Epidemiology of Gastric Cancer in Saudi Arabia

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Abstract

Objectives: This study examines the epidemiological trend of gastric cancer (GC) in all Saudi Arabian administrative areas. It examines the incidence of diagnosed cases, the age-specific incidence rate (AIR), the crude incidence rate (CIR), and the age-standardized incidence rate (ASIR) stratified by age group, year of diagnosis, and region. Methods: From 2004 to 2017, a retrospective descriptive epidemiological study of all GC cases recorded in the Saudi Cancer Registry (SCR) was conducted. The data were analysed with descriptive statistics, the t-test, the Kruskal-Wallis test, and the sex ratio using version 20.0 of the Statistical Package for the Social Sciences (SPSS). Results: Between January 2004 and December 2017, a total of 4,066 GC cases were reported in the SCR. Riyadh, Najran, and Eastern Region had the highest overall ASIR of GC among males and females in Saudi Arabia (Males: 4.0, 3.8, and 3.8; Females: 2.6, 2.3 and 2.2 per 100,000 people). In contrast, Jazan had the lowest overall ASIR of GC among Saudi males and females (1.5 and 0.5 per 100,000 people, respectively). However, the overall ASIR of GC was statistically higher in men than in women (P-value 0.05), with a male-to-female ratio of 2.8 per 100,000 in Saudi Arabia. Conclusion: There was a small decline in the CIRs and ASIRs of GC in Saudi Arabia Between 2004 and 2017. Riyadh, Najran, and the Eastern Region had the greatest prevalence of GC among males and females in Saudi Arabia. Men and women in Jazan, Saudi Arabia, were shown to be the least impacted by GC. In Saudi Arabia, the rates of GC were substantially greater among males than among females.

Epidemiology of Gastric Cancer in Saudi Arabia

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Abstract :

Objectives: This research examines the pattern of gastric cancer (GC) in all Saudi Arabian administrative areas. It examines the incidence of diagnosed cases, the incidence rate (age-specific), the incidence rate (Crude - CIR), and the incidence rate (age-standardized - ASIR) adjusted by age, year, and region.

Methods: All GC cases recorded into the Saudi Cancer Registry (SCR) between 2004 and 2017 were the subject of a retrospective descriptive epidemiological analysis. Using SPSS version 20.0, we performed a descriptive analysis, a t test, a Kruskal-Wallis test, and a sex ratio on the collected data.

Results: Between January 2004 and December 2017, a total of 4,066 GC cases were reported in the SCR. Men and women in Saudi Arabia had the highest overall ASIR of GC in Riyadh, Najran, and Eastern Region (Men: 4.0, 3.8, and 3.8; Women: 2.6, 2.3 and 2.2 per 100,000 people). In contrast, both men and women in Jazan, Saudi Arabia, had the lowest overall ASIR of GC (1.5 and 0.5 per 100,000 people, respectively).

However, men had a statistically greater overall ASIR of GC than women (P-value < 0.05), with a ratio of 2.8 per 100,000 people.

Conclusion: CIRs and ASIRs of GC in Saudi Arabia decreased slightly between 2004 and 2017. Riyadh, Najran, and the Eastern Region had the greatest prevalence of GC among males and females in Saudi Arabia. The region of Jazan were shown to be the least impacted by GC. In Saudi Arabia, the rates of GC were substantially greater among males than among females.

Keywords: Cancer; epidemiology; gastric cancer; Saudi Cancer Registry; oncology; crude Incidence rate.

Introduction

Gastric cancer (GC) is one of the most frequent diseases in both men and women globally, with around 990,000 new cases identified each year.[1-2] It is the third or fourth biggest cause of mortality in the globe, accounting for around 738,000 fatalities per year.[1-3] Incidence rates of GC differ between men and women, as well as between countries. Males are three times as likely than females to have GC disease.[1-2] More than fifty percent of new cases of GC are predicted to occur in developing nations, with the greatest rates in Central and South America, Eastern Europe, and East Asia (China and Japan), and the lowest rates in Australia and New Zealand, Southern Asia, North and East Africa, North America, and Canada.[1&4]

The incidence rates of GC have declined in the majority of the world over the past few decades.[5] The incidence of sporadic intestinal GC has declined, but the incidence of diffuse GC has increased.[6-7] However, the risk of acquiring GC is significantly affected by several factors, such as genetics, nutrition, alcohol intake, smoking, Helicobacter pylori infection, and Epstein-Barr virus (EBV) infection.[1]

In the US, GC accounts for around 1.5% of newly diagnosed cancer cases each year. According to the American Cancer Society, 26,380 new cases of GC will be detected in 2022 (15,900 in men and 10,480 in women), while 11,010 fatalities will be attributed to the disease (6,690 men and 4,400 women).[8]

It was predicted by the International Agency for Research on Cancer (IARC) that in 2020, the age-standardized incidence rate (ASIR) of GC in Saudi Arabia would be 2.7 per 100,000 people across all age groups and sexes (ranking 15), while the age-standardized mortality rate (ASMR) would be 2.1 per 100,000 people (Ranking 12).[9] In addition, the ASIR of GC was much lower in Saudi Arabia and Kuwait compared to the rest of the Arabian Gulf. In 2020, the reported ASIR for all sexes and all ages was higher in Oman, Qatar, Bahrain, and the United Arab Emirates than in Saudi Arabia, at 8.0, 5.2, 4.8, and 4.4, respectively.

This study's primary objectives were to investigate the prevalence of GC in the Saudi population. To achieve this, we focused in on CIR and ASIR, which were then categorized according to the year of diagnosis, geographical region, and age group. As a result, we plan to carry out observational descriptive epidemiological research of the GC, taking into consideration the regional and temporal distribution of cases that have been documented in the SCR between the years 2004 and 2017.

Materials and methods

The purpose of this research was to conduct a retrospective observational descriptive epidemiological analysis on all instances of GC that were identified in Saudi Arabia across all regions between January 2004 and December 2017. Because the information on the GC incidence in Saudi Arabia is readily available to the scientific researchers and can be obtained through the SCR reports with little effort, the observational descriptive epidemiological study that was conducted did not require any kind of ethical approval. The Saudi Ministry of Health established a population-based cancer registry in 1992, and its records provided the basis for this investigation. Furthermore, the first cancer report in Saudi Arabia was issued in 2001, and the most precise cancer reports in Saudi Arabia were published at the beginning of 2004. In addition, the most recent information accessible from the SCR was collected in 2017.

