

Incidence Trends of Major Women's Cancers in Saudi Arabia: A Ten-Year Population-Based Registry Analysis (2014-2023)

Mohammed Alkharaiji¹

¹Department of Public Health, College of Health Sciences, Saudi Electronic University, Riyadh, Saudi Arabia

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ABSTRACT

Background: Women's cancers constitute a substantial cancer burden in Saudi Arabia, yet long-term trend analyses remain limited. This study aims to characterise incidence trends of the five most common women's cancers in Saudi Arabia over a decade.

Methods: We analysed Saudi Cancer Registry data for Saudi females, 2014-2023, covering breast, corpus uteri, thyroid, ovarian, and cervical cancers. Temporal trends were assessed using log-linear regression to estimate Annual Percentage Change (APC) with 95% confidence intervals (CIs); mean annual case counts for 2014-2018 vs 2019-2023 were compared using the Mann-Whitney U test.

Results: The five cancers accounted for 46,922 female cases over the decade. Breast cancer was most common (n = 27,452), with a significant upward trend (APC 8.18%, 95% CI 6.07-10.32; p = 0.0001). Thyroid (APC 7.13%, 4.42-9.91), corpus uteri (6.72%, 4.92-8.55), ovarian (5.21%, 3.02-7.44), and cervical (5.05%, 2.29-7.88) cancers also increased significantly (all p < 0.01).

Conclusions: All five major women's cancers showed significant upward trends among Saudi females between 2014 and 2023. The findings support expanded screening, targeted prevention of metabolic and reproductive risk factors, and strengthened cancer surveillance.

Key-words: Breast Neoplasms, Thyroid Neoplasms, Uterine Neoplasms, Ovarian Neoplasms, Uterine Cervical Neoplasms, Incidence, Registries, Saudi Arabia

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Correspondence: Mohammed Alkharaiji (Email: m.alkharaiji@seu.edu.sa)

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INTRODUCTION

Cancer constitutes a major global public health challenge, with approximately 20 million new cases and 9.7 million cancer-related deaths reported annually worldwide.¹ Among women, cancer imposes a disproportionate burden: breast cancer is the most commonly diagnosed cancer and the leading cause of cancer mortality worldwide, while colorectal, lung, cervical, and thyroid cancers are also among the most frequently diagnosed.² The global cancer landscape is evolving rapidly, driven by population aging, urbanization, and the rising prevalence of modifiable risk factors, particularly in low- and middle-income countries undergoing epidemiological transition.³

Women's cancers comprise a heterogeneous group of malignancies affecting the breast, female reproductive organs (uterus, ovary, cervix), and organs with marked sex-specific differences in incidence, notably the thyroid gland.² Their epidemiological profiles vary substantially across populations, reflecting complex interactions among genetic susceptibility, hormonal influences, lifestyle behaviors, screening practices, and healthcare access.³ Understanding population-specific incidence patterns and temporal trends is therefore essential for evidence-based healthcare planning, resource allocation and targeted prevention and control strategies.

In the Kingdom of Saudi Arabia, the cancer burden is increasing in parallel with rapid socioeconomic transformation, demographic shifts and adoption of urbanized lifestyles.⁴ The Saudi Cancer Registry (SCR), a population-based registry managed by the National Cancer Center under the Saudi Health Council, serves as the primary national source for tracking these trends. The 2023 Saudi Cancer Registry Annual Report provides detailed insights into the national cancer burden and epidemiological patterns.⁵ The Saudi population is characterized by a high prevalence of consanguineous marriages reported nationally at approximately 56%, with first-cousin unions accounting for one-third of all marriages which may shape cancer susceptibility patterns.⁶ Epidemiological studies have documented distinct cancer profiles compared with Western populations, including differences in the distribution of major cancer types, younger age at diagnosis for several malignancies, and emerging trends linked to rising obesity, diabetes, and physical inactivity.^{7,8}

Breast cancer is the most commonly diagnosed malignancy among Saudi women, accounting for approximately 30% of all female cancers, with an age-standardized incidence rate that has risen substantially over the past two decades.^{8,9} The median age at diagnosis of about 50-52 years is notably younger than in most Western settings.¹⁰ Thyroid cancer has also shown a marked upward trajectory globally and in Saudi Arabia, with incidence increases attributed to enhanced diagnostic detection and potentially genuine rises in underlying incidence.¹¹ Corpus uteri

cancer is increasingly recognized as a growing concern in populations with high prevalence of obesity and metabolic syndrome, both established risk factors for endometrial malignancy.¹² By contrast, cervical cancer remains comparatively rare in Saudi Arabia, likely reflecting cultural and behavioral factors and relatively limited exposure to human papillomavirus (HPV).¹³

