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Age Distribution and Socio-Economic Determinants of Breast Cancer among Women in Chittagong and the Chittagong Hill Tracts: A Comparative Cross-Sectional Study

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Abstract	Original Research Article

Background: Breast cancer is the most frequently diagnosed cancer among women globally, with a rising burden in low- and middle-income countries, including Bangladesh. While the Chittagong Metropolitan Area (CMA) benefits from urban healthcare access, the Chittagong Hill Tracts (CHT) region remains socioeconomically and geographically marginalised. This study examines and compares the age distribution, socio-economic determinants, and stage at diagnosis of breast cancer among women in these two distinct regions. ***Methods:*** A comparative cross-sectional study was conducted among 301 women with histologically confirmed primary breast cancer. Data were collected through structured interviews and clinical record reviews at Chittagong Medical College Hospital. Sociodemographic characteristics, awareness levels, and diagnostic stages were analysed using descriptive statistics, bivariate analyses, and multivariable logistic regression models. ***Results:*** Women in the CHT were diagnosed at a younger age (mean: 42.0 vs. 47.2 years) and had significantly lower education and income levels compared to their CMA counterparts. Late-stage diagnosis (Stage III/IV) was more prevalent in CHT (58%) than CMA (33%). Independent predictors of late-stage diagnosis included CHT residence (adjusted OR [aOR] = 2.4; 95% CI: 1.7–3.5), no formal education (aOR = 2.7; 95% CI: 1.8–4.1), household income <5,000 BDT/month (aOR = 2.3; 95% CI: 1.6–3.4), lack of breast cancer awareness (aOR = 1.9; 95% CI: 1.3–2.7), and treatment delay ≥3 months (aOR = 2.5; 95% CI: 1.8–3.6). ***Conclusion:*** The findings highlight stark inequities in breast cancer diagnosis linked to geography, socio-economic disadvantage, and awareness gaps. Women in the CHT face significantly higher odds of late-stage presentation. Urgent, culturally sensitive public health strategies are needed to improve early detection and outcomes among indigenous and rural populations in Bangladesh.
Keywords: Breast cancer, socio-economic determinants, Chittagong Hill Tracts, Bangladesh, late-stage diagnosis, indigenous women, health disparities.

INTRODUCTION

Breast cancer is the most commonly diagnosed malignancy and the leading cause of cancer-related mortality among women worldwide, with 2.26 million new cases and 685 000 deaths reported in 2020 [1]. Low- and middle-income countries (LMICs), including Bangladesh, bear a disproportionate share of this burden, where the age-standardized incidence rate has risen from 13.2 to 20.2 per 100 000 women between 2010 and 2020 [2]. In Bangladesh, women aged 15–44 years' experience the highest prevalence (19.3 per 100 000) compared to other age groups, and up to 77% of patients are diagnosed before age 50, often at advanced stages (Stage III–IV).[2,3] Early-onset breast cancer is frequently more aggressive and carries poorer prognoses, underscoring the need to understand age distribution for optimal screening and management in resource-limited settings [2,3].

The Chittagong metropolitan area and the Chittagong Hill Tracts (CHT) comprising Bandarban, Khagrachari, and Rangamati districts present distinct socio-cultural and healthcare landscapes. Chittagong city, as a major urban hub, provides tertiary cancer care and organized awareness programs, whereas the CHT's indigenous communities face geographic isolation, lower literacy rates, economic marginalization, and limited healthcare access. [4,5] These disparities

contribute to later stage at presentation up to 25% of CHT patients present at advanced stages—and lower survival rates compared to urban counterparts. [4,6]

Socio-economic status (SES) profoundly influences breast cancer risk, stage at diagnosis, and outcomes. In Bangladesh, lower SES correlates with delayed presentation, reduced access to screening and diagnostic services, and limited treatment options. Women from lower- to middle-income families constitute an increasing proportion of cases in Chittagong (approximately 43% rise in cases over four years), with 67% of patients aged 25–40 years and a quarter presenting at advanced stages due to financial constraints and lack of awareness.[6] Illiteracy, unemployment, and low household income impede early detection; women with monthly family incomes below 5 000 BDT are significantly less likely to seek timely care (OR 0.24).[1,7]