SCR has been issuing reports on the pattern of cancer in Saudi Arabia since 2001, with the primary purpose of describing the epidemiological spread of the disease. On the basis of this data, we have access to in-depth reports for 13 administrative regions, covering the years 2004-2017, that detail the CIR and ASIR, adjusted by province in Saudi Arabia, patient gender, and year of diagnosis. However, for this study, all of the information from the SCR was used to collect important data.

Data was analysed using SPSS, the Statistical Package for the Social Sciences, version 20.0. The descriptive statistics of the epidemiological data involved computing the overall of percentage, CIR, and ASIR adjusted by gender, geographical region, and year of diagnosis. Comparisons of CIR and ASIR of GC between male and female Saudis were analysed using t-test for independent samples.

Version 20.0 of the Statistical Package for the Social Sciences (SPSS) was employed in the study of data. The descriptive analysis of the epidemiological data involved computing the overall percentage, the age-specific incidence rate (ASR), the CIR, and the ASIR stratified by gender, geographical region, and year of diagnosis. The independent sample t-test was performed to compare male and female Saudis' CIR and ASIR of GC. In addition, both the CIR and ASIR of GC were analysed across regions of Saudi Arabia using the Kruskal-Wallis test. However, the sex ratio for GC was computed from the age-specific incidence rate, the CIR, and the ASIR in this study.

Results

Gastric cancer among Saudi men

A total of 2477 GC cases were reported by the SCR throughout the time span commencing in January 2004 and ending in December 2017 respectively. This represents a small rise in the number of GC cases. According to Figure 1a, there were 141 GC cases in 2004 (5.7%). This number raised to 201 in 2009, showing a 2.4% increase. From 2010 to 2017, the number of GC cases fluctuated between 165 and 208 every year, suggesting a percentage range of 6.5% to 8.4% per year. However, from 2004 to 2017, the overall number and percentage of GC cases among Saudi males was 175 (7.1%) every year.

Using data from the SCR, the average number and percentage of GC cases diagnosed in male Saudis by age group between 2004 and 2017 were computed. The class width for age groups ranging from 0 to 4 years, 5 to 9 years, 10 to 14 years, 15 to 19 years, 20 to 24 years, and above 75 years of age was 5 years. From 2004 to 2017, GC was most commonly diagnosed in Saudi males aged 75 years and older, then those aged 70–74 years, with 27.4% (48 overall cases annually) and 14.8% (26 overall cases annually), respectively. However, the overall percentage of men in Saudi Arabia aged 50 or older who were diagnosed with GC reached 83.3% between the years 2004 and 2017. In contrast, younger Saudi male age groups (0-49 years) had the lowest cases of GC, with an annual average percentage of 16.7% (Figure 1a). Furthermore, the overall age specific incidence rate of GC among Saudi males was high from 2004 to 2017, with the age groups 75 years and older, 70-74, 65-69, and 60-64 at (37.6, 27.2, 17.2, and 10.9 per 100,000 people). However, the male-to-female ratio of the age-specific incidence rate of GC was three times greater among Saudi males aged 55 to 75 and older, whereas there was no significant difference in the age-specific incidence sex ratio for the 0 to 54 age group (Figure 2).

According to Figure 3, the CIRs of GC cases among Saudi males show a little increase from 2004 to 2009, a slight decline from 2010 to 2011, and then a constant trend from 2012 to 2017. The estimated CIR for 2004 was 1.7 per 100,000 people, and the highest CIR reported by the SCR was 2.2 per 100,000 people in 2009. In addition, the overall CIR of GC among Saudi males between 2004 and 2017 was 1.6 (95% CI: 1.3 to 1.8) per 100,000 people. The t-test for two independent samples revealed that the CIR of GC in male Saudis was considerably higher than in females ($t(23) = 3.823$, P 0.001). However, the overall CIR male-to-female ratio from 2004 to 2017 per 100,000 people was 1.5. Among Saudi men in Asir, Makkah, and Riyadh, the overall CIRs for GC were the highest at 2,3, 2,1, and 2,0 per 100,000 people, respectively. Statistically, these districts of Saudi Arabia are distinct from the rest of the country, as shown by the Kruskal-Wallis test (2(12,N=181) =52,298; P<0.001).In contrast, the smallest overall CIR of GC was reported in both Jazan and Jouf regions, at 1.1 per 100,000 people (Figure 4).

The ASIR of GC cases among male Saudis, adjusted by year of diagnosis from 2004 to 2017 per 100,000 people, was observed using the SCR (Figure 5). Similarly, there was a small increase from 2004 to 2009, then steady decrease from 2010 to 2017. In 2006 and 2009, the ASIR of GC was the highest at 3.9 per 100,000 people, but in 2014 the rate was the lowest at 2.4 per 100,000 people. However, from 2004 to 2017, the overall ASIR of GC among Saudi males per 100,000 persons was 2.8 (95% CI, 2.2 to 3.2). The t-test for two independent samples revealed that the Saudi male ASIR of GC was noticeably higher than that of Saudi females $t(20) = 8.823$, $P<0.001$) However, from 2004 to 2017, the overall male-to-female ratio of ASIR per 100,000 males was 1.5. According to Figure 6, Riyadh, Najran and the Eastern region of Saudi Arabia, had the highest overall ASIR for GC at 4.0 and 3.8 per 100,000 people. the Kruskal-Wallis test showed that these areas were significantly different from other regions of Saudi Arabia (2(12,N=180) =59.556, $P<0.001$). In contrast, Jazan, Hail, and Baha had the smallest overall ASIR of GC at 1.6, 1.5, and 1.5, respectively.

