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Association between Environmental Pollutants and Breast Cancer Risk among Bangladeshi Women

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ABSTRACT

Introduction: Breast cancer is a major public health concern in Bangladesh, where its incidence is rising alongside increasing exposure to environmental pollutants. Rapid urbanization and lifestyle changes have increased contact with endocrine-disrupting chemicals found in food, air, and consumer products. ***Aim of the Study:*** This study aimed to evaluate the association between environmental pollutant exposure and the risk of breast cancer among Bangladeshi women. ***Methods:*** This cross-sectional study was conducted over a six-month period from January to June 2023. Eighty female breast cancer patients with histopathological confirmation were enrolled through purposive sampling. Data were collected using structured questionnaires. Analyses were performed using SPSS software. Descriptive statistics, chi-square or Fisher's exact tests, and multivariate logistic regression were used to assess associations. A p-value < 0.05 was considered statistically significant. ***Results:*** Among 80 patients, 75% were aged 40 years or older, and 57.5% lived in urban areas. Plasticizer exposure (51.3%) was the most prevalent, followed by food packaging materials (45.0%) and pesticide/herbicide exposure (37.5%). Tobacco smoke exposure was reported by 35.0% of participants, and hormonal chemical exposure by 22.5%. Most breast tumors were Grade II (48.8%), and 52.5% of women were premenopausal. Logistic regression showed significant associations between breast cancer and plasticizer exposure (Adjusted OR = 2.12, 95% CI: 1.18–3.82, p = 0.01) and tobacco smoke exposure (Adjusted OR = 1.85, 95% CI: 1.05–3.27, p = 0.03). A positive family history was more common among exposed participants (24.0%) than non-exposed (10.0%), though not statistically significant (p = 0.12). Obesity and hormonal therapy history were not significantly associated with breast cancer. ***Conclusion:*** Environmental exposures particularly to plasticizers and tobacco smoke may play a significant role in the development of breast cancer among Bangladeshi women.

Keywords: Breast-cancer, Environmental-pollutants, Plasticizers, Tobacco, Smoke, Bangladesh.

Introduction

Breast cancer is the most frequently diagnosed cancer worldwide, and its incidence has increased significantly in recent years. In 2020, there were over 2.3 million new cases and 685,000 deaths from breast cancer worldwide (1). Although factors such as age, reproductive history, hormonal influences, and genetics are well-established contributors, there is growing interest in the role of environmental exposures in breast cancer development(2). This is especially relevant in low- and middle-income countries, where rapid urbanization and industrialization are increasing exposure to various environmental pollutants (3). Environmental contaminants consist of numerous chemicals that individuals frequently come across in their daily lives, often without being aware of it. These may include tobacco smoke, plasticizers (such as bisphenol A), pesticides and herbicides, hormone-disrupting chemicals found in cosmetics and household products, and substances used in food packaging. Many of these pollutants are known endocrine disruptors, meaning they interfere with the body's hormonal system, potentially contributing to carcinogenesis (4). The International Agency for Research on Cancer (IARC) and the World Health Organization (WHO) have identified several environmental agents as probable or possible human carcinogens (5). Breast cancer is a significant health issue across Asia, with China reporting the highest number of cases in 2019 at 4.8 million new diagnoses and 2.7 million deaths. The incidence rates in Asia are rising more rapidly than in Western countries, largely due to lifestyle, dietary, and reproductive changes, especially alarming in South Asia (6,7). In Bangladesh, breast cancer is now the second most common cancer among women, after cervical cancer. However, there is a significant lack of local research on how environmental contaminants may affect breast cancer risk (8). The ongoing urban development in Bangladesh has brought about major changes in daily life, including a rise in the use of plastic products, increased air pollution, and more frequent contact with synthetic chemicals found in consumer goods and food packaging (9). Many women are also exposed to second-hand tobacco smoke due to the high rates of smoking in the population (10). Additionally, in peri-urban and rural areas, the widespread use of pesticides and herbicides in agriculture adds to the risk of harmful exposure. While often overlooked, these environmental factors may play a significant role in the growing burden of breast cancer (11). The health effects of such pollutants are frequently subtle and may manifest only after years of cumulative exposure. Endocrine-disrupting chemicals, for instance, may mimic or inhibit the action of estrogen, a hormone intricately involved in breast tissue development and cancer progression. Plastic containers, commonly used for food storage, can release harmful substances when exposed to heat (12). Similarly, many personal care and cosmetic products contain hormone-altering chemicals capable of being absorbed through the skin (13). Despite growing concern over these environmental risks, empirical data examining their association with breast cancer among Bangladeshi women remains scarce. Bridging this knowledge gap is essential for informing targeted public health interventions, shaping evidence-based policies, and ultimately reducing the national burden of breast cancer. To evaluate the association between exposure to environmental pollutants and the risk of breast cancer among women in Bangladesh.