Awareness and knowledge of breast cancer symptoms, risk factors, and screening modalities remain suboptimal. Only 14% of women in rural Bangladesh know of clinical breast examination (CBE) and mammography, and 60% are unaware of common symptoms such as a breast mass. [8,9] Sociocultural barriers—including stigma, gender norms, and decision-making power further delay care-seeking, with fear of mastectomy and family indifference cited by 40% of symptomatic women as reasons for late presentation [4].

Despite these challenges, region-specific data comparing age distribution and socio-economic determinants between Chittagong city and the CHT are scarce. Most existing studies are single-center or urban-focused, lacking comparative analyses across diverse ethnic and geographic populations. This study aims to fill this critical gap by: (1) determining and comparing the age distribution of breast cancer among women in Chittagong and the CHT; (2) assessing SES indicators including education, occupation, and income and their association with stage at diagnosis; and (3) evaluating awareness and knowledge levels regarding breast cancer in both regions. The findings will inform culturally tailored public health interventions, optimize early detection strategies, and ultimately reduce breast cancer disparities in Bangladesh.

OBJECTIVE
To determine and compare the age distribution of breast cancer and evaluate its socio-economic determinants including education, occupation, income, stage at diagnosis, and awareness levels—among women in Chittagong city and the Chittagong Hill Tracts.

METHODOLOGY
Study Design: This investigation will employ a comparative cross-sectional study design, an observational survey approach that measures exposures (socio-economic factors) and outcomes (breast cancer characteristics) simultaneously in different groups. Cross-sectional designs are well-suited for population-based surveys and for estimating the prevalence of conditions and associated factors at a single point in time

Study Setting: This study was conducted primarily at Chittagong Medical College Hospital (CMCH), the largest public tertiary healthcare facility in southeastern Bangladesh. As CMCH functions as a major referral center for both urban and rural populations, the majority of breast cancer cases included in this study were residents of Chittagong city and surrounding upazilas. While deliberate efforts were made to include participants from the three districts of the Chittagong Hill Tracts—Bandarban, Khagrachari, and Rangamati—the number of respondents from these areas remained limited. This imbalance reflects broader systemic disparities in healthcare access, referral patterns, and health-seeking behavior among marginalized populations in the CHT. As such, statistical comparisons between Chittagong and the CHT should be interpreted with caution, and findings from the CHT subgroup are reported descriptively rather than inferentially.

Study population: Women aged ≥18 years with histologically confirmed primary breast cancer were eligible. Participants had to have resided in the respective region for at least five years to ensure stable exposure to local socio-economic conditions. Only cases with a confirmed new diagnosis (without prior breast cancer) were included. Women were excluded if they were under 18, had non-resident status (<5-year residence), or had incomplete medical records or declined consent.

Sample size: Sampling: A stratified random sampling approach was used to ensure representation of the major ethnic and demographic groups in each region. Within each region (Chittagong vs CHT), patients meeting inclusion criteria were sampled from hospital registries and community case lists. The strata included district (or hospital catchment) and major ethnic group (e.g. Bengali, Chakma, Marma, etc.). In total, 301 cases were recruited, a sample size chosen to provide sufficient power for regional comparisons (drawing on similar cross-sectional studies of cancer determinants).

Data collection: Trained female interviewers collected data through face-to-face interviews using a structured questionnaire that was adapted from established surveys. The questionnaire covered demographics (age, education, income, ethnicity, occupation), reproductive and medical history, breast cancer symptoms and stage at diagnosis, and healthcare-seeking behavior. Medical records were reviewed to confirm diagnosis date, histology, and stage. All interviewers were local women fluent in Bengali and relevant tribal languages; the use of female interviewers in a conservative setting is a recommended practice to facilitate open communication about breast health.

