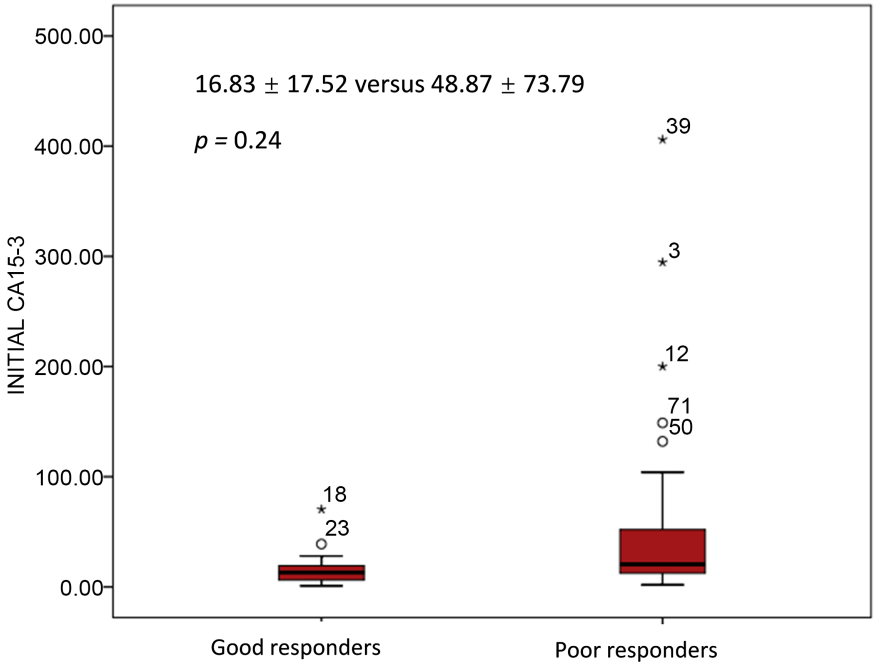

Figure 1. Comparison of the initial CA 15-3 levels between both groups.

Regarding histological type, invasive ductal carcinoma was the most common, representing 79 cases (66.39%). Mucinous carcinoma accounted for 7 cases (5.88%), with other histological types comprising 33 cases (27.73%). There was no significant difference in histological type distribution between good and poor responders (p = 0.30).

Tumour grade was evaluated in 98 participants (82.35%) using Nottingham criteria. Among these, the majority (60, 61.22%) had grade 2 tumours, while 14 (14.29%) had grade 1 and 24 (24.49%) had grade 3. Notably, poor responders demonstrated a higher proportion of histological grade III tumours compared to good responders (26.58% versus 15.79%), a difference that reached statistical significance (p = 0.01). Conversely, good responders had a higher proportion of grade 1 tumours (26.32% versus 11.39%).

Immunohistochemistry (IHC) analysis was performed in 78 of the 119 participants (65.55%), was not done in 36 cases (30.25%), and was inconclusive in 5 cases (4.20%) reportedly due to issues with sample preservation and preparation. Among participants with conclusive IHC results, triple-negative breast cancer was the most prevalent subtype (33, 42.31%), followed by luminal A (25, 32.05%), luminal

B (17, 21.79%), and non-luminal HER2-positive (3, 3.85%). It is noteworthy that among triple-negative cases, most had low Ki67 levels (34.62% low versus 7.69% high). The distribution of IHC subtypes did not differ significantly between good and poor responders (p = 0.81).

Ki67 levels were assessed in 78 participants. The majority (61, 78.21%) had Ki67 ≤ 14%, while 17 (21.79%) had Ki67 > 14%. When comparing mean Ki67 levels between subgroups, good responders showed significantly lower levels than poor responders (Figure 2).