Gastric cancer among Saudis women

From 2004 to 2017, the SCR recorded a total of 1589 cases of GC among Saudi women. According to Figure 1b, there were 70 GC cases in 2004 (4.4%). This number raised to 133 in 2011, showing a 4.0% increase. From 2012 to 2017, the number of GC cases fluctuated between 186 and 208 every year, suggesting a percentage range of 7.5% to 8.4% per year. However, from 2004 to 2017, the overall number of confirmed cases of GC among Saudi women were 110 (7.1%) per year. GC was diagnosed most commonly in Saudi women aged 75 and older, followed by those aged 70–74 years, who accounted for 20.4% (23 overall cases annually) and 11.1% (13 overall cases annually), respectively. However, the overall percentage of women in Saudi Arabia aged 50 or older who were diagnosed with GC reached 70.9% between the years 2004 and 2017. In contrast, younger Saudi women aged (0-49 years) had the smallest overall number of GC cases, with an average of 16.7% per year (Figure 1b). In addition, the overall age specific incidence rate of GC from 2004 to 2017, was high among Saudi women with the age groups 75 years and over, 70-74, 65-69, 60-64 at (18.3, 14.3, 9.8, and 6.5 per 100,000 people) (Figure 2).

According to Figure 3, the CIRs of GC cases among females in Saudi Arabia, adjusted by year of diagnosis from 2004 to 2017, per 100,000 people show a modest increase from 2004 to 2007, a small reduction from 2008 to 2012, and a steady trend from 2013 to 2017. The estimated CIR for 2004 was 0.8 per 100,000 people, and the highest CIR reported by the SCR was 1.7 per 100,000 people in 2007. Furthermore, the overall CIR of GC among Saudi women between 2004 and 2017 was 1.1 (95% CI: 0.9 to 1.2) per 100,000 people. The regions of Asir, Riyadh, and the Eastern region had the highest overall CIRs for GC among Saudi women, at 1,4, 1,3, and 1,3, respectively, per 100,000 people. The Kruskal-Wallis test revealed significant differences between these locations and other regions of Saudi Arabia $\chi^2(12,N=181) = 39.689$, $P < 0.001$). In contrast, the region of Jazan had the lowest overall CIR of GC, at 0.4 per 100,000 people (Figure 4).

The ASIR of GC cases among Saudi women, adjusted by year of diagnosis from 2004 to 2017, was documented using the SCR (Figure 5). From 2004 to 2006, there was a modest rise, followed by a constant trend from 2007 to 2017. In 2006, the ASIR of GC was the highest at 2.7 per 100,000 people, but in 2012 and 2016, it was the lowest at 1.5 per 100,000 people. However, the overall ASIR of GC among Saudi women from 2004 to 2017 per 100,000 people was 1.8 (95% CI, 1.2 to 2.2). Furthermore, the overall ASIR of GC stratified by Saudi Arabian region from 2004 to 2017 per 100,000 people show that Riyadh, Najran, and the Eastern region of Saudi Arabia had the highest overall ASIR for GC at 2.6, 2.3, and 2.2 per 100,000 people, respectively. In contrast, the Jazan region had the lowest overall ASIR of GC at 0.5 per 100,000 people (Figure 6).

Discussion

The CIRs and ASIRs of GC cases among the Saudi population must be tracked and kept current for all Saudi regions. The purpose of this study was to investigate the CIR and ASIR patterns of GC in Saudi Arabia from 2004 to 2017. According to the PubMed database, this is the first descriptive epidemiological research on the spatial/temporal distribution of GC among men and women in different regions of Saudi Arabia. It explores the actual state of the GC trend and the relevance of the disease in the population of Saudi Arabia.

From 2004 to 2017, the overall number of GC cases among Saudi men and women was 175 and 110 (7.1%), respectively. In addition, the overall number of confirmed cases of GC between 2004 and 2017 by age group of Saudi males and females were recorded, as the disease occurred in a significant percentage among those aged 50 years and older (Male: 83.3%, Female: 70.9%), whereas the age group younger than or equal to 49 years was less affected by GC (Male: 16.7%, Female: 29.0%). These findings are similar with those of other studies indicating that the median age of diagnosis for GC is 72 years old and that roughly 10% of gastric carcinomas are diagnosed in patients 45 years of age or younger.[10-12]

In this study, the incidence of GC was observed to be higher in males than in females. From 2004 to 2017, the CIR and ASIR of GC were twofold greater in Saudi men than in women. Globally, the incidence of GC varies by sex and geographical location. It is more prevalent in men than in women, and the risk of developing it rises with age.[13]In the United States, the recent studies indicates that the most major risk factor for the development of GC is male gender, with a ratio 2:1 male to female predominance.[14] As well as, in the developed countries, men are 2,2 times more likely than women to be diagnosed with GC.[15] Therefore, other studies indicate that male gender is a significant predictor of GC. In addition, Yang et al.[16] found in their research of the survival rates of patients with metastatic GC that male patients had poorer survival rates than female patients.

In Saudi Arabia, the ASIR trend of GC among Saudi men and women has dropped steadily from 2004 to 2017. Similarly, over the past several decades, the incidence rates of GC have decreased gradually throughout the majority of the world including the United States (Figure 7).[1 &17] Increasing hygienic standards, enhanced food preservation, increased intake of fresh fruits and vegetables, and Helicobacter pylori eradication could explain this downward trend.[1&18]

Our results indicates that male and female Saudis in Riyadh, Najran, and the Eastern region had the highest overall ASIRs for GC from 2004 to 2017. This suggests that males and females in Riyadh, Najran, and the Eastern region of Saudi Arabia are exposed to a significant risk factor for GC. In contrast, men and women in Jazan, Saudi Arabia, were the least affected by GC, indicating that they were more exposed to GC protective factor than persons in other regions of Saudi Arabia. However, a further epidemiological study should be conducted in the region of Riyadh, Najran, and Eastern region to find out the potential risk factors that lead to the increase of ASIR of GC among Saudis men and women. Furthermore, the protective factors of GC in the Jazan region that contributed to the lower rates of GC, should be investigated.

