Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 2444-2450 | ISSN:2251-6727

An Analysis of the Relationship between Urbanization and the Rise in Cases of Breast Cancer and Its Risk Factors

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(Received: 05 December 2025 Revised: 15 January 2026 Accepted: 10 February 2026)

KEYWORDS :

Breast Cancer, BC, Risk factors, Metropolitan cities, Women Health, Cancer, epidemiology

ABSTRACT:

Introduction: Breast Cancer is the leading cause of Cancer related morbidity and mortality among women globally. This review paper showcasing panoramic analysis of the heterogeneous perspective of Breast Cancer, the prevalent risk factors which are contributing to its occurrence & urbanization impact of rising cases in younger women of metropolitan cities. As populations shifted from rural to urban territories for several reasons, a distinct urban cancer transition has been observed.

Objectives: To evaluate the association between urbanization and the increasing incidence of breast cancer, with particular emphasis on lifestyle changes, reproductive cycles, alter female life course, environmental pollution, and exposure to chemical risk factors prevalent in urban settings.

Methods: This review followed a hybrid Integrative design combining systematic literature review, thematic analysis and Narrative synthesis; the electronic articles were checked in Google Scholar, Web of science, PubMed and Scopus database without any time restriction. The search keywords applied Breast Cancer, risk factors, cancer, women health, globalization, urbanization, mortality, urbanization impact. Inclusion criteria encompassed peer-reviewed original articles on human populations reporting urban-rural comparisons or urbanization gradients with quantitative incidence. 35 relevant abstracts from overall 94 articles published are referred to conclude this study.

Results: Urban populations exhibited a significantly higher incidence rate of breast cancer compared to non-urban populations, The risk increasing direct proportionally with the degree of urbanization. Elevated exposure to urban environmental pollutants, including endocrine-disrupting chemicals such as polycyclic aromatic hydrocarts, phthalates, bisphenols, and organo-chlorine compounds, showed a positive and statistically significant association with breast cancer risk. Multivariable models demonstrated that combined exposure to Electronic, radio transmitting devices and urban lifestyle factor like higher body mass index, physical inactivity, delayed age at first childbirth, and reduced breastfeeding duration, chronic stress, interrupted circadian health has accounted for a substantial proportion of the urban & rural disparity in breast cancer incidence.

Conclusions: The reviewed evidences the incidence rate of breast cancer is rising. It establishes a robust ink between urbanization and elevated breast cancer incidence, largely attributable to modifiable risk factors and access inequities. It further demonstrates that urban cancer transition is not just a reflection of improved screening test but the consequences of changes in women's life course patterns, lifestyle changes, environmental exposures, socio-economical stress. The urban life style changed the behavioral pattern like delayed childbirth, reduced parity and breast feeding, sedentary lifestyles, digital dependency , chronic stress, exposure to endocrine disrupting chemicals collectively increase the risk to the urban population. Importantly, the growing influence of modern urban risk like circadian disruption, air pollution, digital lifestyle patterns, and climate-related environmental change are highlighting the need to expand traditional cancer risk models. Breast cancer prevention must move beyond individual behavior change to embrace life-course, exposome-based and gender-sensitive public health strategies. Addressing these through multi-spectrum interventions could restrain the global burden in urbanizing populations graphic, hereditary; lifestyle & urbanization contribute the rising incidence of breast cancer.

