

Incidence rate of ovarian cancer cases in Saudi Arabia: an observational descriptive epidemiological analysis of data from Saudi Cancer Registry 2001–2008

Ibrahim G Alghamdi^{1,2}
Issam I Hussain¹
Mohamed S Alghamdi³
Mansour M Alghamdi⁴
Ahlam A Dohal⁴
Mohammed A El-Sheemy⁵

¹School of Life Sciences, University of Lincoln, Brayford Pool, Lincoln, UK; ²Al-Baha University, Kingdom of Saudi Arabia; ³Ministry of Health, General Directorate of Health Affairs, Al-Baha, Kingdom of Saudi Arabia; ⁴King Fahad Specialist Hospital–Dammam, Kingdom of Saudi Arabia; ⁵Department of Research and Development, Lincoln Hospital, United Lincolnshire Hospitals, National Health Service Trust, Lincoln, UK

Purpose: This study provides descriptive epidemiological data, such as the percentage of cases diagnosed, crude incidence rate (CIR), and age-standardized incidence rate (ASIR) of ovarian cancer in Saudi Arabia from 2001–2008.

Patients and methods: A retrospective descriptive epidemiological analysis of all ovarian cancer cases recorded in the Saudi Cancer Registry (SCR) from January 2001–December 2008 was performed. The data were analyzed using descriptive statistics, analysis of variance tests, Poisson regression, and simple linear modeling.

Results: A total of 991 ovarian cancer cases were recorded in the SCR from January 2001–December 2008. The region of Riyadh had the highest overall ASIR at 3.3 cases per 100,000 women, followed by the Jof and Asir regions at 3.13 and 2.96 cases per 100,000 women. However, Hail and Jazan had the lowest rates at 1.4 and 0.6 cases per 100,000 women, respectively. Compared to Jazan, the incidence rate ratio for the number of ovarian cancer cases was significantly higher ($P < 0.001$) in the Makkah region at 6.4 (95% confidence interval [CI]: 4.13–9.83), followed by Riyadh at 6.3 (95% CI: 4.10–9.82), and the eastern region of Saudi Arabia at 4.52 (95% CI: 2.93–6.98). The predicted annual CIR and ASIR for ovarian cancer in Saudi Arabia could be defined by the equations $0.9 + (0.07 \times \text{years})$ and $1.71 + (0.09 \times \text{years})$, respectively.

Conclusion: We observed a slight increase in the CIRs and ASIRs for ovarian cancer in Saudi Arabia from 2001–2008. Riyadh, Jof, and Asir had the highest overall ASIR, while Jazan and Hail had the lowest rates. Makkah, Riyadh, and the eastern region of Saudi Arabia had the highest incidence rate ratio for the number of ovarian cancer cases. Further analytical studies are required to determine the potential risk factors of ovarian cancer among Saudi women.

Keywords: cancer epidemiology, ovarian cancer, Saudi Cancer Registry, incidence rate

Introduction

Ovarian cancer is the eighth most common type of cancer among women in the world. Furthermore, it is the seventh leading cause of cancer-related mortality with a severe impact on socioeconomic and community health, globally.^{1–4} Compared to other types of gynecologic malignancies, ovarian cancer has the highest mortality rate in developed countries worldwide.^{5–7} The American Cancer Society estimated that 22,240 women were going to be diagnosed with ovarian cancer in the US in 2013, while the number of ovarian cancer-related deaths was estimated to be 14,230.⁸ Moreover, ovarian cancer was estimated to account for 3% of all cancers among women. Currently, the lifetime

Correspondence: Ibrahim G Alghamdi
15 Copgrove Close, Hamilton,
Leicester, LE5 1AW, UK
Tel +44 116 276 1913
Email bio-stat@hotmail.com

risk of developing ovarian cancer is approximately 1 in 72, while the lifetime risk of dying from ovarian cancer is approximately 1 in 100.⁸

