TRENDS IN BREAST CANCER INCIDENCE AMONG FEMALES IN HANOI, 2014-2023, AND PROJECTIONS TO 2040

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Breast cancer is the most common cancer among women worldwide and in Vietnam. This study aimed to describe trends in breast cancer incidence among females in Hanoi from 2014 to 2023 and to project the future burden up to 2040. A cross-sectional study with temporal trend analysis was conducted using data from the Hanoi Cancer Registry. Incident cases (ICD-10 code C50) diagnosed between January 1, 2014, and December 31, 2023, were included. Trends were analyzed using Joinpoint regression (version 5.0.2, National Cancer Institute, USA), with a jump model applied to account for potential disruptions during the COVID-19 period. Future cases were projected using a Poisson regression model with population as an offset in Stata version 17.0. A total of 15,646 cases were recorded, with an overall age-standardized incidence rate of 37.77 per 100,000 women. Incidence remained stable from 2014 to 2018, followed by a significant increase from 2018 to 2023. Projections indicate that cases may rise from 1,972 in 2023 to approximately 3,325 by 2040, particularly among women aged ≥50 years old, highlighting the urgent need to strengthen targeted early detection and mammography screening programs for this population.

Keywords: Breast cancer, incidence trends, population-based cancer registry, Joinpoint projections, Hanoi.

I. INTRODUCTION

Breast cancer is the most common cancer among women worldwide, with more than 2.3 million new cases reported in 2022 and remains a leading cause of cancer-related mortality. GLOBOCAN estimates indicate that the burden of breast cancer continues to rise, particularly in low- and middle-income countries undergoing rapid socioeconomic and lifestyle transitions.[1,2]

In Vietnam, breast cancer represents the most common cancer among women, with an estimated 24,563 new cases and 10,008 deaths annually, accounting for 13.6% of all incident cancers and 8.3% of cancer-related deaths.[1] These figures are primarily based on data from the population-based cancer registries in Hanoi and Ho Chi Minh City.

Population-based cancer registration plays a critical role in tracking temporal trends in cancer incidence and generating evidence to inform cancer control strategies.[3] The Hanoi Cancer Registry, one of the oldest and most established systems in Vietnam, has consistently provided reliable and high-quality data on cancer incidence within the community.[4]

Understanding long-term trends in cancer incidence, together with projections of future disease burden, is essential for evaluating the effectiveness of prevention strategies, anticipating healthcare needs, and guiding the development of age-appropriate screening and early detection programs. Although previous

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studies have described breast cancer incidence in selected Vietnamese populations, evidence integrating recent temporal trend analysis with future burden projections using population-based registry data remains limited.[5,6] Combining trend analysis with projection modeling provides important evidence for anticipating future healthcare needs and supporting long-term cancer control planning.

Hanoi has experienced rapid urbanization, demographic aging, and lifestyle changes over the past decade, all of which may influence breast cancer incidence patterns. In addition, continuous improvements in the Hanoi Cancer Registry system have enhanced the completeness and quality of cancer surveillance data, making Hanoi an important setting for evaluating temporal trends in breast cancer incidence.

Therefore, this study aimed to describe temporal trends in breast cancer incidence among women in Hanoi from 2014 to 2023 and to project the future burden of disease up to 2040. The findings are expected to provide scientific evidence to support cancer control planning and early detection strategies in Vietnam.

II. METHODS

1. Study population

Breast cancer cases included in this study were obtained from the Hanoi Cancer Registry. Eligible cases comprised women newly and definitively diagnosed with breast cancer between 1 January 2014 and 31 December 2023, coded according to the International Classification of Diseases, 10th Revision (ICD-10), code C50 - malignant neoplasm of the breast. These cases were collected from 46 medical facilities participating in the Hanoi cancer registration system, including 42 public hospitals and 4 private hospitals. Cases were excluded from the analysis if they involved male breast cancer or lacked essential information required for analysis, such as gender, age, year of birth, or year of diagnosis.