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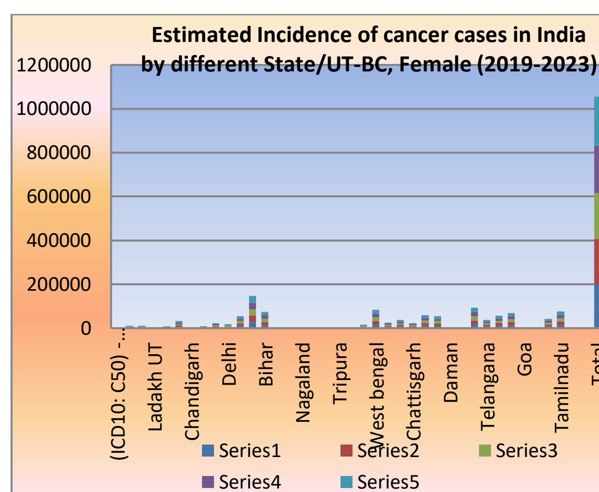
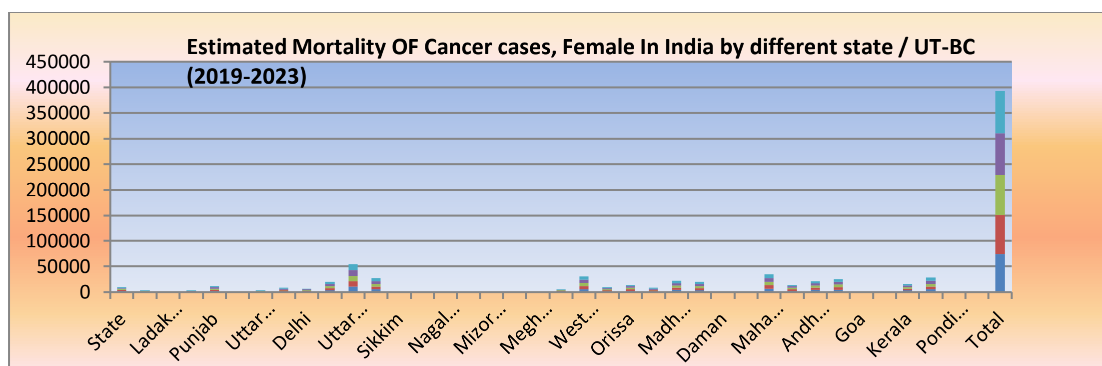
1. Introduction

Urbanization has emerged as a major determinant of the global cancer burden, particularly it influencing the rising incidence of breast cancer among women [1]. As populations shifted from rural to urban territories for several reasons, a distinct **urban cancer transition** has been observed. It marked by a decline in infection-related cancers and a rise in lifestyle oriented- and hormonally driven malignancies. Breast cancer, is mainly hormone-dependent and especially sensitive to changes associated with urban life style, including dietary transitions, physical inactivity, environmental exposures to the pollutions, chronic stress and increased life expectancy. It significantly alters the **female life-course** by reshaping the reproductive cycles due to career orientation [2]. Urban women increasingly experience delayed marriage and childbirth, reduced parity, shorter durations of breastfeeding, and greater use of hormonal contraceptive pills all of them are established risk factors for breast cancer. Additionally, urban employment practices often promote sedentary behavior, irregular dietary habits, chronic psychosocial stress, and sleep disruption, leading to metabolic and hormonal changes that cumulatively elevate breast cancer risk across the life span [3].

Despite of better healthcare infrastructure, **urban inequalities** persist and it contributes to differential cancer outcomes. Socioeconomic disparities, overcrowded, bizarre living conditions, and uneven access to preventive and screening facilities result in delayed diagnosis, particularly among women from underprivileged communities [4]. A **gender-based perspective** further reveals how care giving responsibilities, occupational stress, and gender norms influence health-prioritize behavior and limits participation in early detection programs; strengthen the breast cancer burden in urban population [5].

Furthermore, **modern urban risks** are increasingly recognized in breast cancer epidemiology [6]. Prolonged exposure to digital devices, night-shift work, and artificial lighting disrupt circadian rhythms and melatonin regulation in the body, which have been linked to hormone-dependent cancers. Concurrent exposure to endocrine-disrupting chemicals from cosmetics used, plastics, processed foods, and urban air pollution, combined with rising obesity rates, creates a complex risk environment unique to urban populations. Understanding these interconnected dimensions is essential for designing targeted prevention strategies and equitable cancer control policies in rapidly urbanizing societies





Ref: National Cancer Registry Programme report [33, 34, 35].

2. Objective

- To compare the trends and prevalence of breast cancer across urban, semi-urban, and rural populations.
- To examine the association between urbanization and lifestyle-related risk factors contributing to breast cancer incidence.
- To assess the influence of reproductive and hormonal factors linked to urban living on breast cancer risk.

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JCHR (2026) 16(1), 2444-2450 | ISSN:2251-6727

- To evaluate the role of urban environmental and occupational exposures, including pollution and endocrine-disrupting chemicals, in breast cancer development.

3. Materials and Methods

This review followed a hybrid Integrative design combining systematic literature review, thematic analysis and Narrative synthesis; the electronic articles were checked in Google Scholar, Web of science, PubMed and Scopus database without any time restriction. The search keywords applied Breast Cancer, risk factors, cancer, women health, globalization, urbanization, mortality, urbanization impact. Inclusion criteria encompassed peer-reviewed original articles on human populations reporting urban-rural comparisons or urbanization gradients with quantitative incidence. Data Mainly studies published in English which has the reference of aspects of cancer & breast cancer including current status & past scenario of epidemiology, risk factors, myths, assessment of environmental exposure , globalization impact on health, Non communicable disease, Lifestyle induced diseases were included in the study. 35 relevant abstracts from overall 94 articles published are referred to conclude this study.