The International Agency for Research on Cancer estimated that the age-standardized incidence rate (ASIR) and the age-standardized mortality rate for ovarian cancer in Saudi Arabia in 2012 was 3.4 per 100,000 women and 2.5 per 100,000 women, respectively.⁹ Furthermore, the registry of the King Faisal Specialist Hospital and Research Centre (2011) recorded 1510 cases of ovarian cancer with admission to the hospital from 1975–2011.¹⁰ In 2008, data from the Saudi Cancer Registry (SCR) suggested that ovarian cancer ranked seventh in cancer incidence among Saudi women.¹¹ The ASIR of ovarian cancer in Saudi Arabia is low in comparison with other countries in the Arabian Gulf. For example, in 2012, the reported ASIR of ovarian cancer for Oman, United Arab Emirates, Kuwait, Qatar, and Bahrain was 10.2, 6.4, 4.7, 4.6, and 4.4 per 100,000 women, respectively.⁹

Despite a lack of data on the geographic distribution of ovarian cancer among women in Saudi Arabia, we aimed to investigate and describe the crude incidence rate (CIR) and ASIR of ovarian cancer cases by providing an observational descriptive epidemiological analysis of cancer of the ovary while considering spatial/temporal distribution of recorded cases in the SCR from 2001–2008.¹²

Materials and methods

A retrospective descriptive epidemiological study of the ovarian cancer cases and diagnosed in Saudi Arabia from January 2001–December 2008 was performed. The data of reports regarding cancer incidence in Saudi Arabia are publicly available and easily accessible to be downloaded from the website of SCR. The main mission of SCR is to gather, register, and provide high standard data for cancer incidence stratified by region, age group, and year of diagnosis. Furthermore, the published reports by SCR would be available to policy makers, cancer researchers, treating physician, cancer control, and prevention programs. Therefore, no ethical approval was required for this observational descriptive epidemiological study. The data source for this study was the SCR, a population-based registry established in 1992 by the Ministry of Health of Saudi Arabia. The data cannot be obtained directly from the SCR, but it is published in reports. However, no data was available from 1994–2000 and the latest published report of the SCR was available in 2008.

Since 2001, the SCR has been providing reports on the patterns of cancers in Saudi Arabia with the primary

objective of defining the population-based incidence of the disease. Currently, there are comprehensive reports for each of the 13 administrative regions of Saudi Arabia. Each report discusses the number and percentage of cases diagnosed, the CIR, and the ASIR (adjusted by region and year of diagnosis) of cancer from 2001–2008. The current study utilized the SCR reports to gather all the information on ovarian cancer with the aim of presenting the descriptive epidemiology of ovarian cancer in Saudi Arabia.

Data were analyzed using the Statistical Package for the Social Sciences version 20.0 (IBM Corporation, Armonk, NY, USA). The descriptive analysis of the epidemiological data of ovarian cancer was performed by calculating the overall percentage of ovarian cancer cases, CIR, and the ASIR adjusted by the age group, region, or year of diagnosis. The analysis of variance (ANOVA) test was performed to determine the effect of the geographical area and the year of diagnosis on CIR and ASIR.¹³ Simple linear regression was used separately with an independent variable (year of diagnosis) to predict the annual CIR and the ASIR of ovarian cancer among Saudi women.¹⁴ In addition, the Poisson regression was conducted to calculate the incidence rate ratio (IRR) of ovarian cancer cases for each region of Saudi Arabia.

Results

A total of 991 ovarian cancer cases were recorded in the SCR from January 2001–December 2008. The percentage of women diagnosed with ovarian cancer increased slightly from 2001–2008. Figure 1A and B shows that there were 101 new ovarian cancer cases in 2001 (3.7% of all cancer cases diagnosed in women; 95% confidence interval [CI]: 1.7%–5.7%) and 96 in 2002. This indicates a 0.4% decline in cases. By 2005, 136 ovarian cancer cases were reported, corresponding to a 0.2% increase. The number of ovarian cancer cases diagnosed annually remained slightly high, but the percentages were stable in 2005 and 2008 at 3.5%.