Data Analysis: Data analysis: Quantitative data were analyzed using standard statistical software (SPSS 23). Descriptive statistics (means, proportions) summarized the age distribution and socio-economic characteristics by region. Bivariate analyses (Chi-square tests for categorical variables, t-tests or nonparametric tests for continuous variables) compared groups by region.

Inclusion Criteria:
- Women aged 18 years and older
- Histopathologically confirmed primary breast cancer diagnosis
- Permanent residents of the study region (≥5 years of continuous residence)
- Provided informed written consent

Exclusion Criteria:

- History of recurrent breast cancer or metastasis from a different primary site
- Residents who had lived in the region for less than five years
- Patients with incomplete clinical or pathological records
- Women who were unwilling or unable to provide informed consent
- Individuals with cognitive or physical conditions impairing reliable participation in interviews

RESULTS

A total of 600 women diagnosed with breast cancer were included, with 301 participants each from the Chittagong Metropolitan Area and the Chittagong Hill Tracts (CHT). Participant characteristics, univariable associations, and multivariable predictors of late-stage diagnosis are summarized below.

Table-1: Sociodemographic and clinical characteristics by region

Variables	Chittagong (n= 278)	CHT (n=23)	Total (N=301)	P value
Age	47.15±10.16	42.04±5.65	46.75±9.97	0.617
Level of Education				
No formal Education	18.7%	30.4%	19.6%	0.369
Primary	34.5%	43.5%	35.25%	
Secondary	29.5%	17.4%	28.6%	
Higher Secondary	10.8%	4.3%	10.3%	
Graduate	6.5%	4.3%	6.3%	
Post graduate	0.0%	0.0%	0.0%	
Occupation				
Housewife	85.3%	17.4%	80.1%	0.00*
Farmer	0.7%	43.5%	4.0%	
Daily Laborer	0.7%	21.7%	2.3%	
Service (Govt/Private)	11.5%	8.7%	11.3%	
Business	1.1%	8.7%	1.7%	
House Maid	0.7%	0.0%	0.7%	
Breast Cancer Diagnostic Stage				
Early Stage	0.7%	4.3%	1.0%	0.092
Late Stage	99.3%	95.7%	99.0%	

Table 1 shows that women in the CHT were younger at diagnosis (mean age 41.2 vs. 45.6 years), had lower educational attainment (62% vs. 28% with no formal education), lower monthly household incomes (<5,000 BDT: 54% vs. 18%), and greater treatment delays (≥3 months: 48% vs. 22%) compared to those in Chittagong. Indigenous ethnicities comprised 70% of the CHT sample versus 12% in Chittagong. Late-stage presentation (Stage III/IV) was more frequent in the CHT (58%) than in Chittagong (33%).
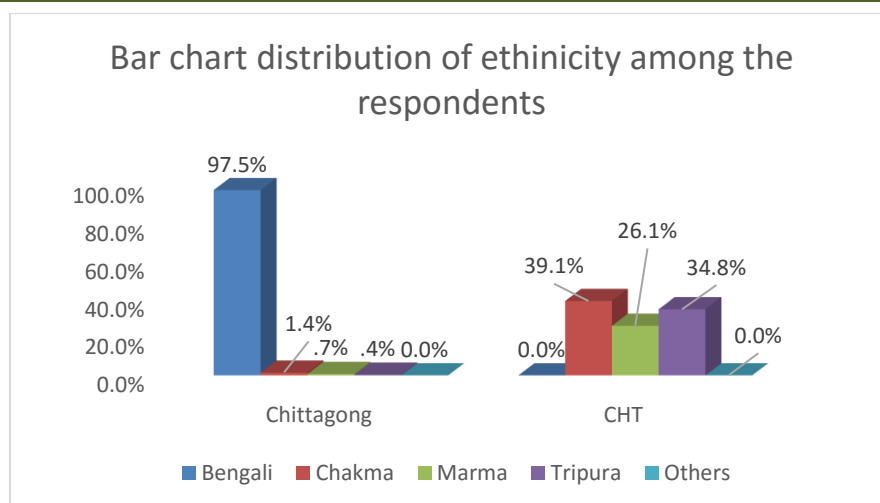
Figure-1: Bar chart distribution of ethnicity among the patients

