

Trend in incidence and mortality of cancer, a high -risk area in Gansu province: Analysis of the 2010 to 2018 in Gansu Central Cancer Registry

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Abstract

Background: The incidence and mortality of cancer in Gansu Province remain high, especially the digestive system tumors have long been in the top 5, and there is a rising trend. This paper uses the cancer registration data in Gansu Province from 2010 to 2018 to analyze the trend of trend changes, and provides information for the government basis for decision-making.

Methods: The registration data of cancer incidence, death and population data reported by 23 cancer registration sites in Gansu Province in 2021 were collected, and the data of 15 registration sites met the quality control standards. The incidence (mortality) rate, age-standardized incidence(mortality) rate, cumulative rate(0~74 years old) were calculated according to gender, areas(urban and rural) and age groups. The age-standardized rate was calculated and adjusted by Chinese standard population in 2000(ASIRC, ASMRC) and world standard(Segi's) population(ASIRW, ASMRW), respectively. Joinpoint Regression Program was used to estimate the annual percentage change(APC) and average annual percentage change(AAPC) to analyze the temporal trends of annual all cancer incidence and mortality rates.

Results: In 2018, the number of new cancer cases in Gansu was 13 592, with an incidence rate of 252.98/10⁵, ASIRC and ASIRW were 189.79/10⁵ and 205.89/10⁵ respectively; there were 7,568 cancer deaths in the province, with a mortality rate of 140.86/10⁵, ASMRC and ASMRW were 103.40/10⁵ and 116.83/10⁵ respectively. The ASIRC and ASMRC in urban areas were lower than those in rural areas. The incidence of cancer in males and females peaked in the 80-84 and 75-79 age groups, respectively, and the mortality rates of cancer in both males and females peaked in the 80-84 age groups. From 2010 to 2018, the ASIRC of cancer in the cancer registration areas of Gansu Province showed a downward trend (AAPC, -1.7%, 95%CI, -4.4%-10%), and the difference was not statistically significant ($P>0.05$). ASMRC showed a downward trend (AAPC, -3.9%, 95%CI,-10.0%-2.7%), the difference was not statistically significant ($P>0.05$).

Conclusions: Digestive tract cancer, lung cancer and female breast cancer have high morbidity and mortality in Gansu Province, and are the main cancer types for the prevention and control of cancer in Gansu Province. According to the epidemic characteristics of cancer, multi-dimensional joint efforts should be made to promote the prevention of cancer populations in our province and reduce the disease burden of cancer in Gansu Province.

Background

Cancer are one of the major diseases that endanger human health [1]. The International Agency for Research on Cancer (IARC) released the latest data on the global cancer burden. In 2020, there were 19.29 million new cancer cases worldwide. In 2020, there were 4.57 million new cancer cases and 3 million deaths in China [2]. In the past ten years, the annual increase in the incidence and mortality of cancer in my country has reached 3.9% and 2.5%, and the prevention and control situation is very serious [3]. Governments around the world are actively carrying out cancer prevention and control work, and knowing the incidence and mortality of cancer in the population is the premise and basis for the government to formulate cancer prevention and control measures for the population. In 2021, Gansu Province has established 14 cancer registries, covering 86 counties and districts in the province, covering a population of 25.02 million, and the data quality has been continuously improved, and the data representation has gradually increased. This study used the morbidity and mortality data collected in 2021 in the registration areas of cancer in Gansu Province in 2018 to analyze the latest epidemic situation of cancer in Gansu Province, and provide an important basis for the prevention and treatment of cancer in Gansu Province.

Methods

Data sources

In 2021, 23 cancer registration sites in Gansu Province reported the 2018 cancer registration data, and the data of 15 registration sites met the quality control standards. There are 4 urban cancer registration sites, namely Pingchuan District of Baiyin City, Baiyin District of Baiyin City, Zhangye Ganzhou District, Wuwei Liangzhou District, and 11 rural cancer registration sites, namely Dunhuang City, Lintan County, Qingcheng County, Jingcheng County Ning County, Tianzhu Tibetan Autonomous County, Huining County, Jingyuan County, Jingtai County, Gaotai County, Minqin County, Gulang County. The registered area covers a population of 5,372,850 people, accounting for about 21.47% of the total population in the same period, including 2,752,177 males and 2,620,673 females. Population data were obtained from the data on the total number of residents, gender and age group composition collected annually by local public security departments and statistical departments.

Quality control

Gansu Cancer Registry Center is based on the "Guidebook for Cancer Registration in China" [4], and refers to "Cancer Incidence in Five Continents Volume IX" [5] and the International Center for Research on Cancer (IARC)/The relevant requirements of the International Association for Cancer Registries (IACR) on registration quality [6, 7] Use database software MSFoxPro, MS-Excel, SAS 9.4 and IARC/IACR's IARC crgTools software [8] to review and evaluate the data. The reliability, completeness and validity of the data in 2018 were evaluated according to the main indicators such as the proportion of pathological diagnoses (MV%), the proportion of only death certificates (DCO%), and the death/morbidity ratio (M/I). The MV%, DCO%, and M/I of the aggregated cancer registry regions included in the analysis were 60.31%, 2.13%, and 0.56, respectively (Table 1).

Table 1
Main quality indices of cancer registries in Gansu Province, 2018

Area	Sex	M/I ^a	MV% ^b	DCO% ^c
All areas	Both	0.56	60.31	2.13
	Male	0.62	60.73	2.50
	Female	0.47	59.78	1.65
Urban areas	Both	0.54	63.72	1.53
	Male	0.57	64.36	1.73
	Female	0.49	62.83	1.26
Rural areas	Both	0.57	57.57	2.62
	Male	0.67	57.62	3.17
	Female	0.45	57.51	1.95

^aM/I: mortality to incidence ratio; ^bMV%: is morphological verified; ^cDCO%: death certificate-only

Statistical analysis

The data of each cancer registration site that met the quality control standards of cancer registration were merged and analyzed, and the incidence (mortality) rate, Chinese population standardized rate (ASIRC, ASMRC), and world population standardized rate (ASIRW, ASMRW), cumulative incidence (mortality) rate (0–74 years old) and the top 10 cancer incidence(mortality) ranking, the urban-rural division standard is consistent with the National Cancer Center, with cities above prefecture level as urban areas and a county or county-level city is a rural area. The Chinese standard population in 2000 and Segi's world population were applied to determine age-standardized incidence and mortality rates. SAS software (Version 9.4, SAS Institute Inc., Cary, USA) and Joinpoint Regression Program were applied for statistical analysis.