The average number and percentage of ovarian cancer cases diagnosed from 2001–2008, adjusted by age group, was calculated using the data from the SCR (Table 1 and Figure 1C). Women aged 45–59 years were most frequently diagnosed with ovarian cancer followed by those aged 60–74 years, representing 31% (38 cases) and 26.0% (33 cases) of the total number of ovarian cancer cases. In contrast, the younger (0–44 years) and older (75 years and over) groups recorded the lowest overall number and percentage of cases.

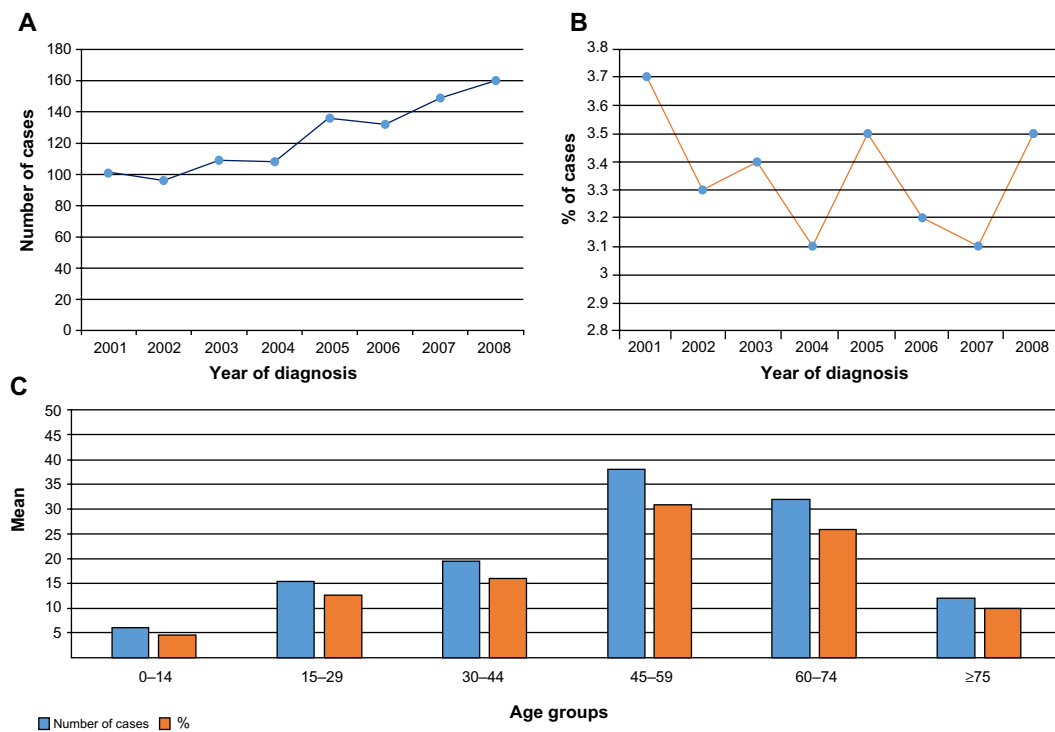


Figure 1 Number and percentage of ovarian cancer cases (**A** and **B**) in Saudi Arabia from 2001–2008. Overall number and percentage of ovarian cancer cases' distribution by age group (**C**) in Saudi Arabia from 2001–2008.

The CIRs per 100,000 women, adjusted for the year of diagnosis, indicated a steady increase in ovarian cancer cases in Saudi Arabia from 2001–2008. As shown in Table 2 and Figure 2A, a CIR of 1.3 (95% CI: 0.6–2.0) ovarian cancer cases per 100,000 women was estimated in 2001; and a CIR of 1.8 (95% CI: 0.9–2.7) cases per 100,000 women in 2008. The latter CIR was the highest rate observed, but it was not statistically significantly different compared to the other years ($F[7, 96]=0.106$; $P>0.05$). Linear regression analysis suggested that the annual increase of CIR for ovarian cancer in Saudi Arabia can be predicted by the equation

$0.9 + (0.07 \times \text{years})$, which indicates that the CIR of ovarian cancer increased on average by 0.9 cases per 100,000 Saudi women per year.