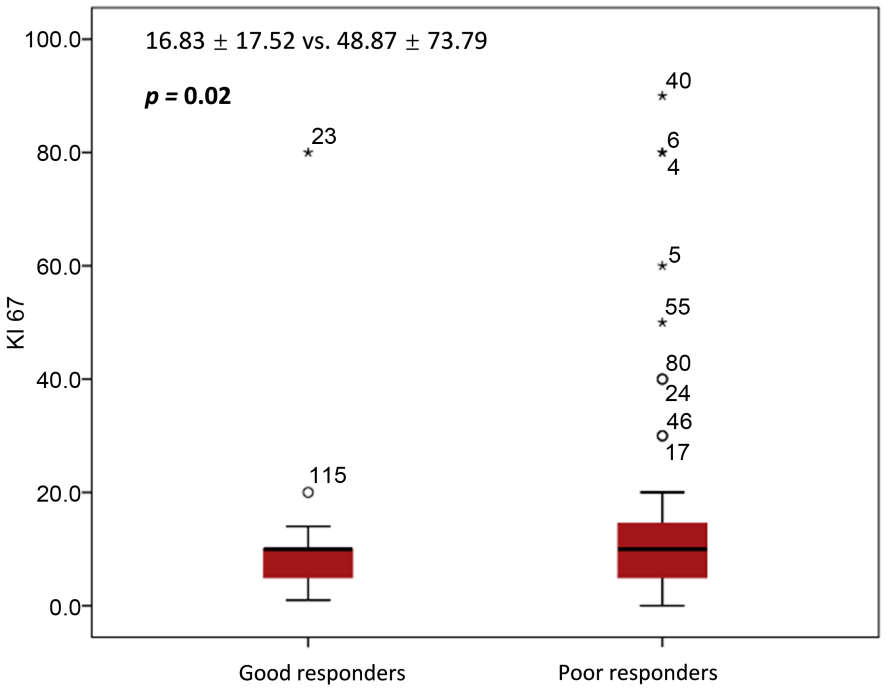

Figure 2. Comparison of the Ki67 levels between both groups.

Regarding disease stage at presentation, 37 participants (31.09%) had local disease and 82 (68.91%) had locally advanced disease. There was no statistically significant difference in stage distribution between good and poor responders (p = 0.08), though good responders showed a trend toward higher proportions of local disease (43.33% versus 26.97%).

3.4. Treatment Profile

All 119 participants received at least one line of neoadjuvant chemotherapy. Additionally, 76 participants (63.87%) received a second cycle of NACT, and one participant (0.84%) received up to four cycles. The most commonly used NACT protocol was AC (doxorubicin plus cyclophosphamide) combined with a taxane, employed in 64 cases (53.78%). AC alone was used in 17 cases (14.29%), while other protocols were used in 38 cases (31.93%). The distribution of NACT protocols did not differ significantly between good and poor responders (p = 0.44).

Regarding surgical intervention, the vast majority of participants (114, 95.80%)

underwent radical surgery (mastectomy), while only 5 (4.20%) underwent conservative surgery. There was no significant difference in surgical technique between good and poor responders (p = 0.78).

3.5. Therapeutic Responses to Neoadjuvant Chemotherapy

3.5.1. Clinical Response

Clinical response after NACT, analyzed using RECIST criteria, showed that the majority of participants achieved partial response (69, 57.98%), followed by complete response (32, 26.89%). Stable disease was observed in 10 participants (8.40%), while progressive disease occurred in 8 (6.72%). Although good responders demonstrated a higher proportion of complete clinical response compared to poor responders (33.33% versus 24.72%), this difference did not reach statistical significance (p = 0.61).

3.5.2. Pathologic Response

Analysis of surgical specimen reports revealed that histopathological reports did not provide information on surgical margins in 20 cases (16.81%). Among cases with documented margin status, the majority (75, 63.03%) had negative margins, while 24 (20.17%) had positive margins. Good responders had a significantly higher proportion of negative surgical margins compared to poor responders (83.33% versus 56.18%, p = 0.01). Importantly, margin status was always specified in good responders, whereas it remained unspecified in 24 poor responders (26.97%).

3.5.3. Factors Associated with Therapeutic Response

The relationship between clinicopathologic and therapeutic characteristics and pathologic response to NACT was analyzed using Spearman's correlation coefficient (ρ). Table 1 presents the results of both bivariate correlation analysis and ordinal logistic regression analysis.