Results

Incidence for all cancer

In 2018, there were 13 592 new cases of cancer in the cancer registration areas of Gansu Province (7 667 in males and 5 925 in females), and 6 069 new cases in urban areas, accounting for 44.65% of the new cases in the whole province, there were 7 523 cases in rural areas, accounting for 55.35% of the new cases in the province. The incidence rate was 252.98/10⁵ (278.58/10⁵ in males, 226.09/10⁵ in females), ASIRC and ASIRW were 189.79/10⁵ and 205.89/10⁵, respectively, and the cumulative rate (0–74 years old) was 22.65%. The incidence rate in urban areas was 266.71/10⁵ (320.86/10⁵ in males, 228.63/10⁵ in females), ASIRC and ASIRW were 179.43/10⁵, and 195.80/10⁵, respectively, and the cumulative rate (0–74 years old) was 22.09%. The incidence rate in rural areas was 242.89/10⁵ (260.70/10⁵ in males, 224.22/10⁵ in females), ASIRC and ASIRW were 200.59/10⁵ and 216.63/10⁵, respectively, and the cumulative rate (0–74 years old) was 23.27% (Table 2).

Table 2
Incidence rates for all cancer sites in the registration areas of Gansu, 2018

Area	Sex	No cases	Incidence rate (1/10 ⁵)	ASIRC ^a (1/10 ⁵)	ASIRW ^b (1/10 ⁵)	Cumulative rate 0~74(%)
All areas	Both	13592	252.98	189.79	205.89	22.65
	Male	7667	278.58	211.12	233.27	26.31
	Female	5925	226.09	169.22	179.40	19.01
Urban areas	Both	6069	266.71	179.43	195.80	22.09
	Male	3535	302.86	205.51	227.63	26.31
	Female	2534	228.63	154.02	164.64	17.93
Rural areas	Both	7523	242.89	200.59	216.63	23.27
	Male	4132	260.70	217.50	240.04	26.40
	Female	3391	224.22	185.18	195.04	20.18

^aASIRC: age-standardized incidence rate by Chinese standard population in 2000, ^bASIRW: age-standardized incidence rate by world standard(Segi' s) population.

Age-specific incidence of cancer

The incidence of cancer gradually increased with age, reached a peak in the age group of 80–84 years old, and then declined. The age-specific incidence rate of males in the age group of 50 years and above was higher than that of females, males and females have the most new cancer cases in the 65–69 and 50–54 years old, respectively. The trend of age-specific incidence rates in urban and rural areas is basically similar, before the age of 30, the incidence of cancer in both urban and rural areas is relatively low. The incidence of cancer in both males and females in urban areas peaks in the age group of 75–79 years old; in rural areas, Both males and females peaked in the 80–84 years old(Fig. 1).

Incidence of major cancer

In 2018, stomach cancer had the highest incidence in both urban and rural areas in Gansu Province, with 3133 new cases and a crude incidence rate of $58.31/10^5$, accounting for 23.05% of all new cancer, followed by breast cancer, lung cancer, liver cancer, colon-rectum cancer, the top 5 accounted for 59.65% of all cancer; the highest incidence rate in men was still stomach cancer, with a crude incidence rate of $84.19/10^5$, accounting for 30.22% of all cancer in men, followed by Lung cancer, liver cancer, esophagus cancer, and colon-rectum cancer were followed in order; breast cancer had the highest incidence in women, with a crude incidence rate of $32.05/10^5$, accounting for 14.13% of all female cancer, followed by stomach cancer, lung cancer, and cervical cancer. and colon-rectum cancer. Both urban and rural cancer registration areas had the highest crude incidence of stomach cancer, with crude incidence rates of $67.46/10^5$ and $51.59/10^5$, accounting for 25.29% and 21.24% of all cancer in urban and rural areas, respectively (Fig. 2).

Analysis by age group and gender showed that both men and women had the highest incidence in the 80 + age group, 1501.43/100,000 in males and 746.86/100,000 in females. Leukemia has the highest incidence in men and women aged 0–14, liver cancer has the highest incidence in men aged 15–44, stomach cancer is the most common cancer in men aged 45 and over; breast cancer is the most common cancer in women 15–59 age groups and have the highest incidence rates, with stomach cancer being the most common cancer in women 60 years of age and older(Table 3).

Table 3
Estimated cancer incidence of all cancer and five leading cancer types by age and sex in Gansu, 2018

Sex	0 ~ 14 sites	Incidence (1/10 ⁵)	15 ~ 44 sites	Incidence (1/10 ⁵)	45 ~ 59 sites	Incidence (1/10 ⁵)	60 ~ 79 sites	Incidence (1/10 ⁵)	80+ sites	Incidence (1/10 ⁵)
Male										
	All sites	11.21	All sites	32.83	All sites	350.93	All sites	1287.23	All sites	1501.43
	Leukemia	3.45	Liver	5.64	Stomach	107.95	Stomach	417.11	Stomach	380.52
	Brain	1.51	Stomach	4.25	Liver	59.59	Lung	192.45	Lung	309.73
	Bone	0.86	Brain	3.63	Lung	44.90	Esophagus	163.62	Esophagus	182.89
	Stomach	0.65	Colon-rectum	3.01	Colon-rectum	33.67	Liver	129.15	Colon-rectum	123.89
	Liver	0.65	Leukemia	2.63	Esophagus	17.33	Colon-rectum	103.71	Prostate	97.34
Female										
	All sites	9.59	All sites	59.61	All sites	376.13	All sites	746.55	All sites	746.86
	Leukemia	2.02	Breast	14.34	Breast	75.36	Stomach	135.53	Stomach	148.81
	Brain	1.77	Cervix	9.83	Cervix	46.97	Lung	96.45	Lung	109.50
	Stomach	1.01	Stomach	4.67	Stomach	37.68	Colon-rectum	73.67	Colon-rectum	81.42
	Liver	0.50	Ovary	2.98	Uterus	34.64	Liver	64.39	Esophagus	70.19
	Lung	0.50	Thyroid	2.98	Lung	29.06	Breast	52.58	Liver	58.96

Regional distribution of cancer incidence

In 2018, the ASIRC in Jingning County, a cancer registration area in Gansu Province, was the highest at $248.97/10^5$, followed by Lintan County ($245.81/10^5$), Gulang County ($217.75/10^5$), Pingchuan District of Baiyin City ($215.65/10^5$), Jingtai County ($213.70/10^5$), Dunhuang City ($211.74/10^5$), Gaotai County ($204.98/10^5$), Minqin County ($204.22/10^5$), Zhangye Gan State District ($201.10/10^5$), Qingcheng County ($194.28/10^5$), Wuwei Liangzhou District ($190.83/10^5$), Huining County ($182.87/10^5$), Jingyuan County ($177.03/10^5$), Tian Zhu County ($175.02/10^5$) and Baiyin District ($126.25/10^5$) in Baiyin City(Table 4).