In Saudi Arabia, the estimated ASIR for GC among both genders in 2020 was 2.7% per 100,000 people. The rate is significantly lower compared to other countries. Oman had the highest rate of GC among both genders in the Arabian Gulf, at 8.0 per 100,000 people; this rate was 2.9 times greater than Saudi Arabia (Figure 8). Furthermore, the ASMR of GC was observed in Saudi Arabia at a rate of 2.1 per 100,000 people among both sexes. Compared to other Arab countries, this mortality rate was slightly lower (Figure 9). However, Oman had the greatest ASMR of GC among both genders, at 6.9 per 100,000 people, which was 3.2 times greater than Saudi Arabia. The results of this study also indicate that the overall ASIR of GC is extremely low in Saudi Arabia compared to Mongolia (32.5 per 100,000 people), Japan (31.6 per 100,000 people), and Korea (27.7 per 100,000 people); these rates were 9 to 10 times higher than in Saudi Arabia.[9]

This study investigates the actual distribution of GC in Saudi Arabia. It helps other researchers in formulating a new hypothesis regarding the potential risk-protective factors of GC among male and female Saudis residing in different regions. However, these studies have some limitations, including the absence of a comparison group and the inability to evaluate the statistical association between factors.[19] In this research, the average death rates of GC in various regions of Saudi Arabia could not be determined since the SCR reports lacked information on the number of GC-related deaths.

Conclusion

This study demonstrated a small decline in the CIRs and ASIRs of GC in the Saudi population between 2004 and 2017. Riyadh, Najran, and the Eastern Region had the highest overall ASIRs of GC among male and female Saudis, whereas Jazan had the lowest rates for both sexes. From 2004 to 2017, the ratio of GC cases in male Saudis was double that of female Saudis. Further epidemiological studies are required to determine the potential risk factors for GC in Saudi Arabia.

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Conflict of Interest (COI)

The authors declare that they have no conflict of interest.

Ethical Approval and Patient Confidentiality

The author declares that the paper does not raise any ethical concern. The data regarding Gastric cancer incidence in Saudi Arabia are publicly available and easily accessible through the Saudi Cancer reports; therefore, no ethical approval was required for this observational descriptive epidemiological study.

All reports can be directly downloaded from the National Health Information Centre's website, available from: https://nhic.gov.sa/en/eServices/Pages/TumorRegistration.aspx

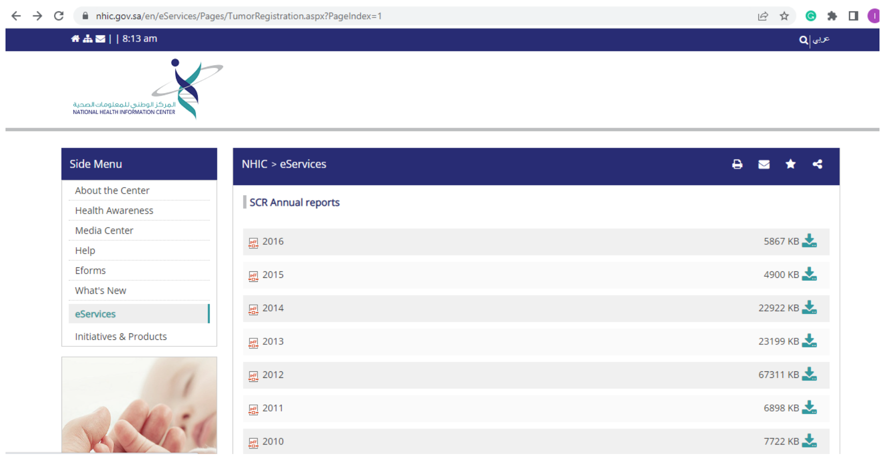


Figure legends

Figure 1: A Gastric cancer cases among male Saudis (Number and percentage) between 2004 and 2014. **B:** Gastric cancer cases among female Saudis (Number and percentage) between 2004 and 2017.

Figure 2: I ncidence rate (age specific) of Gastric cancer cases among the Saudi population from 2004 to 2017.

Figure 3: Incidence rate (Crude) of Gastric cancer cases among the Saudi population from 2004 to 2017.

Figure 4: Incidence rate (Crude) of Gastric cancer cases among the Saudi population by region from 2004 to 2017.

Figure 5: Incidence rate (age-standardised) of Gastric cancer cases among the Saudi population from 2004 to 2017.

Figure 6: Incidence rate (age-standardised) of Gastric cancer cases among the Saudi population by region from 2004 to 2014.

Figure 7: Trend line of Gastric cancer in the USA from 2004 to 2019.

Figure 8: Incidence rate (age-standardised) of Gastric cancer (World) in 2020, both sexes, all ages**.**

Figure 9: Mortality rate (age-standardised) of Gastric cancer (World) in 2020, both sexes, all ages.

Figure 1A

Year of Diagnosis	0-4	5--9	10--14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	≥75	All Ages	% from The Total Cases
Total Number and Percentage of Gastric Cancer Cases by Age Group (Male)																		
2004	0	0	0	0	0	1	4	5	5	4	9	12	27	18	13	42	141	5.7
2005	0	0	0	0	3	1	2	6	3	3	8	13	18	20	30	49	156	6.3
2006	0	0	0	0	1	1	7	0	5	13	11	9	16	21	33	45	162	6.5
2007	0	0	0	0	1	2	2	1	6	4	13	20	18	28	27	51	173	7.0
2008	0	0	0	2	2	2	2	5	6	9	13	26	21	17	15	46	166	6.7
2009	1	0	1	1	0	3	0	5	11	13	12	14	22	19	44	55	201	8.1
2010	1	0	0	0	3	4	3	7	3	15	13	15	17	21	25	38	165	6.7
2011	0	0	0	0	2	2	5	6	5	9	23	15	16	17	25	37	162	6.5
2012	0	0	0	0	1	3	3	7	4	8	21	18	20	20	30	51	186	7.5
2013	0	0	0	0	2	1	6	4	7	13	12	22	21	27	27	53	195	7.9
2014	0	0	0	2	0	2	1	11	9	6	14	20	16	20	18	51	170	6.9
2015	1	0	0	2	2	4	5	4	10	9	16	18	15	21	24	54	185	7.5
2016	0	0	0	1	3	2	8	10	8	7	14	26	22	20	30	56	207	8.4
2017	0	0	0	3	4	4	16	7	14	16	16	26	24	25	25	53	208	8.4
Total	3	0	1	11	24	32	64	78	96	129	195	254	273	294	366	681	2477	Mean % = 7.1
Overall	0	0	0	1	2	2	4	6	6	9	14	18	19	21	26	48	175	
%	0.1	0	0	0.4	1	1.3	2.6	3.1	3.9	5.2	7.9	10.3	11	11.9	14.8	27.4	100	