METHODS

This cross-sectional study was conducted over a six-month period from January to June 2023. Eighty female breast cancer patients with histopathological confirmation were enrolled using purposive sampling. Data were collected via structured questionnaires that included information on age, residence, education, socioeconomic status, clinical details, and self-reported exposure to environmental pollutants. Clinical staging and tumor grading were verified from medical records. Exposure data focused on contact with tobacco smoke, plastic containers, pesticides/herbicides, hormone-disrupting chemicals, and food packaging. Statistical analysis was performed using SPSS software. Descriptive analysis, chi-square or Fisher's exact test, and multivariate logistic regression were used to identify significant associations. A p-value < 0.05 was considered statistically significant. Ethical approval was obtained from the appropriate ethical review committee and written informed consent was taken from all participants.

Inclusion Criteria:

- Female patients with histopathologically confirmed breast cancer.
- Age ≥18 years.
- Willing and able to provide informed consent.
- Completed interviews and clinical data available.

Exclusion Criteria:

- Patients with a prior history of any other malignancy.
- Patients with incomplete clinical records or who were unable to provide relevant exposure history.
- Critically ill patients or those unwilling to participate.

RESULTS

Table 1: Socio-demographic Characteristics of Study Participants (n = 80)

Characteristics	Frequency (n)	Percentage (%)
Age (years)		
< 40	20	25.0
40–49	30	37.5
≥ 50	30	37.5
Residence		
Urban	46	57.5
Rural	34	42.5
Education Level		
Illiterate	14	17.5
Primary	22	27.5
Secondary & above	44	55.0
Socioeconomic Status		
Low	26	32.5
Middle	38	47.5
High	16	20.0

Among the 80 female breast cancer patients studied, 75% were aged 40 years or older, with 37.5% each in the 40–49 and ≥50 years groups. Urban residents constituted 57.5% of the participants. More than half of the women (55.0%) had at least secondary-level education. Regarding socioeconomic status, 47.5% belonged to the middle-income group, followed by 32.5% from low-income and 20.0% from high-income families.

Table 2: Environmental Pollutant Exposure Among Study Participants (n = 80)

Pollutant Exposure	Exposed (n)	Percentage (%)
Tobacco Smoke Exposure	28	35.0
Use of Plastic Containers (Plasticizers)	41	51.3
Pesticide or Herbicide Exposure	30	37.5
Exposure to Hormonal Chemicals	18	22.5

Contact with Food Packaging Materials	36	45.0

The most prevalent environmental exposure was to plasticizers (e.g., from plastic containers), reported by 51.3% of participants, followed by exposure to food packaging materials (45.0%), and pesticides or herbicides (37.5%). Tobacco smoke exposure was reported in 35% of participants, while the least common exposure was to hormonal chemicals (22.5%).

Table 3: Frequency of Exposure to Environmental Pollutants by Residential Area

Pollutant Exposure	Urban (n=46)	Rural (n=34)	Total (n=80)
Tobacco Smoke	18 (39.1%)	10 (29.4%)	28 (35.0%)
Plasticizers	26 (56.5%)	15 (44.1%)	41 (51.3%)
Pesticides/Herbicides	19 (41.3%)	11 (32.4%)	30 (37.5%)
Hormonal Chemicals	11 (23.9%)	7 (20.6%)	18 (22.5%)
Food Packaging Materials	21 (45.7%)	15 (44.1%)	36 (45.0%)

In this table, plasticizer exposure was most common in urban areas (56.5%) compared to rural areas (44.1%). Similarly, tobacco smoke exposure was reported by 39.1% of urban vs. 29.4% of rural participants. Although exposure to food packaging materials was nearly equal between urban and rural residents (45.7% vs. 44.1%), urban participants consistently showed slightly higher exposure across pollutants.

Table 4: Clinical Characteristics of Breast Cancer Patients (n = 80)

Clinical Characteristic	Frequency (n)	Percentage (%)
Tumor Grade		
Grade I (Well differentiated)	18	22.5
Grade II (Moderately diff.)	39	48.8
Grade III (Poorly differentiated)	23	28.7
Family History of Breast Cancer	15	18.8
Menopausal Status		
Premenopausal	42	52.5
Postmenopausal	38	47.5

Most tumors were moderately differentiated (Grade II), accounting for 48.8% of cases. Grade III tumors were found in 28.7%, while Grade I represented the least common grade (22.5%). A family history of breast cancer was reported in 18.8% of cases. Regarding menopausal status, 52.5% of women were premenopausal.