Table 4
The cancer incidence in different areas of Gansu cancer registries, 2018

Areas	Both				Male				Female			
	No cases	Incidence (1/10 ⁵)	ASIRC ^a (1/10 ⁵)	Cumulative rate 0~74(%)	No cases	Incidence (1/10 ⁵)	ASIRC ^a (1/10 ⁵)	Cumulative rate 0~74(%)	No cases	Incidence (1/10 ⁵)	ASIRC ^a (1/10 ⁵)	Cumulative rate 0~74(%)
Jingning county	1477	305.11	248.97	28.90	852	343.42	279.89	34.55	625	264.84	219.87	23.10
Mimqin county	730	300.54	204.22	24.94	395	318.28	211.98	26.80	335	282.01	198.17	22.91
Pingchuan District	629	297.99	215.65	23.71	334	305.23	219.34	25.29	295	290.21	214.91	22.24
Liangzhou District	3034	280.58	190.83	24.21	1847	332.19	234.08	31.17	1187	225.96	151.23	17.82
Gaotai county	403	273.96	204.98	24.69	266	358.07	266.69	31.86	137	188.16	144.20	16.87
Dunhuang county	348	240.47	211.74	24.10	183	244.92	217.33	26.87	165	235.71	207.66	21.49
Ganzhou District	1249	240.27	201.10	24.23	705	267.32	220.01	27.00	544	212.41	182.45	21.44
Baiyin District	754	238.45	126.25	14.11	383	233.89	113.56	13.13	371	243.35	139.66	15.17
Jingtai county	569	237.46	213.70	23.70	310	253.41	236.54	27.57	259	220.83	192.11	19.87
Gulang county	895	230.15	217.75	26.42	508	256.35	250.81	31.60	387	202.92	186.55	21.37
Tianzhu county	410	228.92	175.02	22.80	233	251.72	193.09	26.21	177	204.54	155.77	19.16
Qingcheng county	608	228.64	194.28	20.60	276	201.90	173.80	18.37	332	256.92	216.99	23.07
Huining County	1237	224.58	182.87	20.46	724	258.22	206.77	23.68	513	189.70	159.75	17.11
Lintan county	315	224.24	245.81	26.69	183	253.74	282.67	34.77	132	193.12	218.28	19.96
jingyuan county	934	202.69	177.03	19.63	468	198.48	179.57	20.83	466	207.09	175.79	18.50

^aASIRC: age-standardized incidence rate by Chinese standard population in 2000

Mortality for all cancer

In 2018, there were 7 568 cancer deaths (4 790 in males, 2 778 in females) in the cancer registration areas of Gansu Province, including 3 265 deaths in urban areas, accounting for 43.14% of all cancer deaths, and 4 303 cases in rural areas, accounting for all 56.86% of cancer deaths. The mortality rate of cancer was 140.86/10⁵ (174.04/10⁵ in males, 106.00/10⁵ in females), ASMRC and ASMRW were 103.40/10⁵ and 116.83/10⁵, respectively, and the cumulative rate (0–74 years old) was 12.33%. The mortality rate in urban areas was 143.48/10⁵ (173.32/10⁵ in males, 112.06/10⁵ in females), ASMRC and ASMRW were 94.91/10⁵ and 107.07/10⁵, respectively, and the cumulative rate (0–74 years old) was 11.60%. The mortality rate in rural areas was 138.93/10⁵ (174.58/10⁵ in males, 101.56/10⁵ in females), ASMRC and ASMRW were 112.31/10⁵ and 127.17/10⁵, respectively, and the cumulative rate (0–74 years old) was 13.05%(Table 5).

Table 5
Mortality rate for all cancer sites in the registration areas of Gansu, 2018

Area	Sex	Deaths	Mortality (1/10 ⁵)	ASMRC ^a (1/10 ⁵)	ASMRW ^b (1/10 ⁵)	Cumulative rate 0~74(%)
All areas	Both	7568	140.86	103.40	116.83	12.33
	Male	4790	174.04	130.94	148.25	15.84
	Female	2778	106.00	76.05	85.71	8.81
Urban areas	Both	3265	143.48	94.91	107.07	11.60
	Male	2023	173.32	117.40	132.63	14.56
	Female	1242	112.06	72.57	81.71	8.66
Rural areas	Both	4303	138.93	112.31	127.17	13.05
	Male	2767	174.58	145.06	164.83	17.06
	Female	1536	101.56	80.12	90.39	9.01

^aASMRC: age-standardized mortality rate by Chinese standard population in 2000; ^bASMRW: age-standardized mortality rate by world standard(Segi's population)

Age-specific mortality of cancer

The trend of age-specific mortality is similar to that of incidence, and it gradually increases with age, and reaches a peak in the 80-84 years old, except for the 15-29 year old, the age-specific mortality rate of males is lower than that of females, and the age-specific mortality rate of males in other age groups is higher than that of women., males and females had the highest number of cancer deaths in the 65-69 and 70-74 year old, respectively. The trend of age-specific mortality in urban and rural areas is basically similar, before the age of 40, the mortality rate of cancer in urban and rural areas is relatively low, the mortality rate of cancer in both males and females in urban areas peaks in the age group of 75-79 years old; the mortality rate of males and females malignancy peaked in the age group of 80-84 years(Fig. 3).

Mortality of major cancer

In 2018, stomach cancer had the highest mortality rate in both urban and rural areas in the cancer registration areas of Gansu Province, with 1,996 deaths and a mortality rate of 37.15/10⁵, accounting for 26.37% of all cancer deaths, followed by lung cancer, liver cancer, and esophagus Cancer and colon-rectum cancer, the top five accounted for 73.30% of all cancer deaths; the highest mortality rate in males was stomach cancer, with a mortality rate of 53.63/10⁵, accounting for 30.81% of all cancer deaths in men, followed by lung cancer, liver cancer, esophagus cancer and colon-rectum cancer; the highest mortality rate for females is stomach cancer, with a crude incidence rate of 19.84/10⁵, accounting for 18.72% of all cancer deaths in women, followed by lung cancer, liver cancer, colon-rectum cancer, and breast cancer. The mortality rate of stomach cancer was the highest in both urban and rural cancer registration areas, with mortality rates of 39.59/10⁵ and 35.35/10⁵, accounting for 27.60% and 25.45% of all cancer in urban and rural areas, respectively (Fig. 2).

Analysis by age group and gender showed that both males and females had the highest mortality rate in the 80+ age group, 1448.33/10⁵ in males and 873.20/10⁵ in females. The mortality rate of liver cancer is the highest in the male age group of 0-44, and stomach cancer is the cancer with the highest mortality rate in the male age group of 45 years and above; the mortality rate of leukemia is the highest in the female age group of 0-14, and the mortality rate of breast cancer is the highest in the age group of 15-44, the 45-59 age group has the highest mortality rate from lung cancer, and stomach cancer is the cancer with the highest mortality rate among women aged 60 and over(Table 6).