Table 3 and Figure 2B show the overall CIR of ovarian cancer per 100,000 women, adjusted for the region of Saudi Arabia from 2001–2008. The region of Riyadh had the highest overall CIR for ovarian cancer at 1.9 (95% CI: 1.6–2.2) cases per 100,000 women, followed by the regions of Baha and Makkah at 1.8 (95% CI: 1.0–2.6) and 1.7 (95% CI: 1.4–3.0) cases per 100,000 women, respectively. The ANOVA test revealed that the incidence rates of ovarian cancer were significantly

Table 1 Ovarian cancer cases distribution by age group in Saudi Arabia from 2001–2008

Year	Age group of ovarian cancer													
	0–14		15–29		30–44		45–59		60–74		≥75		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	Total	% of total
2001	4	4	15	14.8	17	16.8	31	30.7	21	20.8	13	12.9	101	3.7
2002	6	6	15	16	13	14	29	30	24	25	9	9	96	3.3
2003	4	4	14	12.8	18	16.5	33	30	26	23.9	14	12.8	109	3.4
2004	6	6	11	10	22	20	32	30	27	25	10	9	108	3.1
2005	8	6	17	12.5	18	13	39	29	40	29.5	14	10	136	3.5
2006	2	2	15	11	22	17	44	33	38	29	11	8	132	3.2
2007	10	6.7	19	12.8	25	17	47	31.5	36	24	12	8	149	3.1
2008	6	3.7	17	10.6	22	13.7	51	32	50	31	14	9	160	3.5
Average	6	5	15	13	20	16	38	31	33	26	12	9.8	123.9	3.4

Table 2 CI for %, CIR, and ASIR of ovarian cancer cases in Saudi Arabia from 2001–2008

Year	Percentage		CIR per 100,000		ASIR per 100,000	
	%	95% CI	CIR	95% CI	ASIR	95% CI
2001	3.7	1.7–5.7	1.3	0.6–2.0	2.3	1.3–3.3
2002	3.3	1.5–4.8	1.2	0.5–1.9	2.0	1.0–3.0
2003	3.4	1.6–5.0	1.4	0.7–2.2	2.0	0.9–3.1
2004	3.1	0.6–3.7	1.3	0.4–1.7	2.2	1.4–3.0
2005	3.5	0.8–4.3	1.6	0.7–2.5	2.8	2.0–3.6
2006	3.2	0.7–3.9	1.5	0.5–2.5	2.8	1.9–3.7
2007	3.1	0.8–3.9	1.7	1.0–2.4	2.6	1.8–3.4
2008	3.5	1.3–4.8	1.8	0.9–2.7	3.0	2.3–3.7
Overall	3.4	1.1–4.5	1.5	0.6–2.2	2.5	1.5–3.3

Note: Values in bold denote there are no significant differences between years of diagnosis, P -value >0.05 .

Abbreviations: CIR, crude incidence rate; ASIR, age-standardized incidence rate; CI, confidence interval.

higher for these three regions compared to the other regions of Saudi Arabia ($F[12, 91]=4.988$; $P<0.001$). Furthermore, Jazan (95% CI: 0.1–0.5), Najran (95% CI: 0.3–1.3), and the northern region of Saudi Arabia (95% CI: 0.3–1.3) had the lowest average CIRs for ovarian cancer at 0.3, 0.8, and 0.8 cases per 100,000 women, respectively.