This study addresses the lack of long-term national evidence by examining incidence patterns and temporal trends for the five leading women's cancers in Saudi Arabia breast, corpus uteri, thyroid, ovarian, and cervical across 2014-2023. Using annual case counts and age-standardised rates from the SCR, we estimated Annual Percentage Change (APC) with 95% confidence intervals for each cancer, compared incidence between 2014-2018 and 2019-2023, and positioned the findings within regional and global patterns to inform data-driven public health planning.

METHODOLOGY

Study Design and Data Source: This retrospective analysis used population-based cancer registry data from the Saudi Cancer Registry (SCR), which is managed by the National Cancer Center of the Saudi Health Council. Data for the ten-year period 2014-2023 were obtained from published SCR annual reports.⁵ Cancer cases are coded according to the International Classification of Diseases for Oncology (ICD-O-3).¹⁴ The dataset includes information on cancer site, morphology, age at diagnosis, gender, nationality, and year of diagnosis; all records were anonymised and aggregated before analysis. The study is reported in accordance with the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement¹⁵; a completed STROBE checklist is provided as Supplementary Material.

The study population comprised all Saudi females diagnosed with malignant neoplasms during 2014-2023. A lower age cutoff of 15 years and older was applied because the SCR publishes age-specific data in five-year age bands beginning at 15-19; isolating a ≥ 18 -year threshold is therefore not feasible from the published reports. The analysis focused on five major cancer types defined by ICD-O-3 topography codes: breast cancer (C50), corpus uteri cancer (C54), ovarian cancer (C56), cervical cancer (C53), and thyroid cancer in females (C73). These cancers were selected because of their clinical importance and their collectively high contribution to the overall female cancer burden in Saudi Arabia.

Because the analysis relied on the complete enumeration of eligible cases captured by a nationwide population-based registry, an a priori sample-size calculation was not performed; the SCR provides near-complete national coverage of cancer diagnoses in Saudi Arabia.

Variables and Measures: The primary outcome variables included the annual number of incident cancer cases, proportional distribution by cancer type, age-standardised incidence rates (ASR), and period-level changes. Case counts and ASR values (per 100,000 person-years, direct standardisation, Segi World Standard population) were obtained directly from the published SCR annual reports, which apply direct standardisation with the Segi World Standard as the reference population; independent rate calculation from age-specific counts was not undertaken. The proportion of each cancer type relative to all female cancers was computed for each year and for the overall study period.

Statistics: Descriptive statistics were employed to characterise the distribution of women's cancer cases by year and cancer type. Frequencies, percentages, means, and ranges were calculated for all relevant variables. Temporal trends were assessed using the Annual Percentage Change (APC) derived from log-linear regression of annual case counts against calendar year¹⁶, modelled as $\ln(\text{count}) = \alpha + \beta(\text{year}) + \varepsilon$ with $\text{APC} = (\exp(\beta) - 1) \times 100$ and 95% confidence intervals obtained by the Wald method. Analyses were based on case counts rather than published ASRs because the SCR revised its standardisation methodology between the 2020 and 2021 annual reports, introducing a step-change in reported ASRs that would render a 10-year ASR trend uninterpretable; case counts are on a consistent basis throughout 2014-2023. Period comparisons were conducted by dividing the study period into two five-year intervals (2014-2018 and 2019-2023). Mean annual case counts were compared between periods using the Mann-Whitney U test (two-sided, exact), which was preferred to the two-sample t-test given the small per-period sample of $n = 5$ annual counts and the absence of normality assumptions; percentage change between periods was computed as $((\text{Period 2 mean} - \text{Period 1 mean}) / \text{Period 1 mean}) \times 100$ with a 95% bootstrap confidence interval (10,000 replicates, percentile method). Statistical significance was set at

$p < 0.05$. A sensitivity analysis re-estimating APC after excluding 2018, 2019, and both years together was also performed to address previously reported identical ASR values in those years. All analyses were conducted using Stata version 16.1 (StataCorp LLC, College Station, TX, USA).