Table 6
Estimated cancer mortality of all cancer and five leading cancer types by age and sex in Gansu, 2018

Sex	0 ~ 14 sites	Mortality (1/10 ⁵)	15 ~ 44 sites	Mortality (1/10 ⁵)	45 ~ 59 sites	Mortality (1/10 ⁵)	60 ~ 79 sites	Mortality (1/10 ⁵)	80+ sites	Mortality (1/10 ⁵)
Male										
	All sites	4.53	All sites	12.90	All sites	174.97	All sites	862.20	All sites	1448.33
	Liver	1.94	Liver	2.78	Stomach	49.85	Stomach	293.62	Stomach	318.57
	Stomach	0.43	Stomach	2.09	Liver	42.92	Lung	159.67	Lung	309.73
	Lung	0.22	Lung	1.93	Lung	30.21	Liver	114.73	Esophagus	203.53
	Brain	0.22	Brain	1.78	Esophagus	8.42	Esophagus	93.82	Liver	162.24
	Leukemia	0.22	Leukemia	0.93	Brain	7.10	Colon-rectum	47.48	Colon-rectum	135.69
Female										
	All sites	2.27	All sites	11.36	All sites	109.49	All sites	469.30	All sites	873.20
	Leukemia	0.76	Breast	1.69	Lung	16.05	Stomach	100.10	Stomach	199.35
	Brain	0.50	Leukemia	1.29	Liver	14.19	Lung	86.04	Lung	154.42
	Lung	0.25	Lung	1.21	Stomach	13.35	Liver	67.48	Liver	101.08
	Kidney	0.25	Brain	1.21	Breast	10.48	Colon-rectum	34.87	Esophagus	87.04
	Bladder	0.25	Stomach	1.13	Cervix	9.97	Esophagus	32.06	Colon-rectum	78.62

Regional distribution of cancer mortality

In 2018, the ASMR in Lintan county, a cancer registration area in Gansu Province, was the highest at 248.97/10⁵, followed by Gulang County (151.19/10⁵), Jingtai County (151.17/10⁵), Zhangye Ganzhou District (138.14/10⁵), Jingning County (132.66/10⁵), Dunhuang City (130.68/10⁵), Tianzhu County (115.60/10⁵), Wuwei Liangzhou District (100.30/10⁵), Huining County (100.00/10⁵), Gaotai County (98.98/10⁵), Pingchuan District, Baiyin City (97.95/10⁵), Jingyuan County (93.06/10⁵), Minqin County (90.46/10⁵), Qingcheng County (82.98/10⁵), Baiyin District of Baiyin City (45.91/10⁵) (Table 7).

Table 7
The cancer mortality in different areas of Gansu cancer registries, 2018

Areas	Both				Male				Female			
	Deaths	Mortality (1/10 ⁵)	ASMRC ^a (1/10 ⁵)	Cumulative rate 0~74(%)	Deaths	Mortality (1/10 ⁵)	ASMRC ^a (1/10 ⁵)	Cumulative rate 0~74(%)	Deaths	Mortality (1/10 ⁵)	ASMRC ^a (1/10 ⁵)	
Jingning county	817	168.77	132.66	16.41	549	221.29	178.89	22.35	268	113.56	86.60	
Ganzhou District	841	161.78	138.14	16.62	518	196.41	166.05	19.90	323	126.12	109.33	
Jingtai county	378	157.75	151.17	14.91	242	197.82	195.01	20.04	136	115.96	109.41	
Gulang county	602	154.80	151.19	18.21	388	195.80	197.16	23.85	214	112.21	105.33	
Tianzhu county	271	151.31	115.60	13.89	176	190.14	145.36	17.02	95	109.78	83.83	
Lintan county	212	150.92	163.49	18.12	132	183.03	211.94	24.36	80	117.04	125.12	
Liangzhou District	1606	148.52	100.30	12.22	1000	179.85	127.64	16.26	606	115.36	74.94	
Mimqin county	343	141.21	90.46	10.59	214	172.44	114.59	12.71	129	108.59	67.88	
Pingchuan District	292	138.34	97.95	10.96	181	165.41	117.89	12.56	111	109.20	77.82	
Dunhuang county	196	135.43	130.68	13.37	130	173.99	169.01	18.89	66	94.29	90.80	
Gaotai county	197	133.92	98.98	12.17	129	173.65	132.44	15.04	68	93.39	66.76	
Huining County	703	127.63	100.00	11.06	454	161.92	127.90	14.58	249	92.08	71.72	
jingyuan county	514	111.54	93.06	10.82	316	134.02	116.12	13.85	198	87.99	71.36	
Baiyin District	329	104.05	45.91	4.98	195	119.08	52.73	5.87	134	87.89	38.20	
Qingcheng county	267	100.40	82.98	8.46	166	121.43	101.69	10.38	101	78.16	64.62	

^aASMRC: age-standardized mortality rate by Chinese standard population in 2000

Trend of cancer incidence

From 2010 to 2018, the incidence of cancer in the cancer registration areas of Gansu Province showed a downward trend (AAPC, -1.7%, 95%CI, -4.4%~10%), and the difference was not statistically significant ($P > 0.05$). According to the statistics of urban and rural areas, ASIRC in urban areas showed a downward trend (AAPC, -2.7%, 95%CI, -5.0% - -0.4%), and the difference was statistically significant ($P < 0.05$); ASIRC in rural areas showed an upward trend. (AAPC, 0.6%, 95%CI, -6.2%~7.9%), and the difference was not statistically significant ($P > 0.05$). According to gender statistics, ASIRC for males showed a downward trend (AAPC, -2.4%, 95% CI: -5.5%~0.8%); ASIRC for women showed an upward trend (AAPC, 0.1%, 95%CI: -3.1%~3.5%), and the difference was not statistically significant ($P > 0.05$)(Table 8, Fig. 4).

Table 8
Temporal trend of incidence of Cancer in Cancer registration Areas in Gansu Province, 2010–2018