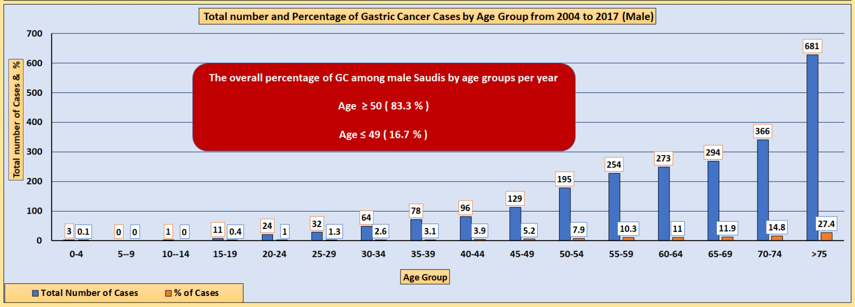


Figure 1B

Year of Diagnosis	0-4	5--9	10--14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	≥75	All Ages	% from The Total Cases
Total Number and Percentage of Gastric Cancer Cases by Age Group (Female)																		
2004	0	0	0	1	1	6	0	3	7	4	5	3	7	11	10	12	70	4.4
2005	0	0	0	0	0	0	4	2	1	5	6	6	13	3	16	12	68	4.3
2006	0	0	0	1	4	3	3	6	8	7	11	6	11	19	16	17	113	7.1
2007	0	0	0	0	3	1	6	7	3	16	14	9	14	14	14	24	126	7.9
2008	0	0	0	0	1	4	5	6	8	6	7	8	11	12	6	26	100	6.3
2009	0	0	0	0	0	3	9	4	8	11	12	11	10	12	12	20	112	7.0
2010	0	0	0	0	1	2	3	8	2	13	16	17	10	4	16	34	126	7.9
2011	0	0	0	1	2	7	4	6	8	5	10	12	16	10	22	30	133	8.4
2012	0	0	0	3	4	3	7	5	7	6	7	7	7	11	15	12	94	5.9
2013	0	0	0	1	2	4	6	9	6	10	15	11	12	12	8	25	121	7.6
2014	0	0	0	0	3	1	7	7	15	10	14	11	9	13	10	30	130	8.2
2015	0	0	0	0	2	6	3	10	10	12	12	18	9	13	9	27	131	8.2
2016	0	0	0	0	2	2	3	5	14	5	13	9	10	14	9	25	111	7.0
2017	0	0	0	0	0	3	3	2	7	13	13	22	17	12	18	30	154	9.7
Total	0	0	0	7	25	45	63	80	104	123	155	150	156	160	181	324	1589	Mean % = 7.1
Overall	0	0	0	1	2	3	5	6	8	9	11	10	11	11	13	23	110	
%	0	0	0	0.4	1.6	2.8	4	5	6.5	7.7	9.8	9.4	9.8	10.1	11.4	20.4	100	

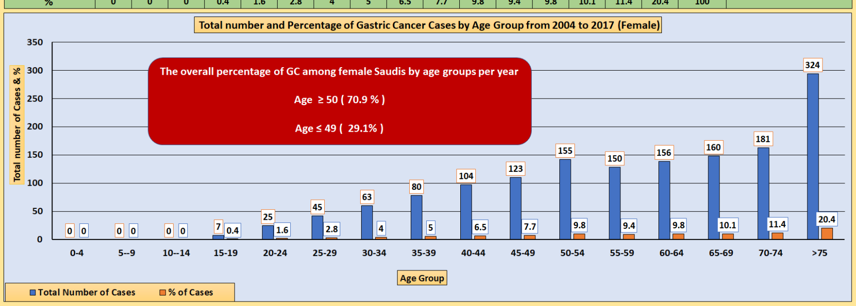


Figure 2

Overall Age Specific Incidence Rate of Gastric Cancer from 2004 to 2017 Per 100,000 Population

						Male / Female	Female / Male
Age Group	Male	Female	Difference	Z-Score	P-value	AIR Sex Ratio	AIR Sex Ratio
0-4	0.0	0.0	0.0	0	1.0	0.0	0.0
5--9	0.0	0.0	0.0	0	1.0	0.0	0.0
10--14	0.0	0.0	0.0	0	1.0	0.0	0.0
15-19	0.1	0.1	0.0	0	1.0	1.2	0.8
20-24	0.2	0.2	0.0	0	1.0	0.8	1.2
25-29	0.2	0.4	-0.1	-0.18	0.85	0.6	1.6
30-34	0.5	0.7	-0.2	-0.14	0.88	0.8	1.3
35-39	0.9	1.0	-0.1	-0.09	0.92	0.9	1.1
40-44	1.3	1.5	-0.2	-0.10	0.92	0.9	1.1
45-49	2.0	2.2	-0.2	-0.09	0.92	0.9	1.1
50-54	4.2	3.6	0.6	0.22	0.82	1.2	0.9
55-59	7.2	4.3	2.9	0.85	0.39	1.7	0.6
60-64	10.9	6.5	4.5	1.07	0.28	1.7	0.6
65-69	17.2	9.8	7.4	1.43	0.15	1.8	0.6
70-74	27.2	14.3	12.9	2.00	0.04	1.9	0.5
≥75	37.6	18.3	19.3	2.58	0.00	2.1	0.5