4. Risk Factors

BC develops and occurs as a result of multiple internal and external factors [7]. It has been observed that 5% to 10% of BCs can be attributed to genetic mutations and family history, and 20% to 30 % of BCs can be attributed to factors that can be modifiable [8]. Despite of knowing many risk factors of BC occurrence in 65 to 70 % of women no

specific risk factor found [9]. Broadly Risk factors can be categorized in to two Modifiable & Non-modifiable Risk Factors [10]. However, Urbanization induces few more risk factors which are adding concern for health indicators

Table-3 Categorization of Risk factors in Breast Cancer

Modifiable Risk Factors	Non modifiable Risk Factors	Urbanization Induced Risk Factors
Dietary Pattern	Age	Environmental hazards (Pollution) ($PM_{2.5}$, NO_2, PAHs)
Alcohol, Tobacco Consumption	Gender	Chronic Stress
Physically Active	Genetic Mutation	Digital Screen time
Obesity	Hereditary	Radiation transmissions / Occupational hazards
Hormone Replacement Therapy	Age of Menarche & Menopause	Disturb Sleep patterns
Child bearing age or delayed Marriages	Prior benign Breast diseases	Vitamin D deficiency due to the desk job

3.1 Incidence Patterns

Urban women exhibit 10–30% higher breast cancer incidence than rural counterparts, with U.S. county-level data showing a $\beta=0.23$ increase per urbanicity unit ($p<0.001$). Chinese studies report annual urban incidence growth of 2.3%, versus stable rural rates. In India, urbanization correlates with rising cases amid lifestyle transitions [11].

3.2 Key Risk Factors

1. **Obesity and Sedentary Lifestyle:** Urban density promotes inactivity and high-calorie diets, elevating postmenopausal risk (OR=1.5–2.0) [12].

2. **Reproductive Factors:** Delayed childbearing and fewer parity in cities link to 20–40% higher risk. [11, 2]

3. **Environmental Exposures:** Urban pollutants (e.g., endocrine disruptors) show modest associations, though evidence is inconsistent, It need cohort study to be conducted.

4. **Screening and Detection Bias:** Higher mammography access inflates urban incidence by early detection, but late-stage rural diagnoses persist

5. **Hormone Therapy and contraceptives**: Estrogen alone increased BC risk by about 1% per year and combined hormone replacement therapy increased 8% of risk per year [13].

Table - 4 Evidence of Urban effects

Risk Factors	Urban effects on Incidence	Key Mediator	Evidence Strength
SES Quintile	Positive (β=0.09 mediation)	Income / Education	Strong [14]
Primary Care services	Positive (β=0.06 mediation)	Screening access	Strong [14]
Residential Segregation	Higher advance – stage diagnosis	Racial disparities	Moderate [15]

Pollution	Inconclusive	Air Pollution	Weak [15]
Stress	Positive	Cortisol stimulation	Moderate [16]
Digital Screen Time	Cohort study required	High Energy Visible blue light	Weak [17]

3.3 Necessity to Evaluate Risk Factors of BC in a Metropolitan Cities

Equal accessibility requires all the patients those who are seeking the health care. Irrespective of financial & social status every patient deserves the good care. Built environment is directly or indirectly creates the urban problems such as overcrowded population, slum, bizarre hygiene, solid waste, pollution [18]. It has overall impact on health. According to census commission of India, if the city's population is over 4 million, the city is considered as Metropolitan city. In India Mumbai, Delhi, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune and Surat come under metropolitan cities. Mumbai has over 18 million populations. Apart from General risk factors there are Environmental factors, modernization, Life style changes, and chronic stress impacted on health. Mumbai is an ec