Areas	Sex	Year	Annual percentage change			Average annual percent change		
			APC ^a (95%CI)	<i>t</i>	<i>P</i>	AAPC ^b (95%CI)	<i>t</i>	<i>P</i>
All areas	Both	2010–2015	2.9(-1.5 ~ 7.4)	1.8	0.1	-1.7(-4.4-10)	-1.2	0.2
		2015–2018	-9.0(-15.7~-1.7)	-3.4	< 0.05			
	Male	2010–2015	3.9(-1.2 ~ 9.1)	2.1	0.1	-2.4(-5.5 ~ 0.8)	-1.5	0.1
		2015–2018	-12.0(-19.5~-3.7)	-3.9	< 0.05			
	Female	2010–2012	9.2(-8.0 ~ 29.7)	1.4	0.2	0.1(-3.1 ~ 3.5)	0.1	0.9
		2012–2018	-2.7(-4.9~-0.5)	-3.4	< 0.05			
Urban areas	Both	2010–2016	1.5(-0.6 ~ 3.8)	2.0	0.1	-2.7(-5.0~-0.4)	-2.3	< 0.05
		2016–2018	-14.4(-23.8~-3.8)	-3.7	< 0.05			
	Male	2010–2016	2.5(0.7-4.3)	3.8	< 0.05	-3.2(-5.1~-1.3)	-3.2	< 0.05
		2016–2018	-18.4(-26.0~-10.0)	-5.8	< 0.05			
	Female	2010–2016	0.5(-3.5 ~ 4.7)	0.4	0.7	-1.9(-6.0 ~ 2.5)	-0.9	0.4
		2016–2018	-8.8(-26.3 ~ 12.9)	-1.2	0.3			
Rural areas	Both	2010–2012	21.9(-16.3 ~ 77.5)	1.5	0.2	0.6(-6.2 ~ 7.9)	0.2	0.9
		2012–2018	-5.6(-9.6~-1.5)	-3.8	< 0.05			
	Male	2010–2012	20.2(-24.6 ~ 91.8)	1.1	0.3	-0.4(-8.8 ~ 8.6)	-0.1	0.9
		2012–2018	-6.5(-11.4~-1.3)	-3.4	< 0.05			
	Female	2010–2012	23.8(-10.0 ~ 70.3)	1.9	0.1	1.8(-4.1 ~ 8.0)	0.6	0.6
		2012–2018	-4.7(-8.0~-1.2)	-3.7	< 0.05			

^aAPC: annual percentage change; ^bAAPC: average annual percentage change

Trend of cancer mortality

From 2010 to 2018, the mortality rate of cancer in the cancer registration areas of Gansu Province showed a downward trend(AAPC, -3.9%, 95%CI: -10.0%~2.7%), and the difference was not statistically significant ($P > 0.05$). In terms of urban and rural statistics, ASMRC in both urban and rural areas showed a downward trend (AAPC, -4.8%, 95%CI: -13.4%~4.8%; AAPC, -2.3%, 95%CI: -8.8%~4.6%), and the difference was no statistical significance ($P > 0.05$). According to gender statistics, ASMRC in both males and females showed a downward trend (AAPC,-3.8%, 95%CI: -8.3%~0.9%; AAPC, -3.8%, 95%CI: -12.7%~6.1%), and the difference was not statistically significant ($P > 0.05$)(Table 9, Fig. 5).

Table 9
Temporal trend of mortality of Cancer in Cancer registration Areas in Gansu Province, 2010–2018

Areas	Sex	Year	Annual percentage change			Average annual percent change		
			APC ^a (95%CI)	t	p	AAPC ^b (95%CI)	t	p
All areas	Both	2010–2016	2.1(-4.4 ~ 9.1)	0.9	0.4	-3.9(-10.0 ~ 2.7)	-1.2	0.2
		2016–2018	-19.8(-41.5 ~ 9.9)	-1.9	0.1			
	Male	2010–2016	2.5(-2.3 ~ 7.5)	1.5	0.2	-3.8(-8.3 ~ 0.9)	-1.6	0.1
		2016–2018	-20.4(-36.8 ~ 0.1)	-2.8	0.1			
	Female	2010–2016	1.8(-7.8 ~ 12.3)	0.5	0.6	-3.8(-12.7 ~ 6.1)	-0.8	0.4
		2016–2018	-18.6(-48.9 ~ 29.6)	-1.2	0.3			
Urban areas	Both	2010–2016	2.1(-6.4 ~ 11.4)	0.7	0.5	-4.8(-13.4 ~ 4.8)	-1.0	0.3
		2016–2018	-22.7(-51.9 ~ 24.0)	-1.5	0.2			
	Male	2010–2016	2.9(-3.4 ~ 9.5)	1.3	0.3	-4.6(-11.1 ~ 2.2)	-1.3	0.2
		2016–2018	-24.1(-46.3 ~ 7.4)	-2.2	0.1			
	Female	2010–2016	1.3(-10.7 ~ 15.0)	0.3	0.8	-4.5(-16.7 ~ 9.4)	-0.7	0.5
		2016–2018	-20.2(-59.2 ~ 56.3)	-0.9	0.4			
Rural areas	Both	2010–2016	2.1(-5.0 ~ 9.8)	0.8	0.5	-2.3(-8.8 ~ 4.6)	-0.7	0.5
		2016–2018	-14.6(-37.9 ~ 17.5)	-1.4	0.2			
	Male	2010–2016	1.4(-4.1 ~ 7.2)	0.7	0.5	-2.4(-7.2 ~ 2.7)	-0.9	0.4
		2016–2018	-12.9(-31.3 ~ 10.4)	-1.6	0.2			
	Female	2010–2012	27.4(-25.2 ~ 117.1)	1.3	0.3	0.4(-9.1 ~ 10.9)	0.1	0.9
		2012–2018	-7.3(-12.7 ~ -1.5)	-3.5	< 0.05			

^aAPC: annual percentage change; ^bAAPC: average annual percentage change

Incidence and mortality trends in selected cancer

From 2010 to 2018, the age-standardized incidence rates of stomach cancer, lung cancer, liver cancer, esophagus cancer and colon-rectum cancer among males in Gansu Province remained stable on the whole, and the mortality rate fluctuated relatively greatly, Stomach cancer ranks first in both incidence and death, and prostate cancer is on the rise; The age-standardized incidence and mortality of various cancer types in women fluctuated greatly, the incidence of stomach cancer and esophagus cancer showed a downward trend, and the mortality of thyroid cancer showed a downward trend (Fig. 6).

Discussion

In 2018, the incidence rate of cancer in Gansu Province was 252.98/10⁵ (278.58/10⁵ in males, 226.09/10⁵ in females), and the mortality rate was 140.86/10⁵(174.04/10⁵ in males and 106.00/10⁵ in females), the incidence rate of males is 1.23 times that of females, and the mortality rate is 1.64 times. The incidence of tumors in urban areas was 266.71/10⁵, and the mortality rate was 143.48/10⁵; in rural areas, the incidence rate was 242.89/10⁵, and the mortality rate was 138.93/10⁵, the urban morbidity rate is 1.10 times that of rural areas, and the mortality rate is 1.03 times that of rural areas. In 2020, there were 19.29 million new cancer cases worldwide [1], the incidence rate was 247.5/10⁵, the ASIRW was 201.0/10⁵, the number of deaths was 9.96 million, the mortality rate was 127.8/10⁵, and the ASMRW was 100.7/10⁵; There were 4.57 million new cancer cases in China, the incidence rate was 315.6/10⁵, the ASIRW was 204.8/10⁵, accounting for 23.7% of the global new cancer cases, the number of deaths was 3 million, and the mortality rate was 207.5/10⁵, ASMRW was 129.4/10⁵, accounting for 30.2% of global cancer deaths. In 2018, Gansu ASIRW (205.89/10⁵) was higher than the world and the whole country, ASMRW (116.83/10⁵) was higher than the world, lower than Nationally, it suggests that the cancer burden in Gansu Province is relatively heavy. The incidence, mortality, ASIRC and ASMRC of cancer in Gansu Province in 2018 were lower than those in 2017 [9] (the incidence rate was 295.63/10⁵, the mortality rate was 154.62/10⁵, the ASIRC was 208.71/10⁵, and the ASMRC was 106.75/10⁵). In 2018, the incidence of cancer in Gansu Province for males and females reached the peak in the age groups of 80–84 years and 75–79 years old respectively, and the most new cancer cases were in the age groups of 65–69 years old and 50–54 years old; The 80-84-year-old age group reached a peak, and the 65-69-year-old and 70-74-year-old age groups had the most cancer deaths, suggesting that the middle-aged and elderly people are high-risk groups for cancer in Gansu Province.