Ethical Considerations: The study relied on publicly accessible, de-identified, and aggregated datasets obtained from the Saudi Health Council Portal. In accordance with national data governance frameworks including the Personal Data Protection Law (PDPL) and the National Data Management Office (NDMO) policies¹⁷ these datasets are classified as public and fully anonymised, with all personal identifiers removed. Because the information carries minimal risk and contains no identifiable data, the analysis does not require individual consent or Institutional Review Board approval, consistent with National Committee of Bioethics (NCBE) regulations. All procedures adhered to the Saudi Open Data License, which permits the reuse of publicly released datasets for research purposes.^{17,18}

RESULTS

Cancer Burden Among Saudi Women: Over 2014-2023, the five most common women's cancers breast, thyroid, corpus uteri, ovarian, and cervical collectively accounted for 46,922 cases among Saudi females in the Saudi Cancer Registry. Figure 1 presents a heatmap of the annual case counts for each cancer type across the study period, illustrating the relative burden and temporal patterns of these five cancers in Saudi Arabia. Figure 2 presents the combined annual total for the five cancers.

Breast cancer was the most common diagnosis ($n = 27,452$). Its age-standardised incidence rate rose from 22.7 per 100,000 in 2014, peaked at 54.4 per 100,000 in 2021 (coinciding with the SCR's standardisation revision), and stood at 58.1 per 100,000 in 2023 (Figure 3).

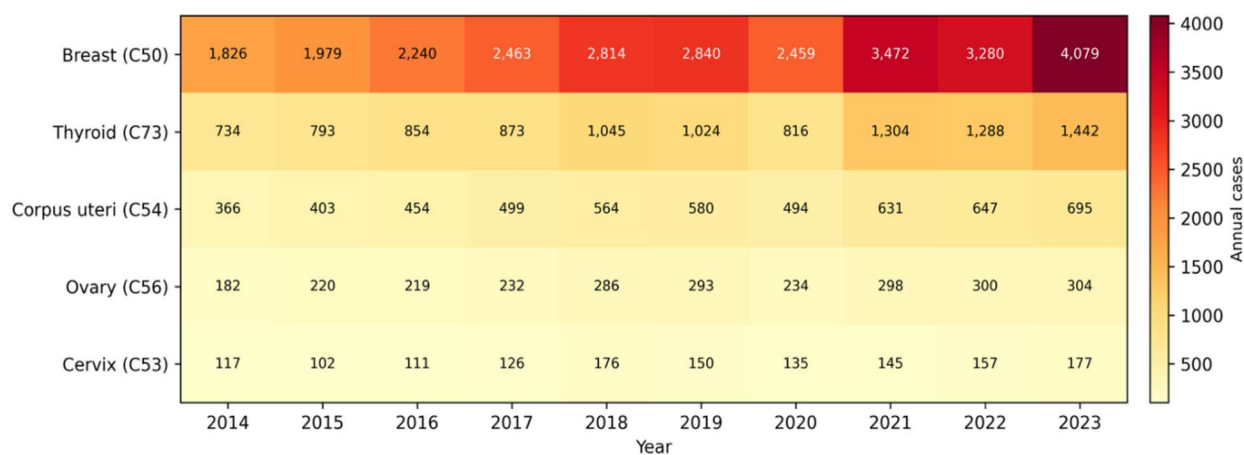


Figure 1: Annual case counts for the five most common women's cancers, Saudi females, 2014-2023