The overall ASIRs per 100,000 women were calculated for all of the SCR reports on the basis of (Segi) world standard

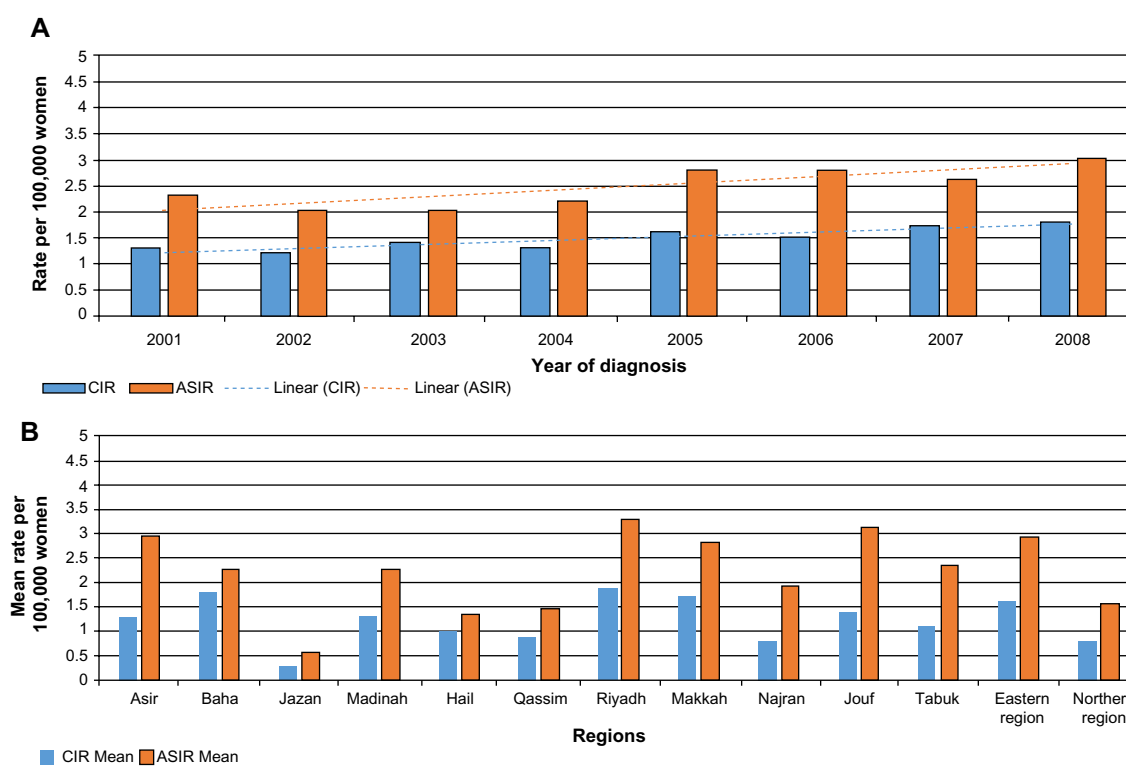
Table 3 CI for overall percentage, CIR, and ASIR of ovarian cancer cases in the regions of Saudi Arabia from 2001–2008

Regions	Overall percentage		Overall CIR		Overall ASIR	
	%	95% CI	CIR	95% CI	ASIR	95% CI
Asir	3.8	2.6–5.0	1.3	0.8–1.8	2.96	1.25–2.66
Baha	5.0	3.4–6.6	1.8	1.0–2.6	2.28	1.32–3.25
Jazan	1.6	0.5–2.7	0.3	0.1–0.5	0.57	0.17–0.97
Madinah	3.7	2.5–4.9	1.3	1.0–1.6	2.27	1.67–2.87
Hail	3.4	1.8–5.0	1.0	0.5–1.5	1.35	0.70–1.99
Qassim	2.3	1.2–3.4	0.9	0.3–1.5	1.46	0.69–2.23
Riyadh	3.4	3.1–3.7	1.9	1.6–2.2	3.30	2.68–3.91
Makkah	3.6	3.1–4.1	1.7	1.4–2.0	2.81	2.20–3.42
Najran	3.1	1.0–5.2	0.8	0.3–1.3	1.92	0.52–3.32
Jouf	4.8	1.4–8.2	1.4	0.7–2.1	3.13	1.50–4.76
Tabuk	3.0	2.5–3.5	1.1	0.8–1.4	2.35	1.51–3.18
Eastern region	3.2	2.6–3.8	1.6	1.3–1.9	2.92	2.39–3.45
Northern region	2.6	0.7–4.5	0.8	0.3–1.3	1.55	0.24–2.85