In 2018, the top five cancer in Gansu Province were stomach cancer, breast cancer, lung cancer, liver cancer, and colorectum cancer, accounting for 59.65% of all cancer incidences. The top five deaths were stomach cancer, lung cancer, liver cancer, esophagus cancer and colorectum cancer, accounting for 73.30% of all cancer deaths, and Gansu Province has always been a province with a high incidence of upper gastrointestinal cancer. In 2018, the incidence and mortality

of cancer in Gansu Province ranked first in stomach cancer. The incidence of stomach cancer accounted for 23.05% of all new cases of cancer, and the deaths from stomach cancer accounted for 26.37% of all deaths from cancer. Compared with the rate level [10] the incidence of stomach cancer in Gansu Province in 2018 ($58.31/10^5$) was 2.03 times the national average ($28.68/10^5$), and the mortality rate ($37.15/10^5$) was the national average ($20.87/10^5$) 1.78 times higher than the national average. Studies have shown that the risk factors for stomach cancer include *Helicobacter pylori* infection, smoking, high intake of pickled food and low intake of fresh vegetables and fruits [11]. Eradication of *Helicobacter pylori* infection can significantly reduce the incidence of stomach cancer, especially non-cardia stomach cancer occurrence and risk of death [12, 13]. Upper gastrointestinal endoscopy is the gold standard for the diagnosis of stomach cancer, and the use of gastroscopic screening can significantly reduce the risk of morbidity and mortality of invasive stomach cancer [14, 15]. Esophagus cancer ranks third in incidence and fourth in death, and colon-rectum cancer ranks fourth in incidence and fifth in death. The national survival data from 2012 to 2015 show [16] that colon-rectum cancer has a better prognosis, while esophagus cancer is relatively the 5-year standardized relative survival rates were 56.9% and 30.3%, respectively, and the former survival rate was nearly twice that of the latter. In 2017, both the incidence and death of lung cancer in the cancer registration areas of Gansu Province ranked second, indicating a high disease burden and a serious threat to the health of residents. Smoking is a major risk factor for the occurrence of lung cancer. At the same time, the occurrence of lung cancer is a complex process involving the interaction of environment and genes, and is closely related to air pollutants [17, 18]. According to data [19], about 14% of lung cancer deaths in the world are related to high levels of PM_{2.5}, while the proportion in China is much higher, with about 20.5% of lung cancer deaths related to it, suggesting that it should be actively control the risk factors of lung cancer and reduce the incidence and death of lung cancer. Since 2009, Gansu Province has started to use the central financial transfer to pay for the rural cancer early diagnosis and early treatment project to conduct free screening for high-risk groups aged 40 to 69 to reduce their morbidity and mortality. Although significant results have been achieved, the disease burden is still heavy. Still need further control.

Breast cancer ranks first in the incidence of female cancer in the cancer registration area of Gansu Province, accounting for 14.13% of all cancer in women. The incidence rate of female breast cancer in urban areas ($23.61/10^5$) is lower than that in rural areas ($26.39/10^5$). Cervical cancer ranks fourth in the incidence of female cancer in Gansu Province, accounting for 9.13% of all female cancer. The key to cancer prevention and treatment lies in early detection, early diagnosis and early treatment. Early detection and treatment can significantly improve the five-year survival rate and quality of life of patients. Relevant data show [20–22], the 5-year survival rate of female breast cancer in my country from 2013 to 2015 was 82.0%, which was significantly higher than that of 73.0% from 2003 to 2005, but there is a gap with developed countries such as the United States (93.8%). HPV infection is a necessary cause of cervical cancer. Previous studies have shown [23, 24] that the combination of human papilloma virus (HPV) vaccination and screening can effectively prevent cervical cancer, and it is speculated that China can achieve this in the early 2070s, the goal of eliminating cervical cancer. This study further found that the incidence of leukemia was the highest in both male and female age groups of 0–14, followed by cancer of the central nervous system, which was consistent with the results of domestic and foreign studies [25], suggesting that leukemia and cancer of the central nervous system should be combined. As a key cancer prevention and control for children in our province, targeted preventive measures have been taken. From the perspective of regional distribution, Gannan Tibetan Autonomous Prefecture (Lintan County) has higher morbidity and mortality, followed by Hexi region (Gaotai County, Ganzhou District of Zhangye City, Liangzhou District of Wuwei City, Gulang County, Tianzhu County, Minqin County, Guohuang City), Hedong Region (Pingchuan District, Qingcheng County, Huining County, Jingtai County, Jingning County, Jingyuan County, and Baiyin District of Baiyin City), are relatively low, it presents certain regional characteristics, suggesting that effective local prevention and control measures should be formulated based on the environmental characteristics of different regions.

This study further analyzed the temporal trends of the ASIRC and ASMRC in Gansu Province from 2010 to 2018. The results of the Joinpoint regression model analysis showed that the standardized incidence and mortality of cancer in Gansu Province decreased from 2010 to 2018, the AAPC were -1.7% and -3.9% , respectively, and the difference was not statistically significant ($P > 0.05$). This may be related to the fact that Gansu Province has successively launched rural cancer early diagnosis and treatment projects and urban cancer early diagnosis and treatment projects in the high-incidence areas of the province. According to urban and rural statistics, ASIRC in urban areas showed a downward trend, AAPC was -2.7% , and the difference was statistically significant ($P < 0.05$); ASIRC in rural areas showed an upward trend, AAPC was 0.6% , and the difference was not statistically significant ($P > 0.05$). The ASMRC in both urban and rural areas showed a downward trend, and the decline in urban areas was greater than that in rural areas, with AAPC of -4.8% and -2.3% , respectively, with no significant difference ($P > 0.05$), this may be related to the limited economic level in rural areas, the relative lack of medical resources, and the weak public health awareness.