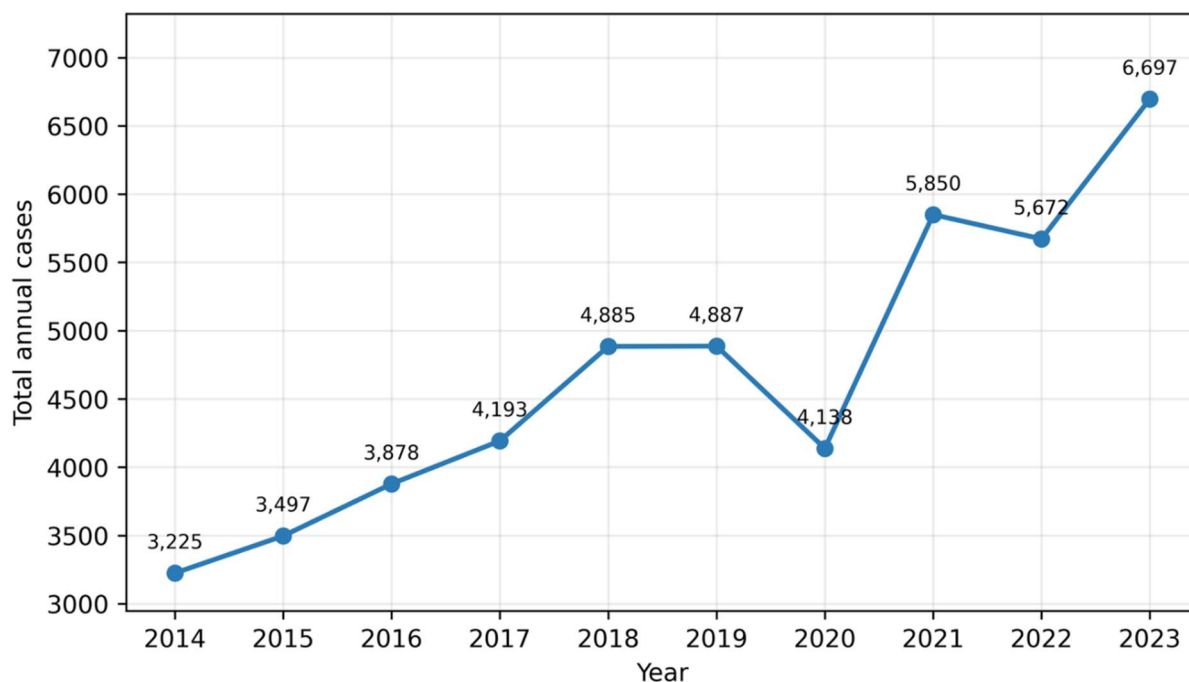


Figure 2: Combined annual case counts for the five most common women's cancers, Saudi females, 2014-2023

Table 1: Ten-Year Summary of Major Women's Cancers: Incidence Trends, Saudi Females, 2014-2023

Cancer Type	Total Cases	% of 5-cancer total	APC (95% CI)	p-value	Trend	ASR Range (SCR)
Breast	27,452	58.5%	8.18% (6.07, 10.32)	0.0001	Increasing*	22.7-58.1
Thyroid	10,173	21.7%	7.13% (4.42, 9.91)	0.0008	Increasing*	7.8-17.5
Corpus uteri	5,333	11.4%	6.72% (4.92, 8.55)	0.0001	Increasing*	5.4-12.1
Ovary	2,568	5.5%	5.21% (3.02, 7.44)	0.0015	Increasing*	2.4-4.6
Cervix	1,396	3.0%	5.05% (2.29, 7.88)	0.0067	Increasing*	1.3-2.6

*p < 0.05 (statistically significant). APC = Annual Percentage Change estimated from log-linear regression of annual case counts ($\ln(\text{count}) = \alpha + \beta \cdot \text{year} + \epsilon$; $\text{APC} = (\exp(\beta) - 1) \times 100$); 95% CI computed by the Wald method. ASR = age-standardised incidence rate per 100,000 person-years, direct method, Segi World Standard population, as reported in the Saudi Cancer Registry annual reports. ASR values before 2021 and from 2021 onward are not directly comparable due to a change in the SCR's standardisation methodology.

