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Evaluating trends in mortality and years of life lost due to gastrointestinal cancers in West Azerbaijan Province, Iran, 2013–2024

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Abstract

Background and objective: Gastrointestinal (GI) cancers are a leading cause of cancer-related death globally and represent a major component of the cancer burden in Iran. This study aimed to evaluate temporal trends in mortality and Years of Life Lost (YLL) due to GI cancers in West Azerbaijan province and to identify demographic groups with the highest burden of premature mortality.

Material and methods: We performed a retrospective, registry-based observational study of all registered cancer deaths among residents of West Azerbaijan province, Iran, from 2013-2024 using the electronic population-based death registry. Descriptive statistics and graphs summarized demographic trends; YLL were calculated using the standard formula with age-weighting (β=0.04), constant C=0.1658, and discount rate r=0.03, standardized to 2013 low-/middle-income country population weights. Spatial patterns were mapped in ArcMap 10.8 and temporal trends modeled with generalized additive models (GAMs) in R version 4.5.1 using the "gam" function.

Results: During 2013–2024, males consistently accounted for a higher proportion of GI cancer deaths (≈60–62%) than females, with the greatest burden observed in individuals aged 50–69 years. Stomach cancer remained the leading cause of death, whereas colorectal and pancreatic cancers showed the largest increases (92% and 119%, respectively). Total YLL rose from 6,026 to 7,361 (83,146 overall), predominantly among men, although YLL per 1,000 population remained stable. Overall mortality counts increased until 2019 and plateaued thereafter, with no significant temporal trend detected in GAM analysis (p=0.822) and no independent associations with demographic factors after adjustment. Spatial analysis showed higher burden in northern and southeastern counties, and gastric, liver/biliary, colorectal, esophageal, and pancreatic cancers together accounted for approximately 90% of the total GI cancer burden.

Conclusion: Gastrointestinal malignancies remain one of the most significant public health challenges in West Azerbaijan, accounting for a considerable burden of mortality and years of life lost. The implementation of effective prevention strategies, enhancement of public awareness, early detection, and improved access to diagnostic and therapeutic services particularly among vulnerable groups and high-risk areas can play an important role in reducing

the burden of these diseases. Furthermore, continuous monitoring of epidemiological trends is essential for evidence-based planning.

Keywords: Gastrointestinal Neoplasms, Mortality, Years of Life Lost, Trend Analysis

Introduction

Gastrointestinal (GI) cancers are among the leading causes of cancer-related morbidity and mortality worldwide and continue to impose a substantial burden on health systems, particularly in low- and middle-income countries (1, 2). Despite advances in cancer prevention, screening, and treatment, cancers of the stomach, colorectum, esophagus, liver, pancreas, and gallbladder remain responsible for a large proportion of premature deaths globally (3). Population aging, urbanization, changes in dietary habits, obesity, tobacco use, alcohol consumption, and chronic infections have contributed to the growing burden of GI malignancies in many regions of the world (4).

In Iran, gastrointestinal cancers represent a major component of the national cancer burden and account for a considerable proportion of cancer-related deaths (5). Previous studies have shown substantial geographic variation in the incidence and mortality of GI cancers across the country, with northern and northwestern provinces reporting relatively high rates for several gastrointestinal malignancies (6, 7). These regional differences may reflect variations in environmental exposures, lifestyle factors, socioeconomic conditions, healthcare accessibility, and population demographics (8).

West Azerbaijan Province, located in northwestern Iran, is one of the country's most populous border provinces and shares borders with Turkey, Iraq, Azerbaijan, and Armenia. According to national census data, the province has a diverse ethnic composition and includes both urban and rural populations with distinct environmental and lifestyle characteristics (9). The region has experienced demographic and epidemiological changes over recent years that may influence cancer mortality patterns. Furthermore, local studies have highlighted the growing importance of non-communicable diseases, including cancer, as major contributors to mortality and premature death in the province (10, 11).

Previous investigations in Iran have primarily focused on cancer incidence, survival, or mortality from specific gastrointestinal cancers, such as gastric or colorectal cancer (12). Although these studies have provided valuable epidemiological information, they offer limited insight into long-term trends in overall GI cancer mortality at the provincial level. Moreover, relatively few studies have simultaneously examined mortality patterns and Years of Life Lost (YLL) due to gastrointestinal cancers within a single analytical framework (13, 14).

Years of Life Lost is a particularly important measure because it reflects not only the number of deaths but also the age at which those deaths occur (15). This indicator provides a more comprehensive assessment of premature mortality by quantifying the potential years of life lost relative to standard life expectancy (16). Consequently, YLL captures dimensions of disease burden that mortality rates alone cannot adequately describe, including the loss of productive years, social consequences for families, and the broader economic impact on communities (17).

Including YLL alongside mortality indicators offers a more policy-relevant perspective for cancer control planning. Two populations may experience similar mortality rates, yet the population with a greater concentration of deaths at younger ages will bear a substantially larger burden of premature mortality. Therefore, assessing both mortality and YLL can help identify priority cancers and vulnerable population groups requiring targeted interventions (18, 19).

Despite the importance of these measures, evidence regarding long-term trends in mortality and YLL due to gastrointestinal cancers in West Azerbaijan Province remains limited (20). This knowledge gap is particularly important because local epidemiological patterns may differ from national averages owing to regional demographic, environmental, and healthcare-related factors. Understanding these trends is essential for evaluating the effectiveness of existing cancer control programs and guiding future prevention and early detection strategies (21).