Conclusions

The cancer burden in Gansu Province is still very heavy, digestive tract cancer, lung cancer and female breast cancer are still the most common cancer types in Gansu Province, and there are large differences between urban and rural areas, and the regional distribution is uneven, therefore, according to the actual situation and epidemic characteristics of cancer in our province, we should strengthen health education, continue to expand the coverage of screening and early diagnosis and early treatment of related cancer, and establish a grading and prevention system for major cancer in line with the conditions of our province, so as to promote cancer in our province. The overall prevention and control capability has been significantly improved, effectively reducing the disease burden caused by cancer, and actively promoting the realization of the goal of building a healthy Gansu.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Gansu Cancer Hospital (A202204080019). Because the research data was from cancer registry system, the privacy of any personal information has not been involved, and the need for providing consent to participate has been waived by Gansu Provincial Cancer Hospital, Gansu.

Consent for publication

Not applicable.

Availability of Data and Material (ADM)

The datasets generated and/or analysed during the current study are not publicly available owing to the grounds of the ethical approval, but are available from the corresponding author on reasonable request. Most of the data supporting the conclusions has been revealed in the tables of this manuscript.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

LYQ, YHR and ZYT conceived and designed the study. LYQ and DGH were involved in data acquisition. YHR and DGH conducted the statistical analysis, interpreted the results of data and drafted the manuscript. ZGJ and GZNNYZ participated in revising the manuscript. All authors read and approved the final manuscript.

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Figures

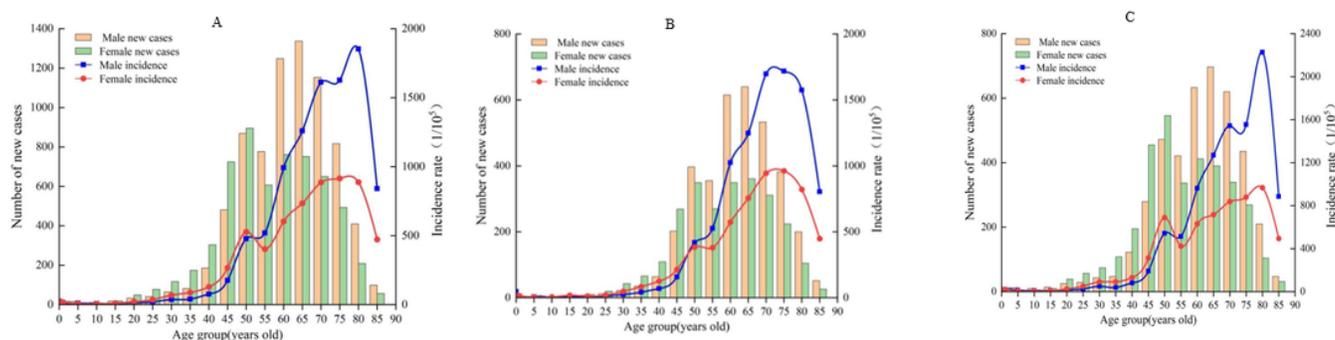


Figure 1

Age-specific incidence by different gender in Gansu, 2018. A: All areas B: Urban areas C: Rural areas

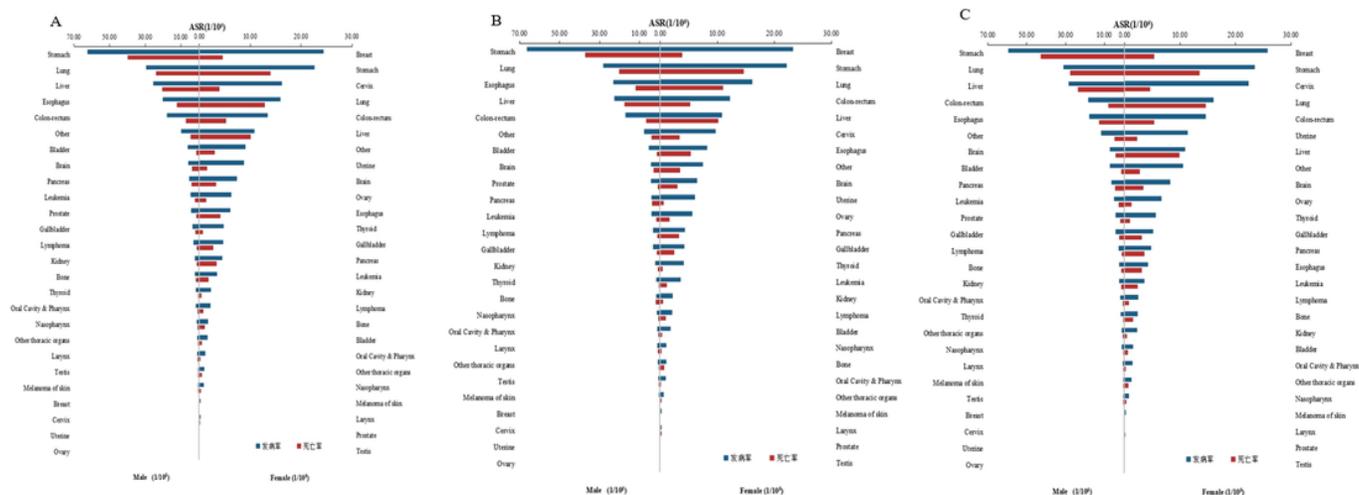


Figure 2

The cancer incidence and mortality in Gansu cancer registry areas, 2018. A: All areas B: Urban areas C: Rural areas

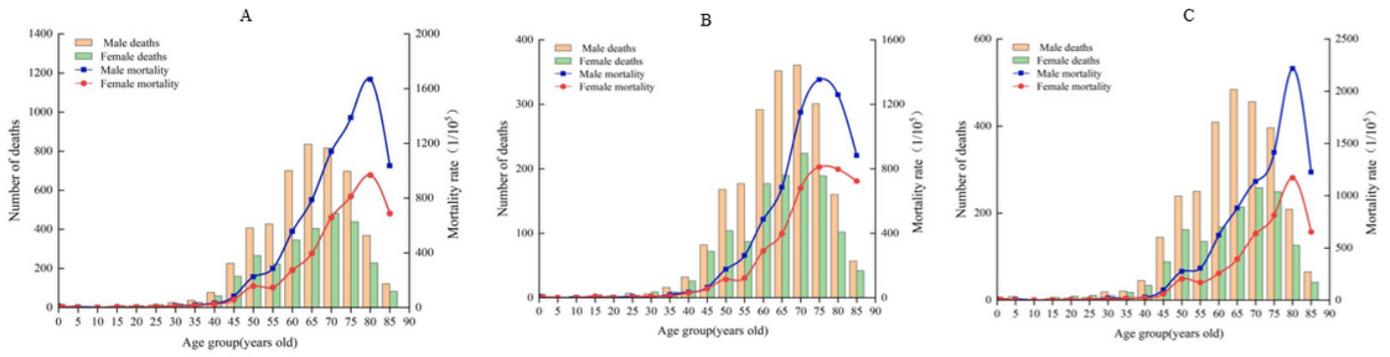


Figure 3

Age-specific mortality by different gender in Gansu, 2018. A: All areas B: Urban areas C: Rural areas