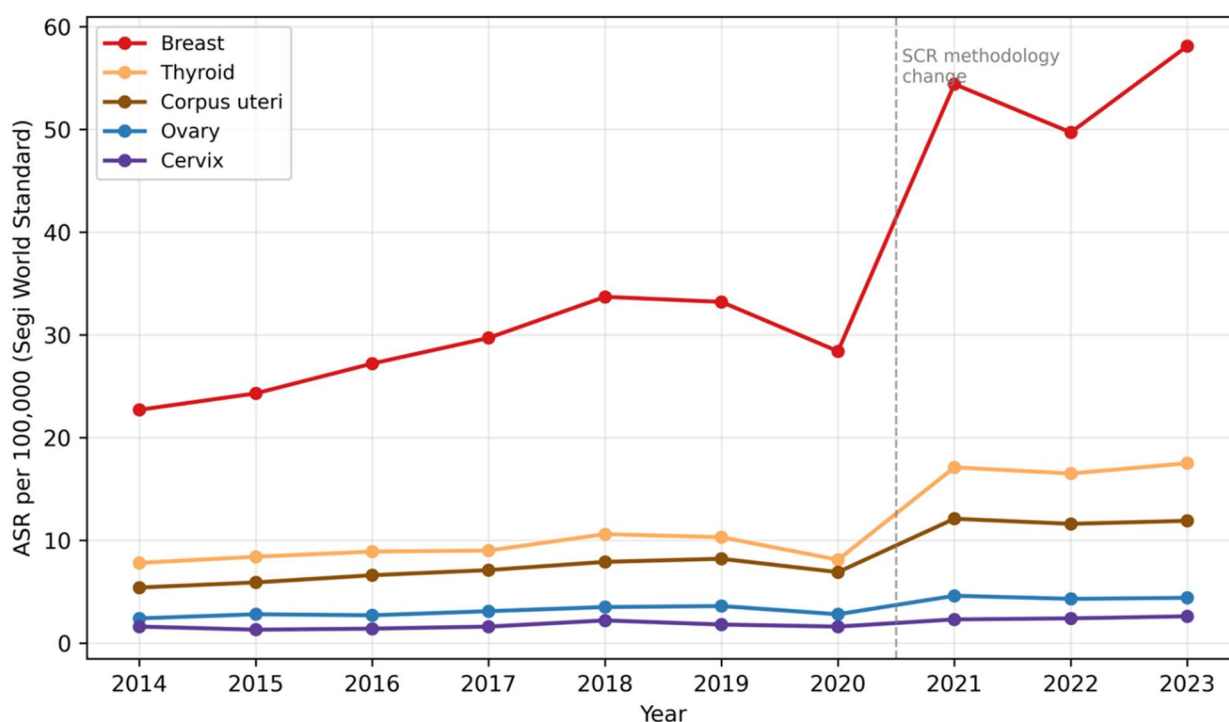


Figure 3: Age-standardised incidence rates (ASR, per 100,000, Segi World Standard)

Case counts rose steadily from 1,826 in 2014 to 4,079 in 2023, yielding an APC of 8.18% (95% CI 6.07-10.32; $p = 0.0001$). Thyroid cancer case counts increased from 734 to 1,442 over the decade, with APC 7.13% (4.42, 9.91; $p = 0.0008$), and corpus uteri cancer from 366 to 695 (APC 6.72%; 4.92, 8.55; $p = 0.0001$). Ovarian cancer exhibited a significant upward trend (APC 5.21%; 3.02, 7.44; $p = 0.0015$), as did cervical cancer (APC 5.05%; 2.29, 7.88; $p = 0.0067$). All five cancers therefore showed statistically significant increases across the study period (Table 1; Figure 4).

Age-standardised incidence rates (ASR, per 100,000, Segi World Standard) for the five most common women's cancers, Saudi females, 2014-2023. The vertical dashed line between 2020 and 2021 marks a change in the Saudi Cancer Registry's standardisa-

tion methodology; ASR values across this boundary are not directly comparable.

Period Comparison Analysis: Comparing 2014-2018 with 2019-2023 (Table 2), the mean annual number of breast cancer cases increased by 42.5% (95% bootstrap CI 16.2-73.6; Mann-Whitney $U = 23$, $p = 0.032$); thyroid cancer by 36.6% (9.5-64.1; $p = 0.095$); corpus uteri cancer by 33.3% (12.9-57.6; $p = 0.032$); ovarian cancer by 25.5% (7.9-44.7; $p = 0.016$); and cervical cancer by 20.9% (-1.2-44.8; $p = 0.095$). Interpretation of the non-significant thyroid and cervical period-comparison p -values must acknowledge that the minimum attainable exact p -value for the Mann-Whitney U statistic on $n = 5$ per period is approximately 0.008; the log-linear APC trend analysis (Table 1), which uses all 10 annual data points, yields significant positive trends for all five cancers.

Table 2: Period Comparison of Mean Annual Case Counts, 2014-2018 vs. 2019-2023

Cancer Type	2014-2018 Mean	2019-2023 Mean	Change (%)	Bootstrap 95% CI	p-value*
Breast	2,264.4	3,226.0	+42.5%	[+16.2%, +73.6%]	0.032
Thyroid	859.8	1,174.8	+36.6%	[+9.5%, +64.1%]	0.095
Corpus uteri	457.2	609.4	+33.3%	[+12.9%, +57.6%]	0.032
Ovary	227.8	285.8	+25.5%	[+7.9%, +44.7%]	0.016
Cervix	126.4	152.8	+20.9%	[-1.2%, +44.8%]	0.095

*Two-sided exact Mann-Whitney U test on the five annual case counts per period; p -values < 0.05 indicate a significant difference between periods. Percentage change between periods = $((\text{Period 2 mean} - \text{Period 1 mean}) / \text{Period 1 mean}) \times 100$. Bootstrap 95% confidence intervals for the percentage change were computed using the percentile method with 10,000 replicates. The small per-period sample size ($n = 5$) limits the statistical power of the Mann-Whitney U test; the log-linear APC in Table 1 uses all 10 annual data points and yields significant positive trends for all five cancers.