Table 1. Association between patient characteristics and pathologic response.

Variable	Bivariate correlation analysis		Ordinal logistic regression analysis			
	Spearman's rho	*p-value*	aPOR	Standard error	95 % CI	*p-value*
Age at diagnosis	−0.01	0.89	0.99	0.31	0.94 - 1.04	0.63
Histological grade	0.37	<0.001	2.39	0.29	1.35 - 4.26	<0.001
Initial AJCC stage	0.09	0.32	1.02	0.24	0.65 - 1.63	0.92
HER2+	−0.03	0.75	0.32	1.697	0.01 - 8.94	0.50
Triple Negative	0.06	0.54	0.37	1.45	0.32 - 6.42	0.63
AC alone	0.06	0.49	0.03	2.18	0.0005 - 2.46	0.12
AC + Taxane	−0.11	0.23	0.07	2.18	0.001 - 4.95	0.22
Others	0.08	0.39	0.02	2.21	0.0002 - 1.16	0.06
Surgical margin status	0.28	<0.001	2.41	0.35	1.22 - 4.76	0.01

95 % CI, 95 % confidence interval; AC, Doxorubicin + Cyclophosphamide; AJCC, American Joint Committee on Cancer; aPOR, adjusted proportional odds ratio; NACT, neoadjuvant chemotherapy, HER2+, human epidermal growth factor receptor 2 positive.

Bivariate correlation analysis revealed statistically significant associations between pathologic response and histological grade ($\rho = 0.37$, $p < 0.001$) and surgical margin status ($\rho = 0.28$, $p < 0.001$). In multivariable ordinal logistic regression analysis, both higher histological grade (aOR = 2.39, 95% CI: 1.35 - 4.26, $p < 0.001$) and surgical margin status (aOR = 2.41, 95% CI: 1.22 - 4.76, $p = 0.01$) remained independently associated with pathologic response.

Age at diagnosis, initial AJCC stage, molecular subtypes (HER2-positive and triple-negative), and NACT protocols showed no significant association with pathologic response in bivariate analysis (all $p > 0.05$). In the multivariable ordinal logistic regression model, only histological grade and surgical margin status remained independently associated with pathologic response.

4. Discussion

This multicenter historical cohort study provides the first detailed characterization of pathologic response to neoadjuvant chemotherapy (NACT) in breast cancer patients managed in Yaounde, Cameroon. The observed pathologic complete response (pCR) rate of 8.40% underscores the major therapeutic challenges faced in resource-limited oncology settings.

4.1. Study Population Characteristics

The median age of 47 years in our study population aligns with regional trends observed by Noa *et al.* in their recent Cameroonian study and mirrors global patterns reported in the literature [19] [20]. This consistency suggests our sample is representative of the general breast cancer population in Cameroon, lending credibility to our findings. The predominance of the 40 - 64 age group (66.39%) and the relatively young age at presentation underscore the significant socioeconomic impact of breast cancer in our setting, affecting women during their most productive years. The sociodemographic profile of our participants, with a majority being married (61.67%) and employed or students (60.00%), reflects the diverse backgrounds of breast cancer patients in urban Cameroon. The high proportion of participants with at least one comorbidity (73.94%) highlights the complexity of managing breast cancer in this population, where concurrent medical conditions may influence treatment decisions and outcomes.

4.2. Pathologic Response Rates and Clinical Implications

The pCR rate identified in this cohort is considerably lower than the 15% - 35% typically reported in high-income countries, particularly for HER2-positive and triple-negative subtypes treated with contemporary targeted regimens. This discrepancy likely reflects structural differences in treatment availability rather than inherent chemoresistance alone [10] [21].

In Cameroon, access to trastuzumab and immune checkpoint inhibitors remains limited by cost, delayed procurement, and lack of reimbursement mechanisms. Consequently, HER2-positive tumors are frequently treated with chemo-

therapy alone, significantly impacting response depth. The evolution of pCR rates observed internationally following incorporation of targeted therapies highlights the therapeutic gap between high-resource and sub-Saharan settings [22].