Note: Values in bold denote for CIR, Riyadh, Baha and Makkah were significantly higher than other regions of Saudi Arabia, P -value <0.05 ; for ASIR, Riyadh, Jouf and Asir were significantly higher than other regions of Saudi Arabia, P -value <0.05 .

Abbreviations: CI, confidence interval; CIR, crude incidence rate; ASIR, age-standardized incidence rate.

for intermediate-age populations (Table 4). This standard can be used in the direct method of standardization to calculate the ASIR. It allows to control the confounding effects of age when making a comparison between populations with

**Figure 2** CIR and ASIR of ovarian cancer cases (A) in Saudi Arabia from 2001–2008. Overall CIR and ASIR of ovarian cancer cases' distribution by region (B) in Saudi Arabia from 2001–2008.

Abbreviations: CIR, crude incidence rate; ASIR, age standardised incidence rate.

Table 4 Segi (world) standard for making comparisons with intermediate-age population (Segi, 1960)

Age group	Segi (world) standard
0–4	12,000
5–9	10,000
10–14	9,000
15–19	9,000
20–24	8,000
25–29	8,000
30–34	6,000
35–39	6,000
40–44	6,000
45–49	6,000
50–54	5,000
55–59	4,000
60–64	4,000
65–69	3,000
70–74	2,000
75+	2,000
Total	100,000

Note: The Segi (world) standard can be used in direct method of standardization to calculate the ASIR and ASMR. ASIR is a technique used to compare the incidence rates among different populations when the confounding variable is age. ASMR is a technique used to compare mortality rates among different populations when the confounding variable is age.

Abbreviations: ASIR, age-standardized incidence rate; ASMR, age-standardized mortality rate.

different age structures.^{15,16} Therefore, the ASIR of ovarian cancer per 100,000 women, adjusted for the year of diagnosis in Saudi Arabia, from 2001–2008, is displayed in Table 2 and Figure 2A. The SCR reports indicated a slight increase in the number of cases of ovarian cancer diagnosed from 2001–2008, with the highest ASIR of three cases per 100,000 women recorded in 2008 (95% CI: 2.3–3.7). Linear regression showed that the annual increase in ASIR of ovarian cancer in Saudi Arabia can be predicted by the equation $1.71 + (0.09 \times \text{years})$, which suggests that the ASIR of ovarian cancer increased by a predicted average of 0.09 cases per 100,000 women per year. Furthermore, Riyadh had the highest overall ASIR for ovarian cancer at 3.3 (95% CI: 2.68–3.91) cases per 100,000 women, followed by Jouf and Asir at 3.13 (95% CI: 1.5–4.76) and 2.96 (95% CI: 1.25–2.66) cases per 100,000 women, respectively (Table 3 and Figure 2B). The ANOVA test indicated that the ASIRs of ovarian cancer were significantly higher for these three regions compared to other provinces of Saudi Arabia ($F[12, 91]=4.100$; $P<0.001$). Furthermore, Jazan, Najran, and the northern region of Saudi Arabia had the lowest average ASIRs for ovarian cancer at: 0.3 (95% CI: 0.1–0.5); 0.8 (95% CI: 0.3–1.3); and 0.8 (95% CI: 0.3–1.3) cases per 100,000 women, respectively.