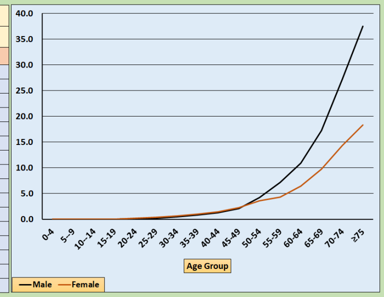


Figure 3

Crude Incidence Rate of Gastric Cancer per 100,000				Male / Female	Female / Male
Year	Male	Female	Difference	CIR Sex Ratio	CIR Sex Ratio
2004	1.7	0.8	0.9	2.1	0.5
2005	1.8	0.8	1.0	2.3	0.4
2006	1.9	1.3	0.6	1.5	0.7
2007	2.0	1.6	0.4	1.3	0.8
2008	1.8	1.1	0.7	1.6	0.6
2009	2.2	1.3	0.9	1.7	0.6
2010	1.7	1.4	0.3	1.2	0.8
2011	1.7	1.4	0.3	1.2	0.8
2012	1.9	0.9	1.0	2.1	0.5
2013	1.9	1.2	0.7	1.6	0.6
2014	1.7	1.4	0.3	1.2	0.8
2015	1.8	1.3	0.5	1.4	0.7
2016	2.0	1.1	0.9	1.8	0.6
2017	2.0	1.5	0.5	1.3	0.8
Mean	1.6	1.1	0.5	1.5	0.7
Median	1.5	1.2	0.3	1.3	0.8
SD	0.4	0.3	0.1	1.5	0.7
95 % CI : Mean	1.3 - 1.8	0.9 - 1.2			

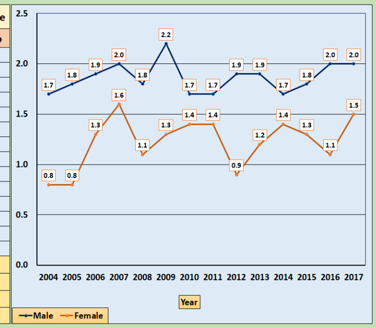
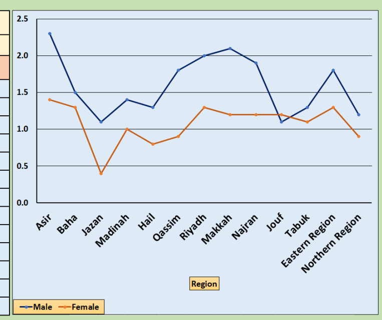


Figure 4

Overall Curde Incidence Rate of Gastric Cancer from 2004 to 2017 Per 100,000 Population

					Male / Female	Female / Male
Regions	Male	P-value	Female	P-value	CIR Sex Ratio	CIR Sex Ratio
Asir	2.3	0.001	1.4	0.001	1.6	0.6
Baha	1.5	0.12	1.3	0.001	1.2	0.9
Jazan	1.1	Reference	0.4	Reference	2.8	0.4
Madinah	1.4	0.24	1.0	0.01	1.4	0.7
Hail	1.3	0.54	0.8	0.07	1.6	0.6
Qassim	1.8	0.001	0.9	0.05	2.0	0.5
Riyadh	2.0	0.001	1.3	0.001	1.5	0.7
Makkah	2.1	0.001	1.2	0.001	1.8	0.6
Najran	1.9	0.002	1.2	0.001	1.6	0.6
Jouf	1.1	0.80	1.2	0.002	0.9	1.1
Tabuk	1.3	0.48	1.1	0.007	1.2	0.8
Eastern Region	1.8	0.01	1.3	0.001	1.4	0.7
Northern Region	1.2	0.58	0.9	0.07	1.3	0.8



Note 1: Values in yellow colour denote for CIR of Stomach cancer in male Saudis, these regions were significantly higher than, Jazan, Baha, Madinah, Hail, Jouf, Tabuk, and Northern region, P-value < 0.05.

Note 2: Values in green colour denote for CIR of Stomach cancer in female Saudis, these regions were significantly higher than Jazan, Hail, and Qassim, P-value <0.05.

Figure 5

Age Standardized Incidence Rate of Gastric Cancer per 100,000				Male / Female	Female / Male
Year	Male	Female	Difference	ASIR Sex Ratio	ASIR Sex Ratio
2004	3.2	1.6	1.6	2.0	0.5
2005	3.5	1.6	1.9	2.2	0.5
2006	3.9	2.7	1.2	1.4	0.7
2007	3.6	2.5	1.1	1.4	0.7
2008	3.2	1.9	1.3	1.7	0.6
2009	3.9	2.1	1.8	1.9	0.5
2010	3.1	2.3	0.8	1.3	0.7
2011	2.8	2.3	0.5	1.2	0.8
2012	3.2	1.5	1.7	2.1	0.5
2013	3.3	1.8	1.5	1.8	0.5
2014	2.4	1.7	0.7	1.4	0.7
2015	2.6	1.7	0.9	1.5	0.7
2016	2.9	1.5	1.4	1.9	0.5
2017	2.8	2	0.8	1.4	0.7
Mean	2.8	1.8	1.0	1.5	0.7
Median	2.9	2.0	0.9	1.5	0.7
SD	0.9	0.5	0.4	1.7	0.6
95 % CI : Mean	2.2 - 3.2	1.2 - 2.2			

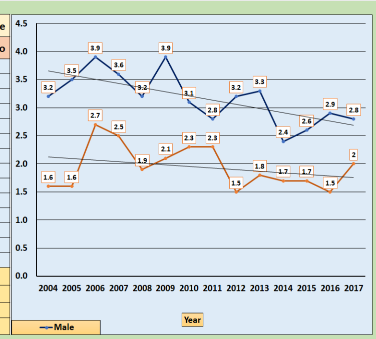
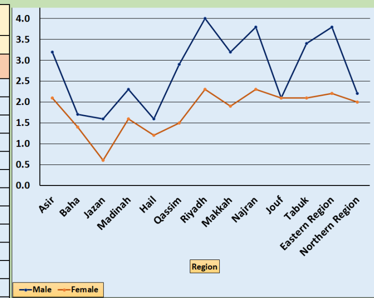


Figure 6

Overall Age Standrardized Incidence Rate of Gastric Cancer from 2004 to 2017 Per 100,000 Population

Regions	Male	P-value	Female	P-value	Male / Female CIR Sex Ratio	Female / Male CIR Sex Ratio
Asir	3.2	0.003	2.1	0.002	1.5	0.7
Baha	1.6	0.81	1.4	0.08	1.1	0.9
Jazan	1.5	Reference	0.5	Reference	3.0	0.3
Madinah	2.3	0.17	1.5	0.04	1.5	0.7
Hail	1.5	0.96	1.1	0.18	1.4	0.7
Qassim	2.9	0.01	1.5	0.06	1.9	0.5
Riyadh	4.0	0.001	2.6	0.001	1.5	0.7
Makkah	3.1	0.002	2.0	0.008	1.6	0.6
Najran	3.8	0.001	2.3	0.001	1.7	0.6
Jouf	2.0	0.30	2.0	0.001	1.0	1.0
Tabuk	3.4	0.001	2.1	0.002	1.6	0.6
Eastern Region	3.8	0.001	2.2	0.001	1.7	0.6
Northern Region	2.2	0.24	2.0	0.003	1.1	0.9



Note 1: Values in yellow colour denote for ASIR of Stomach cancer in male Saudis,these regions were significantly higher than Baha, Jazan, Madinah, Hail, Jouf, and Northern region, P-value < 0.05.