Second, the timing and availability of molecular profiling present significant challenges. IHC analysis was not performed in 30.25% of cases in our study, and when performed, results were often available late in the treatment course or after treatment completion. This delay, attributable to financial constraints, limited patient awareness about breast cancer, and scarcity of molecular testing facilities [23], prevents optimal treatment selection and timely implementation of subtype-specific therapeutic strategies. The 4.20% rate of inconclusive IHC results further underscores quality control issues in molecular testing.

Third, our clinical response data, showing 26.89% complete response and 57.98% partial response, align reasonably well with findings from other African settings, such as the study by Adjade *et al*. in Morocco reporting 33% complete and 61% partial response rates [24]. However, these clinical response rates did not translate into correspondingly high pathologic response rates, suggesting that clinical assessment may overestimate pathologic response in our setting, possibly due to limitations in imaging modalities or differences in assessment techniques.

4.3. Molecular Subtype Distribution and Therapeutic Implications

The predominance of triple-negative breast cancer (42.31%) in our cohort represents a critical finding that corroborates recent Cameroonian studies [25] but contrasts markedly with patterns observed in the West where luminal subtypes predominate by over 70% [26]. This distribution has profound implications for treatment planning and outcomes.

The high prevalence of triple-negative disease may be explained by genetic factors, particularly the higher prevalence of BRCA1/2 mutations documented in African populations [27]. These genetic variations contribute not only to increased triple-negative subtype frequency but also to more aggressive tumor biology and younger age at presentation [2]. The predominance of low Ki67 levels in our triple-negative cases (34.62% low versus 7.69% high) presents an interesting paradox, as triple-negative cancers are typically associated with high proliferative indices. The unexpectedly high proportion of low Ki67 levels among triple-negative cases warrants cautious interpretation. Pre-analytical factors such as delayed fixation, prolonged cold ischemia time, inadequate formalin penetration, and inconsistent immunohistochemical standardization may have degraded antigenicity and resulted in underestimation of proliferation indices. Such technical constraints are well documented in resource-limited settings and may partly explain this biological paradox. Improvement of pathology standardization and external quality assurance programs is therefore critical.

The relative scarcity of HER2-positive non-luminal disease (3.85%) in our cohort may reflect true biological differences or could result from underdiagnosis due to limited IHC testing. This low prevalence has significant implications, as

HER2-targeted therapies represent one of the most successful examples of precision oncology, and their limited application in our setting represents a missed opportunity for improved outcomes.

4.4. Factors Associated with Therapeutic Response

Our findings demonstrate that both histological grade and surgical margin status were independently associated with pathologic response to neoadjuvant chemotherapy. The association between histological grade and treatment response may reflect the higher chemosensitivity of biologically aggressive tumors with high proliferative indices. This is consistent with previous studies showing that high-grade tumors, particularly triple-negative and HER2-positive subtypes, tend to achieve higher pathological response rates [13] [28]-[30].

The association observed with surgical margin status suggests a potential relationship between tumor biology, response depth, and local control. However, given the retrospective design, causality cannot be inferred. Tumors with better response to NACT naturally facilitate achievement of negative surgical margins, as residual disease is reduced or eliminated, allowing for more complete excision. The fact that margin status was unspecified in 26.97% of poor responders but in none of the good responders may indicate documentation challenges in cases with extensive residual disease.

Our findings regarding HER2 status diverge from those of Zhang *et al*., who identified it as an independent predictor of pCR [29]. This discrepancy likely reflects the low representation of HER2-positive non-luminal tumors in our cohort (3.85%) and, critically, the limited access to HER2-targeted therapy. In settings where trastuzumab and other anti-HER2 agents are routinely incorporated into neoadjuvant regimens, HER2-positive status strongly predicts pCR. However, without access to these targeted agents, HER2-positive tumors in our setting are treated primarily with chemotherapy alone, potentially explaining the lack of association between HER2 status and response in our analysis.