The Poisson regression was conducted to calculate the IRR of ovarian cancer cases for the different regions of Saudi Arabia. The model was statistically significant ($\text{LR}\chi^2[15]=850.6$; $P<0.001$). As shown in Table 5, Jazan

Table 5 Poisson regression model to calculate the IRR and check if there is an effect due to geographical area

# cases ^a	IRR	P-value	95% CI
Regions			
1. Asir	0.55	0.06	0.34–0.87
2. Baha	2.56	0.05*	1.56–3.98
3. Jazan	1 reference ^b		
4. Madinah	2.21	0.08	1.39–3.50
5. Hail	0.76	0.23	0.49–1.18
6. Qassim	1.21	0.40	0.77–1.91
7. Riyadh	6.3	0.001*	4.10–9.82
8. Makkah	6.4	0.001*	4.12–9.83
9. Najran	0.50	0.09	0.32–0.81
10. Jouf	0.48	0.12	0.30–0.76
11. Tabuk	0.98	0.60	0.64–1.51
12. Eastern region	4.52	0.001*	2.93–6.98
13. Northern region	0.44	0.10	0.26–0.62

Notes: ^aNumber of cases occurring in regions numbered from 1 to 13. ^bReference is the comparison region, and can be used for comparison with other regions and to calculate IRR. There are no significant differences between regions, $P\text{-value} > 0.05$, $*P\text{-value} < 0.05$.

Abbreviations: IRR, incidence rate ratio; CI, confidence interval.

was used as the reference region for comparing the other provinces of Saudi Arabia. The IRRs were significantly higher ($P<0.001$) for Makkah at 6.4 (95% CI, 4.12–9.83), Riyadh at 6.3 (95% CI, 4.10–9.82), and the eastern region of Saudi Arabia at 4.52 (95% CI, 2.93–6.98).

The differences in the CIRs and ASIRs between 2001–2008 were calculated to investigate the pattern of ovarian cancer in the different regions of Saudi Arabia (Table 6). The greatest changes in percentages and rates were observed in the region of Baha (6.4%; CIR, 2.9; ASIR, 3.6). However, the CIR and ASIR for all regions, with the exception of Baha, were under the predicted values based on the equations for the linear regression, ie, $0.9 + (0.07 \times 8 \text{ years}) = 1.46$ per 100,000 women for the CIR and $2.43 + (0.09 \times 8 \text{ years}) = 2.43$ per 100,000 women for the ASIR. The smallest changes in the CIR and ASIR were observed in the regions of Najran (–5.8%, –1.3 CIR, –4.1 ASIR), and Hail (–2.9%; CIR, –0.5; ASIR, –1.1). The percentage of ovarian cancer cases decreased by 5.8% and 2.9% in Najran and Hail, respectively. Furthermore, in the Najran region the CIR and ASIR decreased by 1.3 and 4.1 cases per 100,000 women, respectively; whereas, in the Hail region the CIR decreased by 0.5 case and the ASIR decreased by 1.1 cases per 100,000 women. However, these data indicate downtrending rates for both regions from 2001–2008.

Discussion

Ovarian cancer is an important malignancy in women with regards to its incidence and mortality. The current study

Table 6 Differences in the percentage, CIR, and ASIR of ovarian cancer cases in the regions of Saudi Arabia from 2001–2008

Regions	Percentage %			CIR per 100,000			ASIR per 100,000		
	2008	2001	Difference	2008	2001	Difference	2008	2001	Difference
Asir	4.7	4.0	0.7	1.9	0.9	0.9	3.0	1.7	1.3
Baha	8.8	2.5	6.4	3.3	0.4	2.9*	4.2	0.6	3.6*
Jazan	2.0	2.5	–0.5	0.5	0.3	0.2	1.1	0.4	0.7
Madinah	3.6	6.5	–2.9	1.6	1.7	–0.1	2.6	3.7	–1.1
Hail	2.2	5.1	–2.9	0.8	1.3	–0.5	1.2	2.3	–1.1
Qassim	2.6	1.4	1.2	1.1	0.5	0.6	2.0	0.9	1.1
Riyadh	4.0	3.6	0.4	2.5	1.8	0.7	4.5	3.8	0.7
Makkah	3.8	3.1	0.7	2.1	1.0	1.1	3.5	1.5	1.5
Najran	1.5	6.8	–5.8	0.5	1.8	–1.3	1.1	5.2	–4.1
Jouf	3.2	3.6	–0.4	1.2	0.5	0.7	2.8	3.3	–0.5
Tabuk	2.4	2.5	–0.1	0.9	0.8	0.1	1.9	1.1	0.8
Eastern region	2.2	3.8	–1.6	1.3	1.6	–0.3	2.1	3.2	–1.1
Northern region	1.9	0.0	1.9	0.8	0.0	0.8	1.3	0.0	1.3