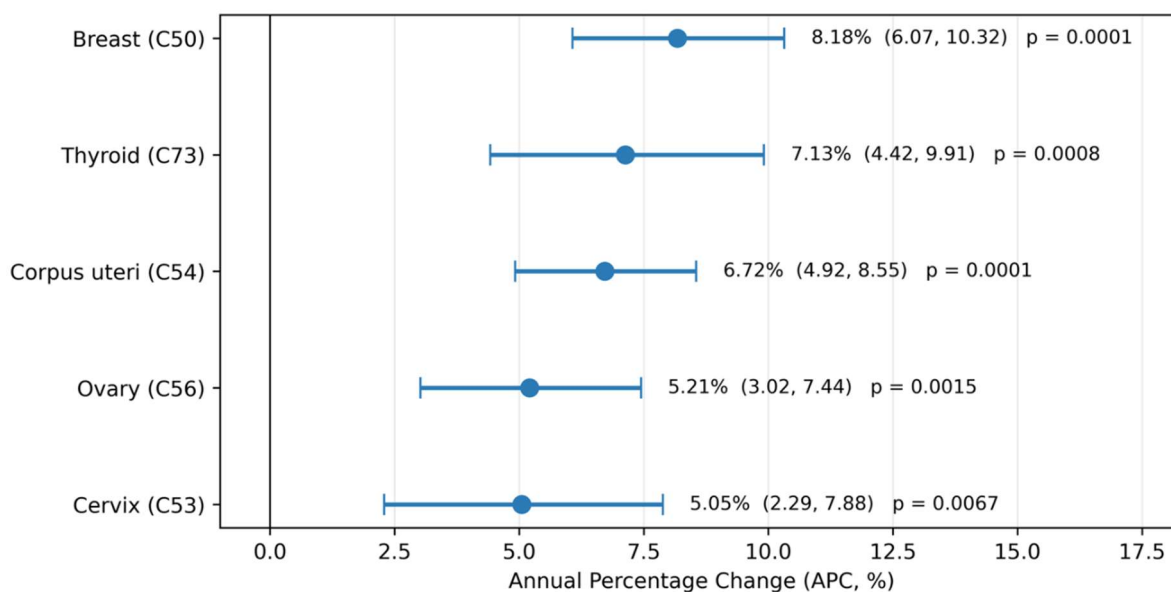


Figure 4: Forest plot of Annual Percentage Change (APC) point estimates with 95% confidence intervals for the five most common women's cancers, Saudi females, 2014-2023. All five cancers showed statistically significant upward trends in case counts.

DISCUSSION

This ten-year analysis of the Saudi Cancer Registry identified statistically significant upward incidence trends for all five of the most common women's cancers breast (APC 8.18%), thyroid (7.13%), corpus uteri (6.72%), ovarian (5.21%), and cervical

(5.05%). The finding that even ovarian and cervical cancer historically regarded as stable or declining in Saudi Arabia now show significant positive APCs marks a shift in the national cancer landscape that warrants targeted public-health attention and further mechanistic investigation.

Breast cancer remained the leading female malignancy and showed the steepest overall rise in absolute numbers (1,826 to 4,079 cases) and the highest APC in our series. Our APC of 8.18% is higher than the previously reported Saudi national APCs of 3.7%,¹⁹ and 5.13%,²⁰ both of which examined earlier study periods and align with the broadly increasing breast-cancer incidence among GCC nationals reported by Chaabna and colleagues, with Saudi female ASR rising from 19.76 (1998-2012) to 24.0 per 100,000 (2013-2015).²¹ The trajectory is consistent with accelerating detection through the Saudi national breast-cancer screening programme and with rising prevalence of metabolic and reproductive risk factors.^{9,22} The comparatively younger age at diagnosis among Saudi women (median ~50-52 years, vs ~62 in most high-income settings)¹⁰ reinforces the need to maintain screening eligibility thresholds, clinical pathways and survivorship care that reflect the Saudi demographic profile.