2. Methods

Study design

A cross-sectional study combined with temporal trend analysis.

Data sources

Sources of cancer data

Cancer incidence data were obtained from the Hanoi Population-Based Cancer Registry, which collects information from 46 healthcare facilities, including 42 public hospitals and 4 private hospitals. The Hanoi Cancer Registry applies standardized procedures for data collection, coding, duplicate checking, and quality control based on international cancer registration guidelines. Diagnostic confirmation was primarily based on pathology reports and hospital medical records to improve data validity and completeness. Data were compiled from multiple sources, including inpatient and outpatient medical records, hospital admission and discharge registers, and hospital health information management systems. When discrepancies occurred between diagnoses at admission and discharge, the discharge diagnosis was considered the final diagnosis and was used for analysis.

Sources of population data

Population data for women residing in Hanoi by calendar year during the period 2014-2023 were obtained from the Hanoi Statistical Yearbook and population projection reports from the General Statistics Office of Vietnam and the Hanoi Statistics Office. Age distribution of the population was standardized using the World Standard Population.

Data collection procedure

Breast cancer incident cases were extracted from the Hanoi Cancer Registry database. The dataset was subsequently reviewed and cleaned to ensure completeness and consistency, and cases not meeting the inclusion criteria were excluded.

Data analysis

The study population was classified into 5-year age groups (0-4, 5-9, 10-14, …, 75-79, and ≥80 years old) and corresponding calendar years of diagnosis according to standard cancer epidemiology reporting methods recommended by the World Health Organization.[7] The cumulative rate (0-74 years) was calculated as the sum of the age-specific incidence rates across the corresponding age groups. The cumulative risk of developing breast cancer before age 75 was derived from the cumulative rate, assuming the absence of competing causes of death. The crude incidence rate (CR), age-specific incidence rates, and age-standardized incidence rates (ASRs) were calculated per 100,000 women. Age-standardized incidence rates were computed using the direct method, with the World Standard Population as the reference.

Temporal trends in breast cancer incidence were analyzed using the Joinpoint Regression Program (version 5.0.2, National Cancer Institute, USA) to estimate the Annual Percent Change (APC) and Average Annual Percent Change (AAPC) with 95% confidence intervals. The Joinpoint regression model identifies points where statistically significant changes in incidence trends occur over time. To assess the potential impact during the COVID-19 pandemic, a jump model was used to account for potential abrupt changes in incidence trends caused by disruptions in cancer diagnosis or reporting. Model selection and goodness-of-fit were evaluated using Weighted Bayesian Information Criterion (WBIC). Both the standard Joinpoint model and the jump model were evaluated. The standard model was used to assess long-term temporal trends under normal conditions, whereas the jump model was applied to account for potential abrupt disruptions in cancer diagnosis and reporting during the COVID-19 period, which may have affected data continuity.

Future breast cancer cases were projected to 2040 using a Poisson regression model, with the logarithm of the female population included as an offset term to account for population size. The projection model incorporated age group and calendar year because these variables were consistently available within the registry dataset and are commonly used in population-level cancer projections when long-term risk factors or screening data are unavailable. The projection model incorporated age group and calendar year of diagnosis, and analyses were performed using Stata version 17.0 (StataCorp, College Station, TX, USA).

3. Ethical considerations

This study used secondary data from the cancer registry system. Personal identifiers were anonymized and used solely for research purposes to ensure confidentiality. The study protocol was approved by the Institutional Review Board of Hanoi Medical University (Decision No. 1774/GCN-HMU IRB, March 19th, 2025).

III. RESULTS

A total of 15,646 incident cases of breast cancer among women were registered in Hanoi during the period 2014-2023. The age-standardized incidence rate was 37.77 per 100,000 women. The cumulative risk of developing breast cancer before the age of 75 was 3.88%, corresponding to approximately 1 in 26 women.