Note: Values in bold denote the differences in the percentages, CIRs and ASIRs of ovarian cancer cases between 2001 and 2008 in different regions of Saudi Arabia. *For CIR and ASIR, the region of Baha showed the greatest changes compared to other provinces of Saudi Arabia, *P*-value <0.05.

Abbreviations: CIR, crude incidence rate; ASIR, age-standardized incidence rate.

focused on the CIR and ASIR of ovarian cancer in different regions of Saudi Arabia from 2001–2008. To the best of our knowledge, this is the first geographical descriptive epidemiological study of ovarian cancer cases in Saudi Arabia. It presents the pattern and the trend of the disease from 2001–2008. In addition, this study provides an important explanation for the observed trend, thereby highlighting the significance of this disease.

The results indicated that the regions of Riyadh, Jouf, and Asir had the highest overall ASIRs for ovarian cancer in Saudi Arabia from 2001–2008; however, the overall ASIRs of these regions did not increase above the expected levels. In contrast, the regions of Jazan and Hail had the lowest overall ASIRs of ovarian cancer in Saudi Arabia from 2001–2008. Women >44 years of age were the most affected by ovarian cancer in the different provinces of Saudi Arabia. Furthermore, the Poisson regression showed that the IRR of ovarian cancer cases in the regions of Riyadh and Makkah was more than six times higher than the reference region of Jazan.

This study also reported the changes in the percentage of ovarian cancer cases diagnosed, CIR, and ASIR from 2001–2008. The Baha region had the largest differences in CIR and ASIR, which were both higher than their predicted values for the years 2001–2008. These differences in rates suggest that, from 2001–2008, more women in the region of Baha were affected by ovarian cancer than predicted. In contrast, the rates of ovarian cancer decreased in the regions of Najran and Hail. These regions reported the lowest changes in the respective study outcomes, with a downtrend observed in the CIR and ASIR from 2001–2008.

However, with the exception of the SCR reports, only limited information was available on the incidence of ovarian cancer in Saudi Arabia. This study intended to explore the real pattern of ovarian cancer in different regions of Saudi Arabia from 2001–2008. The findings of this study may be useful for researchers and decision makers in the field of medicine and health care administration in Saudi Arabia as they can provide opportunities for generating hypotheses about the potential risk factors of ovarian cancer in the highest affected regions. Furthermore, the findings can be utilized to conduct analytical epidemiological studies that aim to identify the relationship between exposure and disease.¹³ The availability of data from the SCR reports can also encourage further descriptive epidemiological studies of other types of cancers among the Saudi population.

Conclusion

The epidemiological analysis of the reports by the SCR, from 2001–2008, revealed that the CIR and ASIR of ovarian cancer were increasing slightly. The regions of Riyadh, Jouf, and Asir had the highest overall ASIR in Saudi Arabia, while Jazan and Hail recorded the lowest rates. The IRR of ovarian cancer cases indicated a concern in the number of ovarian cancer cases diagnosed in certain regions, such as Makkah, Riyadh, and the eastern region of Saudi Arabia. Moreover, the region of Baha documented the greatest changes in CIR and ASIR from 2001–2008, while the regions of Najran and Hail reported the lowest. Nonetheless, further analytical studies are required to determine and to explore the potential risk factors of ovarian cancer in Saudi Arabia.

Disclosure

The authors report no conflicts of interest in this work.

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