The observed thyroid cancer APC of 7.13% aligns with Saudi and international reports describing a marked rise partly attributable to widespread use of thyroid ultrasonography and fine-needle aspiration that detect indolent papillary microcarcinomas.^{11,23} A comparable rise was observed in Oman (1996-2019),²⁴ supporting the interpretation that detection intensity rather than a uniquely Saudi aetiology drives a large portion of the observed trend. The strong female predominance of thyroid cancer observed across populations may reflect hormonal or reproductive influences that warrant dedicated investigation.²⁵

Corpus uteri (endometrial) cancer rose at an APC of 6.72% in parallel with national increases in obesity and metabolic syndrome prevalence among Saudi women both well-established endometrial-cancer risk factors.¹² Recent national surveys report adult Saudi obesity prevalence of 24-37%, with higher rates in women,²² alongside widespread sedentary behaviors and low physical-activity levels among Saudi adolescents patterns that may track into adulthood and amplify long-term metabolic-disease risk.²⁶ The concurrent rise in corpus uteri incidence and adiposity underscores the urgency of integrated prevention strategies linking weight management, metabolic disease control, and gynaecological surveillance.

Ovarian cancer, previously reported as stable in Saudi Arabia, showed a significant APC of 5.21% (3.02-7.44) in the current analysis. The earlier interpretation of stability was based on age-standardised rates published in SCR annual reports, which are influenced by changes in the standard-population denominator; the present analysis of absolute case counts reveals a real absolute increase from 182 cases in 2014 to 304 in 2023. This rising burden may reflect the same demographic and reproductive-factor shifts that drive breast and endometrial trends,¹² combined with improving diagnostic access. Given the typically late-stage presentation and poor survival of ovarian

cancer, dedicated awareness and symptom-recognition programmes for Saudi women are warranted.²⁷

Cervical cancer likewise showed a significant positive APC (5.05%; 2.29-7.88) (see Table 1), reversing the non-significant decline previously inferred from SCR-reported ASRs. The annual number of newly registered cervical cancer cases among Saudi females increased from 117 in 2014 (SCR Annual Report 2014) to 177 in 2023 (SCR Annual Report 2023), a 51.3% rise over the decade.⁵ Saudi Arabia has historically reported one of the world's lowest cervical cancer incidences, reflecting limited HPV exposure in a conservative cultural context.^{13,28} The observed rise may indicate improved ascertainment, gradual epidemiological change, or both; recent national HPV-typing data suggest a non-trivial prevalence of high-risk genotypes in Saudi women.²⁸ The national HPV vaccination programme, introduced in 2022 and not yet reflected in cervical-cancer incidence, will be an important future influence on this trajectory.

Our findings align with, but extend beyond, recent regional evidence. A 2023 GCC-wide ecological analysis by Chaabna and colleagues documented rising breast-cancer incidence across all six GCC states, with the highest rates among nationals of Kuwait and Saudi Arabia.²¹ Parallel trend analyses from Oman²⁴ and historical national data from Egypt²⁹ describe similar upward patterns for breast, thyroid, and corpus uteri cancers, consistent with the shared demographic, nutritional and urbanisation transitions across the MENA region. The concurrent rise we observe for ovarian and cervical cancers is less commonly reported elsewhere and warrants focused regional cohort studies.

The 2020 case-count trough (breast 2,459; thyroid 816) visible across all five cancers is consistent with international reports of substantial pandemic-era drops in new cancer diagnoses attributable to reduced screening uptake, diagnostic delays and healthcare re-prioritisation.^{30,31} The 2021 rebound in both case counts and published ASRs likely reflects a combination of post-pandemic catch-up diagnoses, registry backlog clearance and the SCR's concurrent revision of its standardisation methodology (see Methods). These overlapping influences complicate interpretation of year-on-year rate changes around 2020-2021 and are reflected in our analytic choice to use case counts as the primary trend metric.

Whether the observed rises reflect true increases in underlying incidence or enhanced ascertainment deserves careful consideration. For breast cancer, the coincidence of a steep APC with nationwide expansion of mammographic screening suggests a meaningful detection component overlaid on a real risk-factor-driven trend.⁹ For thyroid cancer, the weight of evidence from overdiagnosis analyses²³ points to detection as a major contributor. For corpus uteri cancer, rising obesity prevalence²² supports a genuine incidence increase. The cervical and ovarian ris-

es, against a backdrop of limited screening infrastructure, are more likely to reflect partly real incidence change rather than ascertainment alone.