Table 1. Distribution of breast cancer cases and incidence indicators among women in Hanoi, 2014-2023

Indicators	Value
Age groups n (%)	**15646 (100)**
<40	1936 (12.37)
40-49	3966 (25.35)
50-59	4236 (27.07)
60-69	3581 (22.88)
70+	1927 (12.32)
Incidence Rates (per 100,000)	
Crude Rate	41.12
Age-Standardized Rate	37.77
Cumulative Indicators (0-74 years) %	
Cumulative Rate (%)	3.96
Cumulative Risk (%)	3.88

1. Trends in breast cancer incidence among women in Hanoi (2014-2023)

Using the jump model, breast cancer incidence rates showed a significant increasing trend over the study period from 2014 to 2023 (APC: 7.20%, 95% CI: 1.79-12.90, p = 0.015). When segmented, incidence rates were stable between 2014 and 2018 (APC: -0.54%, 95% CI: -18.57 to 21.47, p = 0.947), followed by a significant increase from 2018 to 2023 (APC: 15.76%, 95% CI: 0.33-33.55, p = 0.047). (Figure 1)

In contrast, the standard joinpoint model indicated a non-significant overall increase in breast cancer incidence during the same period (APC: 0.46%, 95% CI: -4.61 to 5.80, p = 0.843). When modeled with one joinpoint, the incidence rate decreased slightly from 2014 to 2019 (APC: -6.72%, 95% CI: -17.30 to 5.20, p = 0.197), followed by a non-significant increase between 2019 and 2023 (APC: 9.89%, 95% CI: -6.13 to 28.64, p = 0.185).

The jump model was considered more appropriate for evaluating incidence trends during the COVID-19 period because it accounts for abrupt changes in reporting continuity.

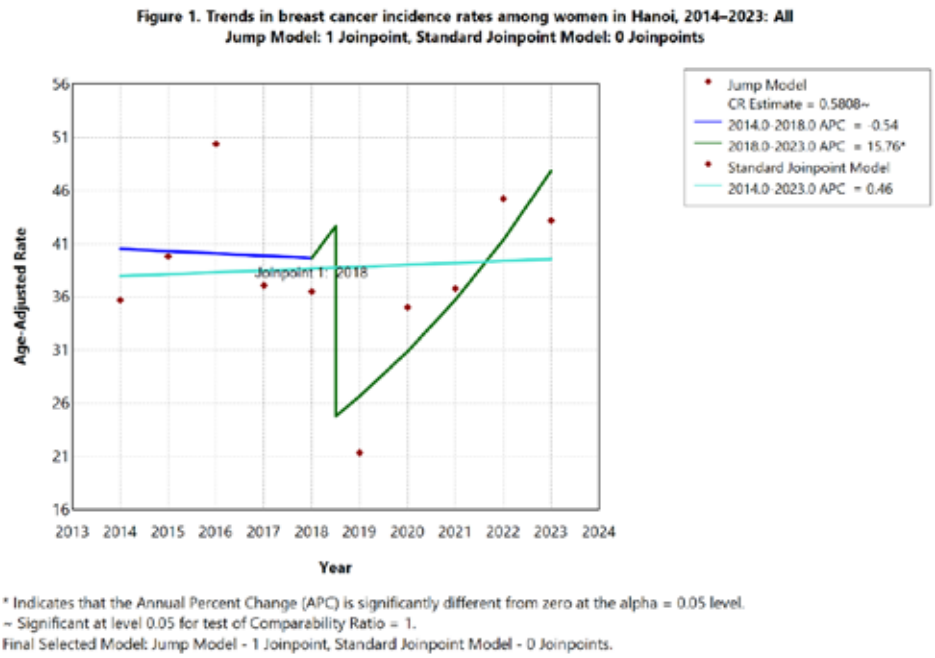

Figure 1. Trends in breast cancer incidence rates among women in Hanoi, 2014-2023

2. Projections of breast cancer cases among women in Hanoi to 2040

Table 2. Observed and projected number of breast cancer cases among women in Hanoi by age group, 2023-2040