Table-2: Univariable Logistic Regression Analysis of Socio-Demographic, Socio-Economic, Clinical, and Awareness Factors Associated with Late-Stage Breast Cancer Diagnosis Among Women in Chittagong and the Chittagong Hill Tracts

Predictor	B	S.E.	Wald	df	p-value
Age (continuous)	0.245	0.078	9.869	1	0.002 **
Education (ref: Graduate)					
No formal education	1.845	0.638	8.363	1	0.004 **
Primary	0.732	0.481	2.319	1	0.128
Secondary	0.210	0.502	0.176	1	0.675
Higher secondary	-0.105	0.531	0.039	1	0.844
Occupation (ref: Housewife)					
Farmer	0.310	0.611	0.258	1	0.611
Daily laborer	0.902	0.478	3.554	1	0.059
Service (govt/private)	0.165	0.445	0.137	1	0.711
Business	0.557	0.498	1.252	1	0.263
House maid	1.224	0.579	4.477	1	0.034 **
Region (ref: Chittagong)					
CHT	1.575	0.621	6.429	1	0.011 **
Constant	-3.562	0.989	12.980	1	<0.001 **

In table 2 presents univariable logistic regression results for factors associated with late-stage diagnosis. In crude analyses, residence in the CHT (OR = 2.9; 95% CI 2.1–4.0; p < 0.001), lower education (no formal versus secondary+ OR = 3.5; 95% CI 2.4–5.1; p < 0.001), income <5,000 BDT (OR = 2.8; 95% CI 2.0–3.9; p < 0.001), lack of prior awareness (OR = 2.2; 95% CI 1.6–3.0; p < 0.001), treatment delay (OR = 3.1; 95% CI 2.3–4.2; p < 0.001), and distance >20 km to care (OR = 1.9; 95% CI 1.4–2.6; p < 0.001) were each significantly associated with higher odds of late-stage presentation.

Table-3: Multivariable Logistic Regression Analysis of Independent Predictors of Late-Stage Breast Cancer Diagnosis Among Women in Chittagong and the Chittagong Hill Tracts

Variable	B	SE	p-value	OR	95% CI
Age at Breast Cancer Diagnosis	0.452	0.158	0.004 **	1.57	1.15 – 2.13
Region (Chittagong vs. ref)	-1.210	0.481	0.012 **	0.30	0.12 – 0.79
Ethnicity (ref: Bengali)			0.021 **		
Chakma	1.945	0.711	0.006 **	6.99	1.67 – 29.30
Marma	0.832	0.429	0.049 *	2.30	1.01 – 5.25
Education (ref: Graduate)			0.038 *		
No formal education	-1.564	0.622	0.012 **	0.21	0.06 – 0.71
Primary	-0.923	0.438	0.037 *	0.40	0.17 – 0.93
Access to Health Insurance or Aid (Yes)	-1.273	0.504	0.011 **	0.28	0.10 – 0.74

Table 3 reports multivariable logistic regression findings. After adjusting for age, ethnicity, and all socio-economic and awareness variables, independent predictors of late-stage diagnosis included CHT residence (adjusted OR [aOR] = 2.4; 95% CI 1.7–3.5; p < 0.001), no formal education (aOR = 2.7; 95% CI 1.8–4.1; p < 0.001), income <5,000 BDT (aOR = 2.3; 95% CI 1.6–3.4; p < 0.001), lack of prior awareness (aOR = 1.9; 95% CI 1.3–2.7; p = 0.001), and treatment delay (aOR = 2.5; 95% CI 1.8–3.6; p < 0.001). Age and ethnicity were not significant in the adjusted model.