onomical capital of India. It has high population density which amplifies the healthcare challenges. 2021 census was not conducted due to Covid, but as per estimated reports received according to the growth; Mumbai's population to be around 26,129,000for metropolitan area and 17,67,3000 for city. Different social economical classes have different affordability towards health care facilities. There is also high demand for awareness programs irrespective of High or low economical class as the cases is prevalent in each stratum. Conservative attitudes may hinder discussions on breast health. In Indian society BC is still having stigma. Today also it links with character of women in orthodox families and hence women don't open up or hesitate to talk on it. Economical variances created disparities in healthcare access leave many women undiagnosed or diagnosed at advance stages. Looking at rising inflation and living expenses in metropolitan cities women are stand in competitive work culture, which affecting hormonal health and lifestyle choices [5]. The work culture and urbanization also introduced chronic stress levels, sedentary lifestyles and unhealthy eating habits which are contributing to BC risk [4]. Prolonged use of electronic devices may affect lifestyles indirectly through sleep disruption. Career focused women often delay marriage and childbirth, increasing hormonal exposure and risk. Many women are reluctant for breast feeding to their kid. Surrogacy is new tread is emulsifying in higher social economical class which is also not good indicator. Many industrial outlets, Chemical factories, constructive sites, vehicles emulsify high pollution levels in Mumbai and the population is expose to the pollution has carcinogenic substances like Radon, benzene, asbestos, diesel engine exhaust, coal combustion daily [19]. Increased consumption of processed foods and sugary beverages is linked to obesity, a known risk factor for BC. Junk food, easy or ready to cook food, street food, packaged food production has spread their wings in all metropolitan cities. Highly saturated fats, preservative, synthetic color, taste enhancer are not good for the health but they are preference to all especially younger age group and it has ill effects on health [20]. Evaluation is crucial for women with a family history of BC, especially given the lack of awareness about genetic counseling [21]. The rise in alcohol and tobacco use among urban women adds to the risk. On the name of status, stress reliever or to show off smoking and alcohol con

sumption by women is very common in metro cities. Hukkah bar trend is also getting settled within youngsters [22]. Despite education, awareness about breast self-examination and early symptoms remains low. Screening programs are not uniformly accessible, and many women neglect routine checkups. Screening cost is not covered by all the health insurance [23].

3.4 Preventive Measures

Regular screening based on family history, age and risk factors needs to encourage in women. Mammography or clinical breast examination should be the part of annual health checkup post 40 years of age. Practicing healthy life style, maintaining healthy weight, managing balance diet, keeping oneself physically active and restriction on consumption of alcohol and tobacco can minimize the risk of developing BC. Women those who have family history of cancer or genetic mutation should prioritize **genetic investigations** and counseling to take preventive decisions [24]. Women of all strata should be informed & educated about BC risk through **awareness program** like seminars, community programs or through social media. Local municipal bodies or Anganvadi sevika or ASHA workers can take part in spreading the awareness. Gynecologist should encourage spreading the information when women visit to them during their pregnancy or deliveries and encourage proper **breast feeding**. Alternate protection can be advised by the healthcare professional to avoid uses of contraceptive pills [25].

Post Individual measures, community level measures are important which should includes city level risk reduction strategies, **Urban exposure-Focused prevention** : Such as Improving air qualities by restricting number of constructions sites, promoting electronic vehicles, giving subsidies on the sale of it. The chemical industries should not be get the permissions in the area of dense population, strict regulation

policies to be set for Industrial emission, The atomic research plant should be shifted from the dense habitats. Reducing traffic related pollution & ensuring safe housing, GIS-based exposure mapping and urban health surveillance can be helpful to identifying high-risk neighborhoods, enabling targeted screening, awareness, and environmental interventions.

Endocrine Disruptor Chemicals Exposure Reduction: Public health program should be promote EDC consumer products, regulate chemical content in Cosmetics and food packaging, instead promote alternative which are safe. Community campaign educates women for minimizing daily exposure mainly vulnerable life stages such as adolescence, pregnancy and menopause [26]. **Bisphenol A (BPA) and phthalates** are endocrine disrupting chemicals released when plastic containers are come in contacts with heat. They are potentially carcinogenic, hence the utensil, food packaging materials, Tiffin boxes should be use wisely [27].

Circadian Health based prevention: Workplace regulation to limit night shift duration, promote proper sleep & rotating shifts schedule, further to avoid sleep deprivation bed time screen time has to be reduced, as disruption in circadian rhythms associated with hormone based cancer. To **minimize digital screen** time & sedentary schedules, promote workplace exercise breaks, digital detox or fasting campaign with nutritional education for the employees [17]. **Mental health** promotion is equally important, the can be addressed incorporating **stress management** programs, workplace counseling, social support network, it can strengthen the resilience and indirectly minimize the cancer vulnerability