Note 2: Values in green colour denote for ASIR of Stomach cancer in female Saudis, these regions were significantly higher than Baha, Jazan, Hail, and Qassim, P-value <0.05.

Figure 7

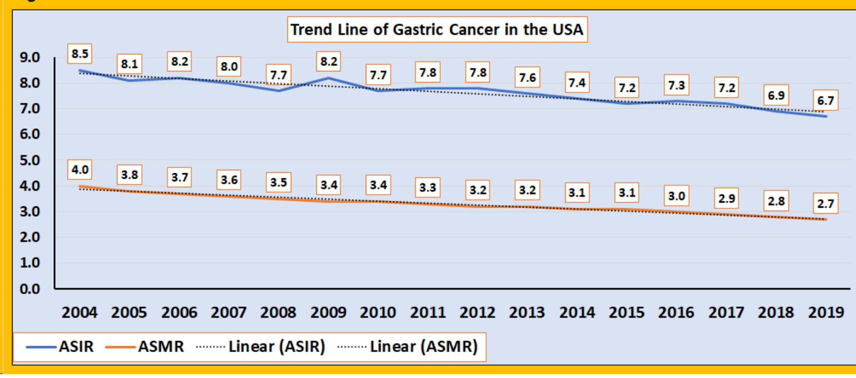
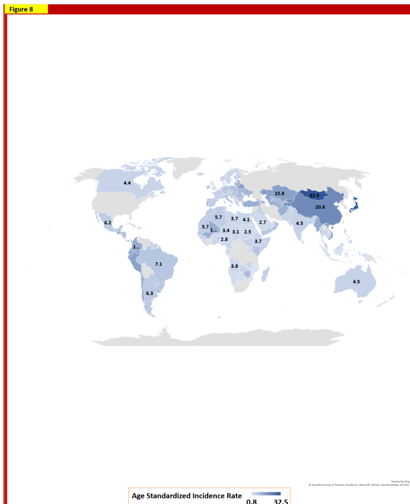
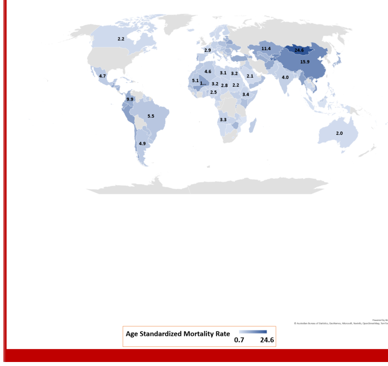


Figure 8



Country	ASIR	Country	ASIR	Country	ASIR	Country	ASIR
Mongolia	32.5	Zimbabwe	9.4	Austria	5.7	United States of America	4.2
Japan	31.6	ElSalvador	9.2	Cyprus	5.7	Egypt	4.1
Korea	27.9	Papua New Guinea	9.2	Guam	5.7	Trinidad and Tobago	4.0
Tajikistan	23.4	Albania	9.2	Morocco	5.7	Norway	4.0
China	20.6	FrenchGuiana	9.1	Algeria	5.7	UnitedKingdom	4.0
Kyrgyzstan	19.8	Panama	8.9	Mauritania	5.7	Cambodia	4.0
CaboVerde	18.4	North Macedonia	8.7	Czechia	5.5	Cameroon	3.9
Bhutan	17.7	Croatia	8.7	Burundi	5.3	Central African Republic	3.9
Iran	17.6	Slovenia	8.4	Bangladesh	5.2	Zambia	3.8
Kazakhstan	15.8	Georgia	8.4	Cuba	5.2	Timor-Leste	3.8
VietNam	15.5	Honduras	8.3	Qatar	5.2	Finland	3.8
Belarus	15.4	Rwanda	8.1	Luxembourg	5.2	Angola	3.8
Peru	15.2	Oman	8.0	TheNetherlands	5.2	Ethiopia	3.7
SaoTome and Principe	14.7	Uruguay	8.0	Gaza Strip and West Bank	5.2	Fiji	3.7
Korea	14.6	Dominican Republic	7.9	Suriname	5.2	Guyana	3.7
Myanmar	13.7	Bolivia	7.8	Israel	5.1	Iceland	3.7
Haiti	13.5	Hungary	7.8	Switzerland	5.1	Philippines	3.7
Russian Federation	13.5	Italy	7.8	Congo	5.1	Libya	3.7
Brunei Darussalam	13.5	Poland	7.8	Togo	5.0	Thailand	3.5
Chile	13.1	Bulgaria	7.6	Madagascar	4.9	South Africa	3.5
Lithuania	13.0	Kenya	7.6	Guinea-Bissau	4.9	Uganda	3.4
Colombia	12.9	French Polynesia	7.5	Iraq	4.9	Malawi	3.4
CostaRica	12.8	Ireland	7.3	SierraLeone	4.8	Niger	3.4
Samoa	12.8	Singapore	7.2	NewZealand	4.8	Sweden	3.3
Mali	12.8	Yemen	7.1	Belize	4.8	Tunisia	3.2
Azerbaijan	12.7	Brazil	7.1	Barbados	4.8	Eritrea	3.1
Turkey	12.6	Senegal	7.0	Bahrain	4.8	Chad	3.1
Ecuador	12.5	Benin	7.0	Somalia	4.7	The Republic of the Gambia	3.0
Afghanistan	12.4	Germany	7.0	France	4.7	Lebanon	3.0
Estonia	12.4	Paraguay	6.9	Liberia	4.7	Equatorial Guinea	3.0
Guatemala	12.2	Serbia	6.8	Côted'Ivoire	4.6	BurkinaFaso	2.9
Latvia	12.0	Venezuela	6.8	SyrianArabRepublic	4.6	Djibouti	2.9
Turkmenistan	11.8	Montenegro	6.7	Congo	4.5	Nigeria	2.8
Armenia	11.1	Mauritius	6.6	India	4.5	Vanuatu	2.7
Portugal	11.0	Argentina	6.3	Australia	4.5	SriLanka	2.7
Slovakia	10.8	Bahamas	6.2	SouthSudan	4.5	SaudiArabia	2.7
France	10.7	Nepal	6.2	Canada	4.4	Kuwait	2.7
Ukraine	10.5	Mexico	6.2	Denmark	4.4	PuertoRico	2.5
Nicaragua	10.4	Greece	6.1	UnitedArabEmirates	4.4	Sudan	2.5
Republic of Moldova	10.0	Malta	6.0	Malaysia	4.3	Gabon	2.5
Uzbekistan	9.8	Jordan	6.0	Tanzania	4.3	Namibia	2.4
France	9.8	Spain	5.8	Guinea	4.2	Solomon Islands	2.3
SaintLucia	9.4	Belgium	5.8	Pakistan	4.2	Botswana	1.8
Romania	9.4	Jamaica	5.8	Ghana	4.2	Lesotho	1.7
						Eswatini	1.6
						Indonesia	1.3