Age group	Observed cases 2023	Projected 2025	Projected 2030	Projected 2035	Projected 2040
<40	210	241	249	255	268
40-49	534	587	690	734	690
50-59	434	507	627	786	923
60-69	494	549	560	605	750
≥70	300	326	455	591	694
Total	**1,972**	**2,210**	**2,581**	**2,971**	**3,325**

Breast cancer cases among women in Hanoi are projected to rise significantly, from 1,972 in 2023 to 3,325 in 2040, a 69% increase. Most new cases will occur in women aged 50 and older. Cases in women aged 50-59 are expected to more than double (from 434 to 923), while women aged 60-69 will see cases rise from 494 to 750, and those aged ≥70 from 300 to 694. The number of cases in younger women (<40 years) is expected to increase modestly (from 210 to 268), and cases in those aged 40-49 will rise slightly and then stabilize.

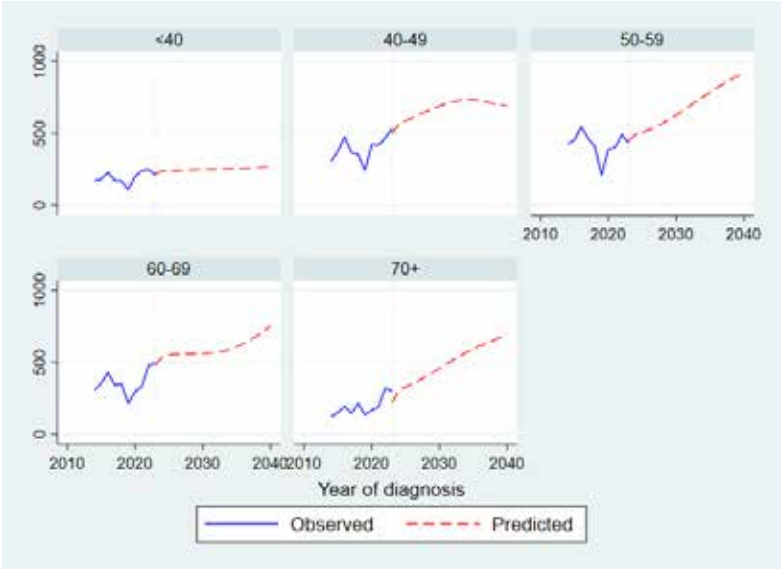

Figure 2. Age-specific projections of breast cancer cases in Hanoi 2040

Figure 2 illustrates the projected trends in breast cancer cases among women in Hanoi by age group from 2023 to 2040. The increase is most pronounced in women aged 50 years old and older, particularly in the 50-59 and 60-69-years old age groups, where the curves show the steepest rise throughout the projection period.

Women ≥70 years old also exhibit a marked increase in projected case numbers, especially after 2030. In contrast, the trend among younger women aged <40 years old remains relatively flat, with only a slight increase in projected cases over time.

IV. DISCUSSION

This study analyzed temporal trends and projected the future burden of breast cancer among women in Hanoi using population-based cancer registry data. The findings indicate that breast cancer incidence has shown an increasing trend in recent years, particularly after 2018, and the number of cases is expected to rise substantially in the coming decades. The observed increase in breast cancer incidence may reflect a combination of true epidemiological changes and improved detection through expanded screening, greater diagnostic capacity, and improved cancer registration completeness. The slight decline in projected cases among women 40-49 years old after 2035 likely reflects demographic aging, whereby a substantial proportion of this population cohort transitions into the 50-59-years old age group over time. Consequently, the projected burden shifts toward older women, particularly those ≥50 years old. These results are consistent with the global pattern of increasing breast cancer incidence observed in many low- and middle-income countries.[2]

In many Asian countries, including Vietnam, the incidence of breast cancer has increased rapidly over the past few decades due to population aging, urbanization, and changes in reproductive and lifestyle-related risk factors.[8] Similar increasing trends have been reported in other Asian populations, including China and Thailand.[9,10]