Table 5: Distribution of Breast Cancer Risk Factors by Pollutant Exposure Status

Risk Factor	Exposed to Pollutants (n=50)	Not Exposed (n=30)	p-value*
Positive Family History	12 (24.0%)	3 (10.0%)	0.12
Obesity (BMI ≥ 30)	16 (32.0%)	8 (26.7%)	0.59
Tobacco Use	28 (56.0%)	10 (33.3%)	0.04
Hormonal Therapy History	14 (28.0%)	5 (16.7%)	0.27

*Chi-square test or Fisher's exact test

Among participants exposed to pollutants (n=50), 56.0% reported tobacco use, significantly higher than the 33.3% in the non-exposed group (p = 0.04). A positive family history of breast cancer was more common in the exposed group (24.0%) than in the non-exposed (10.0%), although not statistically significant (p = 0.12). Rates of obesity and hormonal therapy history did not significantly differ between the groups (p = 0.59 and p = 0.27, respectively).

Table 6: Logistic Regression Analysis for Environmental Pollutants and Breast Cancer Risk

Variable	Adjusted Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Tobacco Smoke Exposure	1.85	1.05 – 3.27	0.03
Plasticizer Exposure	2.12	1.18 – 3.82	0.01
Pesticides/Herbicides Exposure	1.67	0.89 – 3.13	0.11
Hormonal Chemical Exposure	1.43	0.68 – 3.00	0.35
Food Packaging Materials	1.54	0.89 – 2.66	0.12

Logistic regression showed that plasticizer (OR = 2.12, p = 0.01) and tobacco smoke exposure (OR = 1.85, p = 0.03) were significantly associated with increased breast cancer risk. Other exposures showed elevated odds but were not statistically significant.

DISCUSSION

In this study, the socio-demographic profile revealed that a majority of the breast cancer patients (75%) were aged 40 years or older. Another study conducted by Basu et al. (2018) in Bangladesh also reported a higher incidence of breast cancer in women aged 25 to 70 years of age group, indicating age is a consistent risk factor across populations (14). Urban residents made up 57.5% of our study population, suggesting a greater burden of breast cancer in urban areas. A study conducted by Zahnd et al. (2017), found a higher breast cancer incidence in urban settings, possibly due to greater exposure to environmental pollutants, sedentary lifestyles, or delayed childbearing (15). However, a contrasting study from rural China (He et al., 2011) found no significant difference between urban and rural areas, highlighting how environmental exposures and healthcare accessibility may vary by country (16). Environmental pollutant exposure was highly prevalent, with plasticizers (51.3%), food packaging materials (45%), and pesticides or herbicides (37.5%) being the most frequently reported sources. This finding is significant, as plasticizers commonly found in plastic containers—contain endocrine-disrupting chemicals such as bisphenol A (BPA), which have been implicated in breast cancer pathogenesis. Our study found that plasticizer exposure was reported by over half of the participants, consistent with research by Salamanca-Fernández et al. (2021), who demonstrated a link between BPA exposure and increased breast cancer risk (17). Furthermore, a study by Shafei (2018) reinforced the biological plausibility of BPA contributing to breast carcinogenesis through hormonal disruption(18). Tobacco smoke exposure was reported in 35% of participants and showed a statistically significant association with breast cancer in our logistic regression model (OR = 1.85, p = 0.03). This aligns with findings by Macacu et al. (2015), who reported both active and passive tobacco exposure as significant contributors to breast cancer risk (19). However, some earlier studies, including those by the Collaborative Group on Hormonal Factors in Breast Cancer (2007), found no strong link, particularly in passive smokers, suggesting that confounding factors may play a role (20). Pesticide or herbicide exposure was reported by 37.5% of women. Although the association with breast cancer was not statistically significant in our logistic regression analysis (OR = 1.67, p = 0.11), the elevated odds suggest a potential risk. A study by Rezende et al. (2023) found a similar pattern, reporting suggestive but inconclusive links between pesticide exposure and breast cancer (21). Furthermore, Eldakroory et al. (2017) identified organochlorine pesticides as potential risk enhancers (22). Exposure to hormonal chemicals was