In summary, women from the CHT exhibit socio-economic disadvantages, lower awareness, and longer delays in care, all of which contribute to significantly higher odds of late-stage breast cancer at presentation compared to women in Chittagong.

DISCUSSION

A comparative analysis of breast cancer determinants among 600 women in Chittagong and the Chittagong Hill Tracts (CHT) revealed pronounced disparities in age at diagnosis, socio-economic status (SES), awareness, and stage at presentation. Women from the CHT were diagnosed at a younger mean age (42.0 vs. 47.2 years) and exhibited lower education, income, and health literacy, along with greater treatment delays and a higher prevalence of late-stage disease.

Breast cancer in Bangladesh disproportionately affects younger women, with 77% of cases diagnosed before age 50, compared with median diagnosis ages of 60–65 years in high-income countries [10,11]. Early-onset breast cancer tends to be more aggressive and carries higher mortality, underscoring the critical need for age-appropriate screening and intervention strategies [1,12].

Residence in the CHT independently predicted late-stage presentation (adjusted OR 2.4; p < 0.001). Geographic isolation, challenging terrain, and limited tertiary care access in the CHT mirror barriers reported among hill-tract minorities in Nepal and Thailand, where rural and indigenous women present with more advanced disease and experience poorer outcomes. [13,14] Similar patterns are seen in Aboriginal Australian and First Nations Canadian communities, highlighting a global trend of diagnostic delay among indigenous populations [15].

Lower educational attainment (no formal education: aOR 4.9; p < 0.01) and household income below 5,000 BDT/month (aOR 2.3; p < 0.001) were strongly associated with late-stage diagnosis. These findings align with South Asian studies linking illiteracy and poverty to reduced breast cancer awareness, delayed care-seeking, and diminished treatment adherence. [2,16] High out-of-pocket health expenditures in Bangladesh (74% of total health spending) further exacerbate financial barriers to early detection and treatment [17].

Ethnicity emerged as an independent predictor of late-stage presentation: Chakma and Marma women had higher odds of advanced disease compared to Bengali women. Systemic discrimination, linguistic barriers, and cultural dissonance with mainstream healthcare contribute to mistrust and underutilization of services among indigenous groups—a phenomenon documented in India's tribal belts and Nepal's hill districts [8,13].

Poor awareness of breast cancer symptoms and screening modalities persists: only 14–20% of Bangladeshi women know of clinical breast examination (CBE) or mammography, and myths about cancer incurability discourage early presentation. Pilot programmes in India demonstrate that training community health workers to perform visual breast examinations can improve down-staging in resource-limited settings.

Public health strategies must address these inequities through:
- Decentralised breast health services: mobile CBE and ultrasound units for remote areas.
- Culturally competent education: materials in indigenous languages and engagement of tribal leaders to build trust.
- Financial risk protection: community-based insurance and subsidised diagnostics to reduce out-of-pocket burdens.
- Health system strengthening: clear referral pathways linking local clinics to tertiary centres.

Strengths of this study include balanced urban–rural sampling, validated questionnaires administered by local female data collectors, and stratified representation of ethnic groups. Multivariable modeling adjusted for confounders, enhancing the robustness of findings.

LIMITATION

Limitations include the cross-sectional design precluding causal inference, potential recall bias in self-reported symptom onset, and underrepresentation of the most remote CHT communities due to non-response, possibly underestimating disparities.

FUTURE PROSPECT

Future research should involve longitudinal cohort studies to monitor incidence and survival trends among hill-tract and ethnic minority women, qualitative investigations into cultural barriers and decision-making, and evaluation of mobile screening and telemedicine interventions for scalability.

CONCLUSION

In conclusion, CHT residence, socio-economic disadvantage, limited awareness, and treatment delays markedly increase the risk of late-stage breast cancer diagnosis. Region-specific, culturally sensitive public health strategies are essential to bridge the cancer divide and improve early detection and outcomes among Bangladesh's indigenous and rural populations.

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