In this study, the jump model identified a significant rise in breast cancer incidence

after 2018, whereas the standard joinpoint model did not reveal any statistically significant changes in the overall trend. Previous research has indicated that abrupt increases in cancer incidence may follow the introduction of screening programs or enhancements in cancer registration systems.[11,12]

Another plausible explanation for the observed increase in breast cancer incidence in Hanoi is the gradual expansion of early detection and screening initiatives within the city. In 2008, Hanoi commenced breast cancer screening under the National Cancer Control Plan, aiming to facilitate early detection through clinical breast examination, awareness campaigns, and improved access to diagnostic services. Consequently, awareness of breast cancer among women and healthcare professionals has grown, resulting in increased utilization of screening and diagnostic resources.

Advancements in diagnostic capabilities-including broader access to mammography and ultrasound, as well as improved pathological confirmation-may also have contributed to the rise in recorded incidence. Such increases typically reflect better detection of previously undiagnosed cases rather than a genuine surge in disease prevalence. Therefore, the upward trend observed in this study can be partially attributed to improvements in early detection, diagnostic practices, and completeness of cancer registration, alongside underlying epidemiological changes.

The projection analysis suggests that the number of breast cancer cases among women in Hanoi will increase substantially by 2040, with the largest increases occurring in women aged 50 years and older. Women aged 50–59 years and 60–69 years are expected to account for a large proportion of future cases. This pattern is consistent with the well-established age-related increase in breast cancer risk.[13] Population aging is therefore likely to be a major driver of the future breast cancer burden in Hanoi.

The increasing burden of breast cancer in Hanoi highlights the need to strengthen early detection and screening strategies in Vietnam. These findings support the implementation of the National Breast and Cervical Cancer Control Plan 2026-2035, which prioritizes expanding access to screening and improving integration across the care continuum. They are also aligned with Resolution No. 72-NQ/TW, which promotes at least one annual health check-up for all citizens, creating an opportunity to integrate breast cancer screening into routine primary care services.

Currently, breast cancer screening activities in Vietnam remain largely opportunistic and have not yet been implemented as a nationwide population-based program. Given the projected increase in breast cancer burden among women ≥50 years old, targeted mammography screening and early detection programs for middle-aged and older women should be prioritized. Expanding access to screening services at primary healthcare facilities and integrating breast cancer screening into routine health examinations may improve early diagnosis and reduce future disease burden.

In addition, the National Target Program on Health Care and Population 2026-2035 and the Law on Disease Prevention provide a supportive policy framework for scaling up population-based screening and strengthening preventive care. Translating these policies into practice will be essential to mitigate the projected rise in breast cancer incidence.

This study has several strengths. It uses data from a long-standing population-based cancer registry system, which provides reliable information on cancer incidence in Hanoi.

Differences between the standard Joinpoint and jump model results likely reflect the impact of disruptions in cancer diagnosis and reporting during the COVID-19 pandemic. The jump model may better capture abrupt temporal changes associated with healthcare service interruptions. However, some limitations should also be considered. First, projections assume that recent trends in incidence will continue in the future. Second, potential changes in screening practices, risk factor distributions, or healthcare access may influence future incidence patterns. In addition, changes in diagnostic practices, increased access to imaging technologies, and improvements in cancer registration completeness over the study period may have contributed to the observed increase in incidence rates. Furthermore, long-term Poisson projection models inherently involve uncertainty because future demographic changes, screening practices, and risk factor distributions may differ from current assumptions. Formal external validation and sensitivity analyses were not performed because of the limited number of annual observations available for projection modeling. Thus, projected estimates should be interpreted as indicative future scenarios rather than precise predictions.

V. CONCLUSION

This study provides population-based evidence on the temporal trends and future burden of breast cancer among women in Hanoi. Strengthening targeted early detection and mammography screening programs for women aged ≥50 years old, improving access to diagnostic services, and integrating breast cancer screening into routine preventive healthcare will be essential to reduce the future burden of breast cancer in Vietnam.

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