3.5 Persistent Researches in Breast Cancer Domain

Various researchers are uninterruptedly working in BC domain to minimize the challenges across the globe. World Health Organization has proposed the booklet of essential medicines for the treatment of cancer in 2015. This is good initiative but it is still remaining challenging more many regions. Collaboration strategies have been designed to encourage clinical trials for biomarkers and using social media encourage participants to participate in large numbers to identify patients with genetic predisposition for better management. Without scarifying the outcome of treatment BC therapies can de-escalate [28]. Tamoxifen is the first selective estrogen modulator (SERm) has to be approved for the treatment. Positive effects of this trial have given new hope to check its efficacy for prevention in the women who does not have BC [29]. New targeted therapies are focused on genetic mutation and molecular markers for improving treatment efficacy and to reduce the adverse effects [30]. Screening methods apart from Mammography, researchers are aim to develop more sensitive, feasible screening methods to identify the new cases and to understand individual susceptibility. Focusing on genetic and epigenetic changes studies helps to improve prognosis and the effect of biomarkers and bio-molecular changes will improve the ability to treat BC effectively [31]. Arrangement of regular awareness activities in general populations helps to remove stigma and talk about the disease. Researchers are identifying more lifestyles modifications which may

prevent the disease. By emphasizing on preventive measures hopefully the mortality and morbidity of BC will be reduced [32]. Further a longitudinal cohort studies are required to track early life into adulthood to clarify how timing, duration, and interaction of exposures influence urban breast cancer risk. These trajectories enable more precise prevention strategies Future research should focus on Objective digital exposure metrics, wearable devices, and behavioral analytics to analyze the impact of urbanization. Climate driven changes may indirectly influence the risk however research can be emphasized on of intersection of climate vulnerability mainly in the women in low resource urban settings.

5. Discussion

This review highlights urbanization as a critical aspect of the rising burden of the breast cancer. It encompasses complex biological, behavioral, environmental, and social pathways. The rising cases in the urban population is just not a solely consequence of improved screening but the reflection of shift of epidemiological transformation [33]. The union of lifestyle changes, reproductive histories, environmental exposures, and psychosocial stressors combination of in urban environments creates a multidimensional risk landscape that disproportionately affects women health. The review further underscores, that these changes are cumulative, operating across the life span of the women rather than as isolated risk events [4, 34].

Beyond individual behaviors, urban environments introduce novel risks through air pollution, endocrine-disrupting chemicals, artificial light exposure, and circadian rhythm disruption. These modern exposures further compound hormonal imbalances & metabolic disruptions which rarely encountered at similar levels in the rural populations. Importantly, Socioeconomics inequalities, gender biasness and healthcare access shape the cancer vulnerabilities & treatment outcome [17].

Women from lower-income urban communities often experience delayed diagnosis, reduced screening opportunities, and fragmented treatment pathways, despite residing in the areas with have advanced medical facilities. A gender-sensitive lens reveals how care giving responsibilities, workplace stress, and socio-cultural norms influence health-seeking behavior and limit preventive care [35].

The findings of this review support the need for a paradigm

Journal of Chemical Health Risks

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JCHR (2026) 16(1), 2444-2450 | ISSN:2251-6727

shift in breast cancer prevention—from an individual lifestyle approach to a city-wide, life-course, and exposome-based public health strategy. Urban health planning must integrate environmental regulation, occupational health policies, gender equity, mental health promotion, and digital lifestyle management to reduce long-term cancer risk.

6. Result

Urban populations exhibited a significantly higher incidence rate of breast cancer compared to non-urban populations, The risk increasing direct proportionally with the degree of urbanization. Elevated exposure to urban environmental pollutants, including endocrine-disrupting chemicals such as polycyclic aromatic hydrocarts, phthalates, bisphenols, and organo-chlorine compounds, showed a positive and statistically significant association with breast cancer risk. Multivariable models demonstrated that combined exposure to Electronic, radio transmitting devices and urban lifestyle factor like higher body mass index, physical inactivity, delayed age at first childbirth, and reduced breastfeeding duration, chronic stress, interrupted circadian health has accounted for a substantial proportion of the urban & rural disparity in breast cancer incidence. Importantly, the growing influence of modern urban risk like circadian disruption, air pollution, digital lifestyle patterns, and climate-related environmental change are highlighting the need to expand traditional cancer risk models. Breast cancer prevention must move beyond individual behavior change to embrace life-course, exposome-based and gender-sensitive public health strategies. Addressing these through multi-spectrum interventions could restrain the global burden in urbanizing populations graphic, hereditary, lifestyle & urbanization contribute the rising incidence of breast cancer.

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