4.5. Treatment Patterns and Implications

The treatment profile in our study reflects current practice patterns in Cameroon and highlights both adherence to international guidelines and resource-related constraints. The predominant use of AC plus taxane (53.78%) aligns with standard recommendations for sequential anthracycline-taxane regimens [31], demonstrating appropriate adoption of evidence-based protocols despite resource limitations. However, the very high rate of radical surgery (95.80%) compared to conservative surgery (4.20%) suggests limited breast conservation, likely reflecting advanced disease at presentation and possibly conservative surgical practices to minimize risk of local recurrence in a setting where radiotherapy access is limited.

The clinical response rates observed in our study (26.89% complete, 57.98% partial) demonstrate that neoadjuvant chemotherapy achieves meaningful tumor reduction in a substantial proportion of patients even in a resource-limited set-

ting. However, the discordance between clinical and pathologic response rates underscores the importance of pathologic assessment, as clinical complete response does not reliably predict pathologic complete response. This finding has implications for treatment planning and reinforces the need for surgery following NACT even in cases of apparent clinical complete response. A notable finding is the discordance between clinical complete response (26.89%) and pathologic complete response (8.40%). Several explanations may account for this difference.

First, clinical response assessment in our context relies primarily on physical examination and ultrasound, with limited availability of breast MRI. MRI is recognized as the most accurate imaging modality for assessing residual disease post-NACT. Limited access to this technology may result in overestimation of tumor regression.

Second, tumor fibrosis and treatment-induced stromal changes may mimic disappearance on ultrasound evaluation while microscopic residual disease persists.

This finding reinforces the critical need for systematic surgical evaluation even in apparent clinical complete response in low-resource contexts.

5. Limitations and Strengths

Several limitations merit consideration when interpreting our findings. The retrospective design limited our control over data quality and completeness, resulting in missing information for some variables of interest. The relatively small sample size, while adequate for primary objectives, may have limited statistical power for detecting associations, particularly for subgroup analyses. The high proportion of cases excluded due to incomplete pathologic response documentation (16.02%) may have introduced selection bias if cases with incomplete documentation differed systematically from included cases. The single-region nature of the study, while allowing for detailed characterization of practice patterns in Yaounde, limits generalizability to other regions of Cameroon or sub-Saharan Africa with different healthcare infrastructure and patient populations. The inconsistent availability of molecular profiling data prevented comprehensive subtype-specific analyses and may have obscured important associations between molecular characteristics and response.

An additional potential source of selection bias arises from the exclusion of 170 patients (16.02%) whose surgical specimen reports lacked documentation of therapeutic effect analysis. These cases may not have been randomly distributed in terms of disease severity or response patterns. It is possible that patients with more advanced disease, incomplete surgical resections, or suboptimal pathological documentation were disproportionately excluded. This could have led to an underestimation or overestimation of true response rates in our population. Future prospective studies with standardized pathology reporting are warranted to mitigate this limitation.

Treatment adherence and dose intensity, although clinically important determinants of response, could not be analyzed due to incomplete documentation in

retrospective records, representing an additional limitation.

Although the total sample size (n = 119) met the minimum requirement calculated for comparing two proportions, the number of covariates included in the multivariate ordinal logistic regression relative to the number of outcome events may have limited statistical power. This constraint increases the risk of type II error and may have limited statistical power to detect additional independent factors associated with those identified (histological grade and surgical margin status).

Despite these limitations, our study possesses significant strengths. It represents the first comprehensive analysis of therapeutic response to NACT and associated factors in Cameroon, providing baseline data essential for monitoring trends and evaluating interventions. The inclusion of two major referral centres enhances generalizability within the urban Cameroonian context. The systematic application of standardized response assessment criteria (RECIST for clinical response and Sataloff for pathologic response) ensures reproducibility and facilitates comparison with other studies. The detailed characterization of patient demographics, tumor characteristics, and treatment patterns provides valuable insights into breast cancer care in a resource-limited setting.