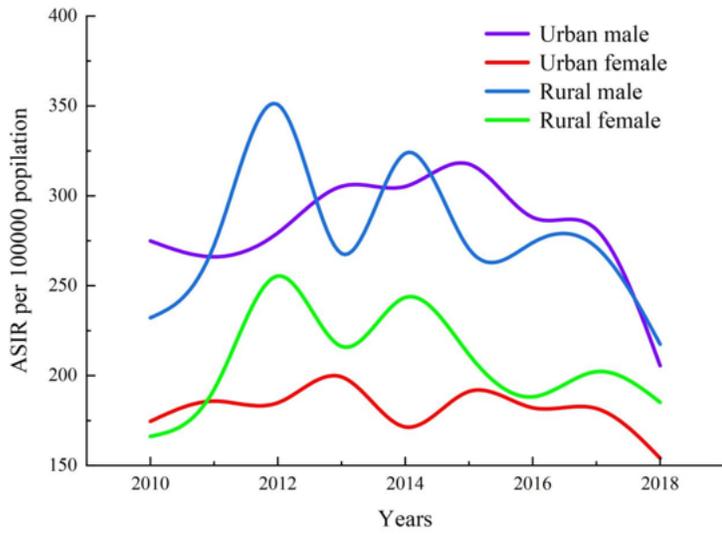


Figure 4

The ASIRC of all cancer in Gansu province from 2010 to 2018(1/10⁵)

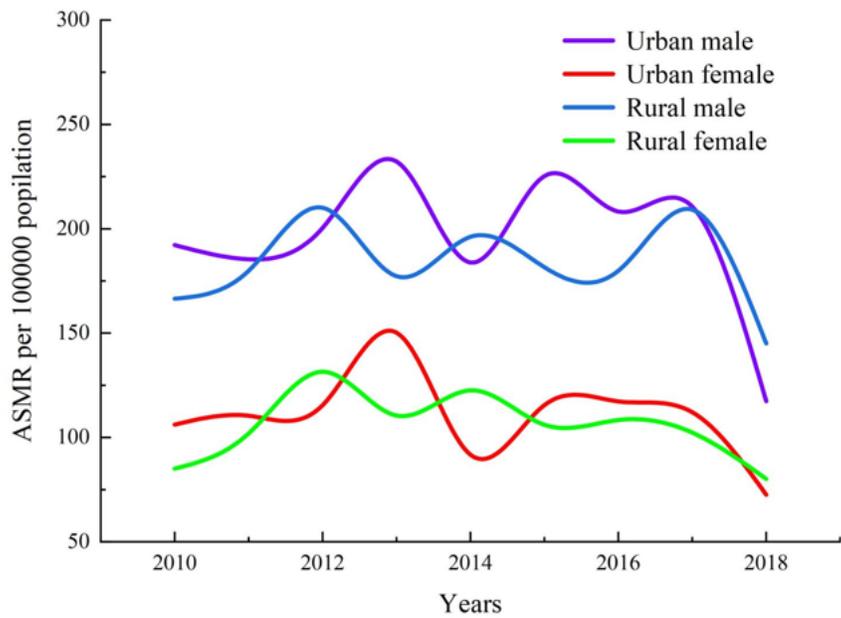


Figure 5

The ASMR of all cancer in Gansu province from 2010 to 2018(1/10⁵)

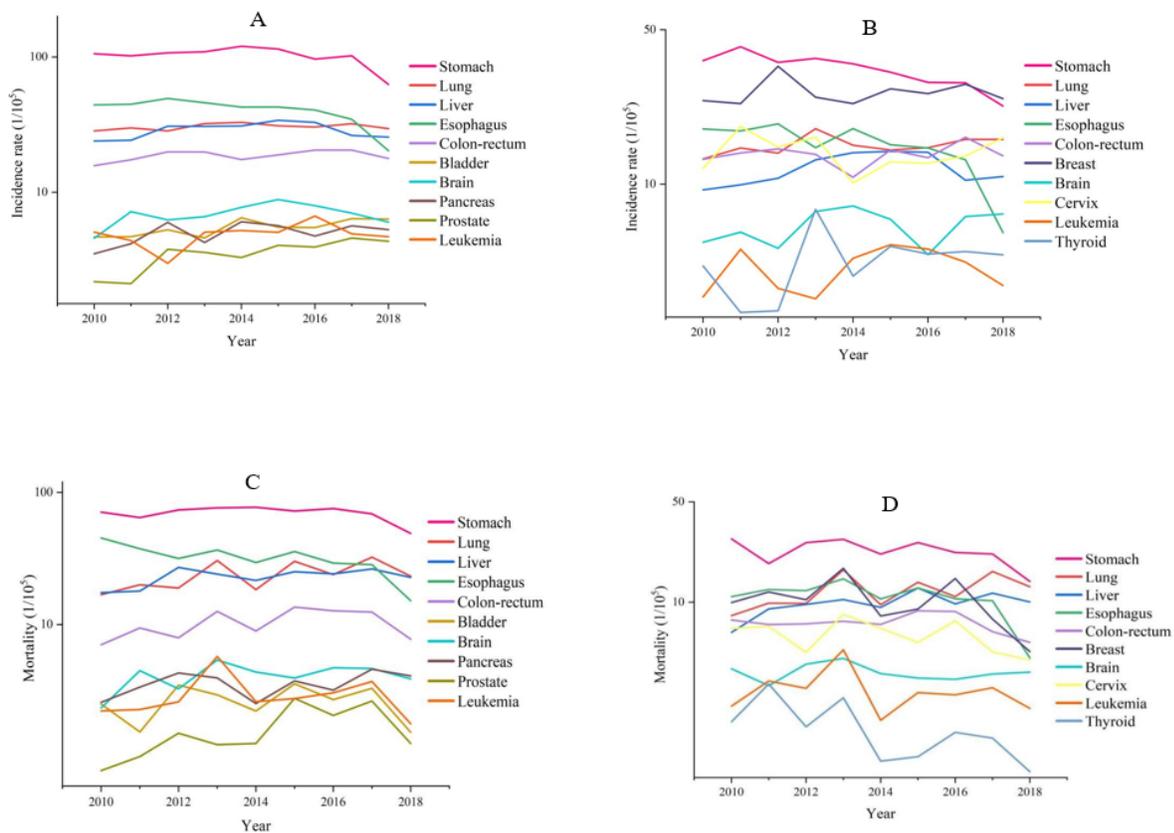


Figure 6

Trends in incidence and mortality rates for selected cancer by sex in Gansu, 2010 to 2018. A: Male incidence B: Female incidence C: Male mortality D: Female mortality