Saudi Vision 2030 elevates preventive and primary care as strategic pillars of the national health transformation, with specific targets for early detection of non-communicable diseases and for strengthening population-level data systems. The rising APCs we document across all five women's cancers underscore both the urgency of implementing these priorities and the importance of continued investment in the Saudi Cancer Registry, with progressive addition of stage, treatment, and survival fields to enable evaluation of outcomes alongside incidence.

STRENGTHS

This study draws on ten consecutive years of nationally-collected SCR data, providing the first comparative multi-cancer APC analysis of the five most common women's cancers in Saudi Arabia across 2014-2023. Using population-based registry data mitigates selection bias, and the case-count-based APC framework avoids the methodological discontinuity introduced by the SCR's mid-decade ASR standardisation revision. The sensitivity analysis showed that APC estimates were robust to exclusion of individual years around the documented identical-ASR period (maximum deviation across scenarios ≤ 0.19 percentage points).

LIMITATIONS

Several limitations warrant acknowledgment. First, the analysis relied on published SCR case counts and age-standardised rates rather than record-level data; individual variables such as cancer stage, grade, tumour subtype, treatment modality, and survival outcomes could not be examined, limiting our ability to interpret trends in clinical context. Second, the SCR revised its age-standardisation methodology between the 2020 and 2021 annual reports, producing a discontinuity in published ASRs; for this reason all APC estimates in the present analysis were computed from case counts rather than ASRs (see Methods). Third, the per-period sample size for the Mann-Whitney U test is small ($n = 5$ annual counts per period), which limits statistical power, particularly for the cervical and thyroid period comparisons that yielded $p = 0.095$ despite consistent positive trends by APC. Fourth, national screening-coverage data for breast and cervical cancers by year were not accessible at the resolution required to disentangle incidence from ascertainment. Fifth, SCR publications aggregate age in five-year bands starting from 15-19, which precluded separate reporting for the 15-17 age group and prevented a pre-planned age-stratified (<50 vs ≥ 50) subgroup trend analysis from being performed within the scope of this study. Sixth, the five-cancer 10-year case total extracted from the

SCR annual reports (46,922) differs slightly from earlier published aggregates, reflecting ongoing SCR data reconciliation across report revisions; the impact on the APC direction and magnitude is minimal given the consistency of year-on-year values across reports.

PUBLIC HEALTH IMPLICATIONS

The consistent upward trends documented across all five women's cancers indicate that Saudi cancer-control efforts must continue to expand organised screening (particularly mammography and cervical-cytology/HPV testing), strengthen early-diagnosis pathways, and intensify prevention targeting modifiable metabolic risk factors (obesity, diabetes, physical inactivity) that underpin breast and endometrial risk. Sustained investment in the Saudi Cancer Registry with staging, treatment, and outcome fields, and transparent documentation of methodological revisions would materially enhance the capacity for national cancer surveillance and policy evaluation. The rising ovarian and cervical trends identified here point to emerging priorities for symptom-awareness campaigns, HPV vaccination uptake monitoring, and regional cohort studies to elucidate mechanisms.

CONCLUSION

Between 2014 and 2023, all five leading women's cancers in Saudi Arabia exhibited statistically significant upward trends in case counts, with APCs ranging from 5.05% (cervix) to 8.18% (breast). Breast, thyroid, and corpus uteri cancers showed the steepest trajectories, while the newly identified significant upward trends for ovarian and cervical cancer warrant dedicated public-health and research responses. These findings provide quantitative support for expanded screening, targeted prevention, and strengthened registry infrastructure, and they identify emerging priorities for mechanistic and outcomes research aligned with Saudi Vision 2030 health-transformation objectives.

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Individual Authors' Contributions: MA was the sole contributor to this work and was responsible for the study conception and design, data analysis and interpretation, manuscript drafting and revision, and final approval of the version to be published.

Availability of Data: Data used in this study are publicly available from the Saudi Cancer Registry and

nual reports (2014-2023) and via the Saudi Data and Artificial Intelligence Authority (SDAIA) National Open Data Platform (<https://open.data.gov.sa>).

Declaration of Non-use of Generative AI Tools:

This article was prepared without the use of generative AI tools for content creation, analysis, or data generation. All findings and interpretations are based solely on the author's independent work and expertise.

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