Figure 9



Country	ASMR	Country	ASMR	Country	ASMR	Country	ASMR
Mongolia	24.6	Albania	7.2	Madagascar	4.4	Malawi	3.1
Tajikistan	19.7	Rwanda	7.2	SierraLeone	4.4	Fiji	3.1
Bhutan	15.9	France,Martinique	7.0	Mauritius	4.4	Uganda	3.1
China	15.9	Oman	6.9	Guinea-Bissau	4.4	SouthAfrica	3.0
Kyrgyzstan	15.7	Honduras	6.9	Somalia	4.4	France	2.9
Iran	15.5	ElSalvador	6.8	Bahamas	4.3	Eritrea	2.9
CaboVerde	14.8	Kenya	6.6	Italy	4.3	Switzerland	2.9
VietNam	12.6	Bolivia	6.5	Gaza Strip and West Bank	4.3	Chad	2.8
Myanmar	12.0	Poland	6.5	Bahrain	4.2	Denmark	2.8
Korea	11.9	Croatia	6.4	Liberia	4.2	Gambia	2.8
Peru	11.8	Yemen	6.4	Greece	4.2	BurkinaFaso	2.7
Haiti	11.6	Bulgaria	6.3	Côted'Ivoire	4.1	Finland	2.7
Mali	11.6	Senegal	6.3	Iraq	4.1	Vanuatu	2.7
SaoTome and Principe	11.6	France, Guadeloupe	6.3	SouthSudan	4.1	Equatorial Guinea	2.7
Kazakhstan	11.4	SaintLucia	6.3	Spain	4.1	The Netherlands	2.7
Afghanistan	11.2	France, NewCaledonia	6.2	Guam	4.0	Tunisia	2.7
Lao People's Democratic	11.0	Benin	6.2	Suriname	4.0	Djibouti	2.6
Belarus	10.9	French Guiana	6.0	India	4.0	Lebanon	2.6
Azerbaijan	10.7	Singapore	6.0	Cuba	3.9	NewZealand	2.6
CostaRica	10.3	Montenegro	6.0	United Arab Emirates	3.9	Guyana	2.6
Samoa	10.3	Slovakia	6.0	Guinea	3.8	Thailand	2.6
Turkey	10.2	France, LaRéunion	5.9	Malta	3.8	Belgium	2.5
Guatemala	10.1	Dominican Republic	5.9	Israel	3.8	Nigeria	2.5
Armenia	10.1	Hungary	5.8	Germany	3.8	United Kingdom	2.4
Chile	10.0	Paraguay	5.8	Tanzania	3.8	Norway	2.4
Ecuador	10.0	FrenchPolynesia	5.8	Pakistan	3.7	Kuwait	2.4
Colombia	9.9	Nepal	5.6	Syrian Arab Republic	3.7	Canada	2.2
Russian Federation	9.8	Venezuela	5.6	Ghana	3.7	Sudan	2.2
Turkmenistan	9.7	Brazil	5.5	Central African Republic	3.6	Gabon	2.2
Estonia	9.0	Serbia	5.5	Czechia	3.6	SaudiArabia	2.1
Latvia	9.0	Slovenia	5.4	Luxembourg	3.6	Sweden	2.1
Lithuania	9.0	Jordan	5.1	Cameroon	3.5	PuertoRico	2.1
Brunei Darussalam	8.6	Mauritania	5.1	Malaysia	3.5	Namibia	2.1
Bosnia and Herzegovina	8.3	Uruguay	5.1	Ethiopia	3.4	SriLanka	2.0
Republic of Moldova	8.3	Morocco	5.0	Zambia	3.4	Australia	2.0
Nicaragua	8.3	Cyprus	5.0	Cambodia	3.4	Iceland	1.9
Zimbabwe	8.3	Jamaica	5.0	Angola	3.3	United States of America	1.7
Japan	8.2	Argentina	4.9	Austria	3.3	SolomonIslands	1.6
Uzbekistan	7.9	Burundi	4.8	Barbados	3.3	Lesotho	1.5
Portugal	7.9	Mexico	4.7	Ireland	3.3	Botswana	1.5
Ukraine	7.8	Bangladesh	4.6	Timor-Leste	3.3	Eswatini	1.5
Papua New Guinea	7.5	Algeria	4.6	Egypt	3.2	Comoros	1.2
Panama	7.4	Congo	4.6	Trinidad and Tobago	3.2	Indonesia	1.1
Georgia	7.4	Togo	4.5	Niger	3.2	Mozambique	0.7
Romania	7.4	Belize	4.5	Philippines	3.2		
North Macedonia	7.3	Qatar	4.5	Libya	3.1		