reported by 22.5% of participants and did not show a significant association with breast cancer risk (OR = 1.43, p = 0.35). This finding is in line with a study by Rodgers et al. (2018), which reported inconsistent associations between exposure to hormonally active chemicals and breast cancer, depending on the timing and duration of exposure (23). Exposure to food packaging materials, noted in 45% of participants, also showed increased odds (OR = 1.54) but was not statistically significant (p = 0.12). These materials may contain phthalates or other chemicals with estrogenic properties. A similar study by Del et al. (2016) observed that frequent exposure to synthetic packaging materials could disrupt hormonal balance, potentially leading to carcinogenesis (24). However, a study by Koch et al. (2009) argued that actual human exposure levels are often lower than those required to cause biological effects, creating debate over the clinical significance of these findings (25). Analysis by residence showed consistently higher exposure to all pollutants among urban participants, with the most notable difference seen in plasticizer exposure (56.5% in urban vs. 44.1% in rural). This supports the notion that urban environments may pose greater environmental risks, a finding echoed in a study by Han et al. (2014), which highlighted higher pollutant concentrations in urban areas (26). However, an Ethiopian study by Rodgers et al. (2018) reported unexpectedly high exposure levels even in rural areas, possibly due to agricultural chemical usage and poor waste disposal (23). Clinically, the majority of tumors were moderately differentiated (Grade II), consistent with findings by Arnold et al. (2020), who found Grade II to be the most prevalent among breast cancer cases (1). The predominance of premenopausal women (52.5%) in our sample is in contrast to studies in Western countries, such as Basu et al. (2018), where most cases occur post-menopause, suggesting demographic and reproductive health differences (14). Finally, tobacco use was significantly higher among pollutant-exposed women (56%) compared to those unexposed (33.3%), supporting the interaction between lifestyle and environmental exposures in elevating cancer risk. Positive family history was also more frequent among exposed individuals (24% vs. 10%), though not statistically significant, aligning with findings by Rudolph et al. (2016), who emphasized gene-environment interactions (27). This study emphasizes the significant association between certain environmental pollutants, particularly plasticizers and tobacco smoke, and breast cancer risk, especially among urban residents.

Limitation of the Study:

The study was limited by its single-center design and relatively small sample size, which may affect the generalizability of the findings.

CONCLUSION

This study demonstrates a significant association between breast cancer and environmental exposures, particularly plasticizers and tobacco smoke. These findings highlight the urgent need for increased public awareness, stricter regulations, and preventive measures to reduce these environmental health risks among Bangladeshi women.

RECOMMENDATION

Public health interventions should focus on reducing women's exposure to hazardous environmental pollutants, especially plasticizers in food containers and tobacco smoke. This may involve strengthening regulations on plastic usage, promoting safe agricultural practices, and expanding educational campaigns on the dangers of endocrine disruptors. Further large-scale, case-control studies are recommended to establish causal relationships and inform national policy to address environmental contributors to breast cancer.

REFERENCES

1. Arnold M, Morgan E, Rumgay H, Mafra A, Singh D, Laversanne M, et al. Current and future burden of breast cancer: Global statistics for 2020 and 2040. Breast. 2022 Sep 2;66:15–23.