6. Conclusion

This study provides the first comprehensive characterization of therapeutic response to neoadjuvant chemotherapy in Cameroonian breast cancer patients, revealing a pathologic complete response rate of 8.40%, significantly lower than rates in high-resource settings, likely reflecting limited access to targeted therapies, delayed molecular profiling, and the predominance of triple-negative subtype (42.31%). In this cohort, histological grade and surgical margin status were independently associated with pathologic response to neoadjuvant chemotherapy. However, pathologic response itself was not independently associated with survival outcomes. The high prevalence of triple-negative breast cancer combined with limited access to targeted therapies and the discordance between clinical and pathologic response rates represents critical challenges requiring urgent attention through policy interventions, healthcare system strengthening, and research efforts. These findings emphasize the need for enhanced early detection strategies, improved access to molecular profiling and targeted therapies, strengthening of healthcare infrastructure, and continued research to characterize the unique biology of African breast cancer, ultimately calling for urgent action to address disparities in breast cancer care that continue to affect outcomes for African women.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Bray, F., Laversanne, M., Sung, H., Ferlay, J., Siegel, R.L., Soerjomataram, I., *et al.*

(2024) Global Cancer Statistics 2022: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA*: *A Cancer Journal for Clinicians*, **74**, 229-263. https://doi.org/10.3322/caac.21834

[2] Joko-Fru, W.Y., Jedy-Agba, E., Korir, A., Ogunbiyi, O., Dzamalala, C.P., Chokunonga, E., *et al.* (2020) The Evolving Epidemic of Breast Cancer in Sub-Saharan Africa: Results from the African Cancer Registry Network. *International Journal of Cancer*, **147**, 2131-2141. https://doi.org/10.1002/ijc.33014

[3] Essiben, F., Meka, E.J.U., Ayissi, G., Essome, H., Atenguena, E. and Foumane, P. (2020) Factors Associated with Breast Cancer Occurrence before the Age of 40 in Yaoundé. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, **9**, 782-788. https://doi.org/10.18203/2320-1770.ijrcog20200377

[4] Bertrand, K.A., Bethea, T.N., Adams-Campbell, L.L., Rosenberg, L. and Palmer, J.R. (2017) Differential Patterns of Risk Factors for Early-Onset Breast Cancer by ER Status in African American Women. *Cancer Epidemiology, Biomarkers & Prevention*, **26**, 270-277. https://doi.org/10.1158/1055-9965.epi-16-0692

[5] Ngo, U.E.M., Ntsama, J.A.M., Motolouze, K., Schouame, N.M.L.N., Atenguena, O.E., Ndoua, C.C.N., *et al.* (2024) Determinants of Early Survival of Breast Cancer Patients in Yaoundé-Cameroon. *Open Journal of Obstetrics and Gynecology*, **14**, 487-501. https://doi.org/10.4236/ojog.2024.143042

[6] Sando, Z., Fouogue, J.T., Ngowa Kemfang, J.D. and Fouelifack, F.Y. (2018) A Nationwide Study of Breast Cancer Histopathology in Cameroon (Central Africa). *Journal of Cytology & Histology*, **9**, Article ID: 1000503. https://doi.org/10.4172/2157-7099.1000503

[7] Amin, M.B., Greene, F.L., Edge, S.B., Compton, C.C., Gershenwald, J.E., Brookland, R.K., *et al.* (2017) The Eighth Edition AJCC Cancer Staging Manual: Continuing to Build a Bridge from a Population-Based to a More "Personalized" Approach to Cancer Staging. *CA*: *A Cancer Journal for Clinicians*, **67**, 93-99. https://doi.org/10.3322/caac.21388

[8] Ngowa, J.D.K., Fouedjio, H.J., Tchami, A.M., Likeng, J.L.N., Noche, C.D., Djouonang, B.W., *et al.* (2022) Diagnostic and Therapeutic Options of Breast Cancer Patients in Yaounde, Cameroon. *Advances in Breast Cancer Research*, **11**, 50-62. https://doi.org/10.4236/abcr.2022.111003

[9] Sando, Z., Fouogue, J.T., Fouelifack, F.Y., Fouedjio, J.H., Mboudou, E.T. and Oyono, J.L. (2014) Profil des cancers gynécologiques et mammaires à Yaoundé—Cameroun. *Pan African Medical Journal*, **17**, Article 28. https://doi.org/10.11604/pamj.2014.17.28.3447

[10] Etienne, A., Nkeng, G., Ruth, M., Ndedi, P., Lionel, T., Pelagie, D., *et al.* (2024) Lymph Node Response after Neoadjuvant Chemotherapy and Correlation with Relapse Free Survival in Breast Cancer at Yaoundé General Hospital. *Journal of Science and Diseases*, **2**, 13-17.