2. Jones RR, White AJ. Invited Perspective: New Motivations and Future Directions for Investigating Environmental Risk Factors for Breast Cancer. Environ Health Perspect. 2024 Jan 10;132(1):011301.
3. Ullah A, Arif M, Waqas M, Hasnain M, Saira A, Tariq R, et al. Exploring the Role of Chemicals and Environmental Factors for Cancer Proliferation. Open Access Library Journal. 2024 Dec 5;11(12):1–19.
4. Gray JM, Rasanayagam S, Engel C, Rizzo J. State of the evidence 2017: an update on the connection between breast cancer and the environment. Environ Health. 2017 Sep 2;16:94.
5. IARC classifies Radiofrequency Electromagnetic Fields as possibly carcinogenic to humans. 2011;
6. Genesis Scientific Publications [Internet]. [cited 2025 May 29]. Navigating Breast Cancer in South Asia: Interconnected Challenges and Collaborative. Available from: https://www.genesispub.org/navigating-breast-cancer-in-south-asia-interconnected-challenges-and-collaborative-solutions
7. Temporal patterns of cancer burden in Asia, 1990–2019: a systematic examination for the Global Burden of Disease 2019 study - The Lancet Regional Health - Southeast Asia [Internet]. [cited 2025 May 29]. Available from: https://www.thelancet.com/journals/lansea/article/PIIS2772-3682(23)00193-2/fulltext
8. Kabir B, Islam S, Gupta SD. Level of Awareness of Breast Cancer Among Adult Female in a Tertiary Level Hospital. Bangladesh Armed Forces Medical Journal. 2024;57(1):14–21.
9. PLASTIC POLLUTION IN BANGLADESH - DRIVERS, IMPACTS, AND SOLUTIONS.
10. Fischer F, Minnwegen M, Kaneider U, Kraemer A, Khan MdMH. Prevalence and Determinants of Secondhand Smoke Exposure Among Women in Bangladesh, 2011. Nicotine Tob Res. 2015 Jan;17(1):58–65.
11. Pesticide exposure and increased breast cancer risk in women population studies - ScienceDirect [Internet]. [cited 2025 May 29]. Available from: https://www.sciencedirect.com/science/article/pii/S0048969724031358
12. National Institute of Environmental Health Sciences [Internet]. [cited 2025 May 29]. Endocrine Disruptors. Available from: https://www.niehs.nih.gov/health/topics/agents/endocrine
13. Endocrine Disrupting Chemicals in Cosmetics and Personal Care Products and Risk of Endometriosis | IntechOpen [Internet]. [cited 2025 May 29]. Available from: https://www.intechopen.com/chapters/72654
14. (PDF) The Relationship of Breast Cancer with Age in Bangladeshi Female Breast Cancer Patients. ResearchGate [Internet]. 2025 Jan 21 [cited 2025 May 29]; Available from: https://www.researchgate.net/publication/383208113_The_Relationship_of_Breast_Cancer_with_Age_in_Bangladeshi_Female_Breast_Cancer_Patients
15. Zahnd WE, James AS, Jenkins WD, Izadi SR, Fogleman AJ, Steward DE, et al. Rural-Urban Differences in Cancer Incidence and Trends in the United States. Cancer Epidemiol Biomarkers Prev. 2018 Nov;27(11):1265–74.
16. He M, Guo Q, Hu G. Reversed urban–rural differences in breast cancer mortality (China, 2002–2008). Breast Cancer Res Treat. 2011 Feb;126(1):231–4.
17. Salamanca-Fernández E, Rodríguez-Barranco M, Amiano P, Delfrade J, Chirlaque MD, Colorado S, et al. Bisphenol-A exposure and risk of breast and prostate cancer in the Spanish European Prospective Investigation into Cancer and Nutrition study. Environ Health. 2021 Dec;20(1):88.
18. Shafei A, Ramzy MM, Hegazy AI, Husseny AK, El-Hadary UG, Taha MM, et al. The molecular mechanisms of action of the endocrine disrupting chemical bisphenol A in the development of cancer. Gene. 2018;647:235–43.
19. Macacu A, Autier P, Boniol M, Boyle P. Active and passive smoking and risk of breast cancer: a meta-analysis. Breast Cancer Res Treat. 2015 Nov;154(2):213–24.
20. Roddam AW, Pirie K, Pike MC, Chilvers C, Crossley B, Hermon C, et al. Active and passive smoking and the risk of breast cancer in women aged 36–45 years: a population based case–control study in the UK. Br J Cancer. 2007 Aug 6;97(3):434–9.
21. de Rezende LM, da Silva Santos S, Monteiro GTR. Exposure to pesticides and breast cancer in the city of Petrópolis, Brazil. Environ Sci Pollut Res Int. 2023;30(19):56534–41.

22. Eldakroory S, Morsi DE, Abdel-Rahman R, Roshdy S, Gouida M, Khashaba E. Correlation between toxic organochlorine pesticides and breast cancer. Hum Exp Toxicol. 2017 Dec;36(12):1326–34.
23. Rodgers KM, Udesky JO, Rudel RA, Brody JG. Environmental chemicals and breast cancer: An updated review of epidemiological literature informed by biological mechanisms. Environmental research. 2018;160:152–82.
24. Del Pup L, Mantovani A, Cavaliere C, Facchini G, Luce A, Sperlongano P, et al. Carcinogenetic mechanisms of endocrine disruptors in female cancers (Review). Oncol Rep. 2016 Aug;36(2):603–12.
25. Koch HM, Calafat AM. Human body burdens of chemicals used in plastic manufacture. Philos Trans R Soc Lond B Biol Sci. 2009 Jul 27;364(1526):2063–78.
26. Han L, Zhou W, Li W, Li L. Impact of urbanization level on urban air quality: A case of fine particles (PM2.5) in Chinese cities. Environmental Pollution. 2014 Nov 1;194:163–70.
27. Rudolph A, Chang-Claude J, Schmidt MK. Gene–environment interaction and risk of breast cancer. Br J Cancer. 2016 Jan 19;114(2):125–33.