[11] Wang, H. and Mao, X. (2020) Evaluation of the Efficacy of Neoadjuvant Chemotherapy for Breast Cancer. *Drug Design, Development and Therapy*, **14**, 2423-2433. https://doi.org/10.2147/dddt.s253961

[12] Krishnan, Y., Alawadhi, S.A., Sreedharan, P.S., Gopal, M. and Thuruthel, S. (2013) Pathological Responses and Long-Term Outcome Analysis after Neoadjuvant Chemotheraphy in Breast Cancer Patients from Kuwait over a Period of 15 Years. *Annals of Saudi Medicine*, **33**, 443-450. https://doi.org/10.5144/0256-4947.2013.443

[13] Tang, S., Wang, K., Zheng, K., Liu, J., Zhang, H., Tan, M., *et al.* (2020) Clinical and Pathological Response to Neoadjuvant Chemotherapy with Different Chemotherapy

Regimens Predicts the Outcome of Locally Advanced Breast Cancer. *Gland Surgery*, **9**, 1415-1427. https://doi.org/10.21037/gs-20-209

[14] Lueong, S.S., Tonouo, P.D.T.D., Tiofack, A.A., Kenfack, R.N., Kuiate, J.R., Mbassi, E.D., *et al.* (2024) Abstract 3929: Comparative Genomics of Breast Cancer in Indigenous African and Western Populations First Results from the E-Predict Study. *Cancer Research*, **84**, 3929-3929. https://doi.org/10.1158/1538-7445.am2024-3929

[15] Fleiss, J.L., Tytun, A. and Ury, H.K. (1980) A Simple Approximation for Calculating Sample Sizes for Comparing Independent Proportions. *Biometrics*, **36**, 343-346. https://doi.org/10.2307/2529990

[16] Eisenhauer, E.A., Therasse, P., Bogaerts, J., Schwartz, L.H., Sargent, D., Ford, R., *et al.* (2009) New Response Evaluation Criteria in Solid Tumours: Revised RECIST Guideline (Version 1.1). *European Journal of Cancer*, **45**, 228-247. https://doi.org/10.1016/j.ejca.2008.10.026

[17] Sataloff, D.M., Mason, B.A., Prestipino, A.J., Seinige, U.L., Lieber, C.P. and Baloch, Z. (1995) Pathologic Response to Induction Chemotherapy in Locally Advanced Carcinoma of the Breast: A Determinant of Outcome. *Journal of the American College of Surgeons*, **180**, 297-306.

[18] Shrestha, B. and Dunn, L. (2020) The Declaration of Helsinki on Medical Research Involving Human Subjects: A Review of Seventh Revision. *Journal of Nepal Health Research Council*, **17**, 548-552. https://doi.org/10.33314/jnhrc.v17i4.1042

[19] Ndoua, C.C.N., Motolouze, K., Etienne, A., Ntsama, J.A.M., Rs, T.N., Tatsipie, W.L., *et al.* (2022) Survival of Patients Operated on for Breast Cancer in Yaounde: A Study of 166 Cases. *Health Sciences and Disease*, **23**, 27-30.

[20] Arnold, M., Morgan, E., Rumgay, H., Mafra, A., Singh, D., Laversanne, M., *et al.* (2022) Current and Future Burden of Breast Cancer: Global Statistics for 2020 and 2040. *The Breast*, **66**, 15-23. https://doi.org/10.1016/j.breast.2022.08.010

[21] Vanderpuye, V., Grover, S., Hammad, N., PoojaPrabhakar,, Simonds, H., Olopade, F., *et al.* (2017) An Update on the Management of Breast Cancer in Africa. *Infectious Agents and Cancer*, **12**, Article No. 13. https://doi.org/10.1186/s13027-017-0124-y

[22] McFarland, D.C., Naikan, J., Rozenblit, M., Mandeli, J., Bleiweiss, I. and Tiersten, A. (2016) Changes in Pathological Complete Response Rates after Neoadjuvant Chemotherapy for Breast Carcinoma over Five Years. *Journal of Oncology*, **2016**, Article ID: 4324863. https://doi.org/10.1155/2016/4324863

[23] Esson Mapoko, B.S., Frambo, A., Saidu, Y., Bell Mbassi, E.D., Atenguena, E., Azemafac, K., *et al.* (2023) Assessment of Barriers to Optimal Cancer Control in Adult Cancer Treatment Centres in Cameroon. *eCancerMedicalScience*, **17**, Article 1601. https://doi.org/10.3332/ecancer.2023.1601

[24] Adjadé, G., Tafenzi, H.A., Jouihri, H., Al Tamimi, N.S., Bennouna, Y., Négamiyimana, G., *et al.* (2023) Localised Breast Cancer: Neoadjuvant Chemotherapy Impact Evaluation on the Pathological Complete Response (PCR) in a Lower Middle-Income Country. *eCancerMedicalScience*, **17**, Article 1648. https://doi.org/10.3332/ecancer.2023.1648

[25] Guy, E.M.R., Junie, N.Y., Tatah, N.H., Yannick, M., Thérèse, A.M., Flore, Z.N.M., *et al.* (2023) Immuno-Histochemical Profile of Breast Cancers at the General Hospital of Douala-Cameroon. *Open Journal of Obstetrics and Gynecology*, **13**, 1377-1388. https://doi.org/10.4236/ojog.2023.138115

[26] Łukasiewicz, S., Czeczelewski, M., Forma, A., Baj, J., Sitarz, R. and Stanisławek, A. (2021) Breast Cancer—Epidemiology, Risk Factors, Classification, Prognostic Markers, and Current Treatment Strategies—An Updated Review. *Cancers*, **13**, Article 4287.

https://doi.org/10.3390/cancers13174287

[27] Adedokun, B., Zheng, Y., Ndom, P., Gakwaya, A., Makumbi, T., Zhou, A.Y., *et al.* (2020) Prevalence of Inherited Mutations in Breast Cancer Predisposition Genes among Women in Uganda and Cameroon. *Cancer Epidemiology, Biomarkers & Prevention*, **29**, 359-367. https://doi.org/10.1158/1055-9965.epi-19-0506

[28] Cortazar, P., Zhang, L., Untch, M., Mehta, K., Costantino, J.P., Wolmark, N., *et al.* (2014) Pathological Complete Response and Long-Term Clinical Benefit in Breast Cancer: The CTNeoBC Pooled Analysis. *The Lancet*, **384**, 164-172. https://doi.org/10.1016/s0140-6736(13)62422-8

[29] Zhang, T., Liu, Y. and Tian, T. (2024) Predicting Pathological Complete Response after Neoadjuvant Chemotherapy in Breast Cancer by Clinicopathological Indicators and Ultrasound Parameters Using a Nomogram. *Scientific Reports*, **14**, Article No. 16348. https://doi.org/10.1038/s41598-024-64766-2

[30] von Minckwitz, G., Untch, M., Blohmer, J., Costa, S.D., Eidtmann, H., Fasching, P.A., *et al.* (2012) Definition and Impact of Pathologic Complete Response on Prognosis after Neoadjuvant Chemotherapy in Various Intrinsic Breast Cancer Subtypes. *Journal of Clinical Oncology*, **30**, 1796-1804. https://doi.org/10.1200/jco.2011.38.8595

[31] Ortmann, O., Blohmer, J., Sibert, N.T., Brucker, S., Janni, W., Wöckel, A., *et al.* (2022) Current Clinical Practice and Outcome of Neoadjuvant Chemotherapy for Early Breast Cancer: Analysis of Individual Data from 94,638 Patients Treated in 55 Breast Cancer Centers. *Journal of Cancer Research and Clinical Oncology*, **149**, 1195-1209. https://doi.org/10.1007/s00432-022-03938-x