Therefore, the present study aimed to evaluate temporal trends in mortality and YLL due to gastrointestinal cancers in West Azerbaijan Province, Iran, during the period 2013–2024. The main research questions were: how have mortality and YLL attributable to gastrointestinal cancers changed over time in the province, which demographic groups have experienced the greatest burden of premature mortality, and what implications do these trends have for future cancer prevention and control policies?

Methods

Study design and setting:

This retrospective, registry-based observational study used death registry records from 2013 through 2024 to examine all registered cancer-related deaths occurring in both urban and rural areas of West Azerbaijan province, Iran, during the study period. West Azerbaijan is a northwestern Iranian province with Urmia as its capital. Excluding Lake Urmia, the province covers roughly 37,059 km², making it the 13th-largest province in Iran and representing about 2.25% of the country's land area. According to the 2006 census, its population was 2,873,459 (4.08% of the national total), ranking it eighth by population among Iran's provinces. Approximately 68% of residents live in urban areas and 32% in rural settlements. The province's landscape is predominantly mountainous.

Data sources:

Mortality information was obtained from the electronic, population-based death registration system. For cancer deaths, the Legal Medicine Organization (Forensic Medicine) was the principal data provider. To maximize sensitivity and completeness, those records were supplemented with reports from hospitals, cemeteries, and urban and rural health centers.

Data integration process

A centralized mortality registration unit in West Azerbaijan, staffed by trained personnel, manages and enters death records into the electronic system. Deaths are reported to this unit from the Legal Medicine Organization, hospitals, cemeteries, and health centers using a uniform national reporting form. Incoming records undergo a structured, multi-step integration: first, entries are matched by National Identification Number to identify and remove duplicates; then, registry staff review submitted forms to resolve discrepancies and fill in missing information. The electronic registry is linked to the national civil registration database, enabling automatic verification of ID numbers and retrieval of basic demographic information. The system blocks duplicate identification numbers, reducing duplicate records and improving data integrity.

Data completeness assessment and quality assurance

Mortality registration in Iran is handled through an integrated national framework coordinated by the Ministry of Health and Medical Education, the National Organization for Civil Registration, and the Legal Medicine Organization. Because Iranian law mandates forensic investigation of all deaths, the electronic registry achieves high coverage. In addition, an independent quality control officer performs

periodic random audits, cross-checking electronic entries against paper source documents to evaluate accuracy and uphold data quality.

Eligibility criteria

All deaths attributed to cancer, as recorded in the electronic population-based death registration system among residents of West Azerbaijan province from 2013 to 2023, were included irrespective of age or sex. Duplicate entries (identified through matching of father's name, date of death, and national identification number) were excluded, as were records in which cancer could not be confirmed as the cause of death due to insufficient information.

Coding of causes of death and managing misclassification

Causes of death were classified according to the International Classification of Diseases, 10th Revision (ICD-10), following national and WHO guidance to ensure consistent cancer coding. A multi-tiered verification procedure was used to cross-check registry entries against forensic records to reduce misclassification.

Statistical analysis

Trends in mortality were first explored with graphs and descriptive statistics stratified by demographic variables. YLL due to cardiovascular deaths was calculated using the standard formula (22):

$$YLL = NC^{(ra)}/(\beta + r)^2[e^{-(\beta+r)(L+a)}[-(\beta + r)(L + a)_1] - e^{-(\beta+r)a}[-(\beta + r)a - 1]]$$

where N represents the number of deaths at a given age and sex, L denotes the standard life expectancy for that age and sex, r is the discount rate (0.03), β is the age-weighting parameter (0.04), C is a constant (0.1658), a is the age at death, and e is Euler's number (≈2.718). The YLL approach estimates the total premature years lost by multiplying age-specific death counts by the remaining expected life years, applying age-weighting and other standard adjustments, and discounting future years to present value. For standardization, population weights for low- and middle-income countries from 2013 were used (23). The sex-adjusted mortality ratio was plotted separately. Spatial distribution of cancer mortality across West Azerbaijan Province was mapped with ArcMap version 10.8. Temporal trends in mortality were modeled using generalized additive models (GAMs), with the cancer mortality rate as the response variable; GAMs express the response as a sum of unknown smooth functions of predictor variables. All analyses and figures were produced in R version 4.5.1, and the model fitting used the "gam" function.

Ethical Statement

Ethical approval for the study was granted by the Research Ethics Committee of Urmia University of Medical Sciences (Approval ID: IR.UMSU.REC.1404.292). All procedures complied with applicable ethical standards and institutional requirements for research using retrospective data.

Result:

The findings reveal that males consistently accounted for a higher proportion of deaths (approximately 60-62%) compared to females (38-40%) throughout the study period, indicating that men had a significantly higher mortality burden from digestive system cancers than women. Regarding education level, illiterate individuals comprised the majority of deaths (ranging from 48-72%), though their proportion declined markedly from 66.1% in 2013 to 48.9% in 2024, while individuals with primary and high school education showed increasing trends, and university-educated individuals consistently had the lowest mortality rates (only 2.5-4.5%). In terms of occupational status, the self-employed (Free) and unemployed individuals together accounted for over 80% of deaths across all years, with the self-

employed showing the highest proportion (up to 44.4% in 2024), while formal employees consistently showed the lowest mortality rates (below 5.5%). The residence pattern demonstrated a significant urban shift, with urban residents increasing from 51.6% in 2013 to 64.5% in 2024, meaning that urban dwellers had a progressively higher proportion of deaths compared to rural residents, who decreased from 48.4% to 35.5% over the same period (**Figure 1**).

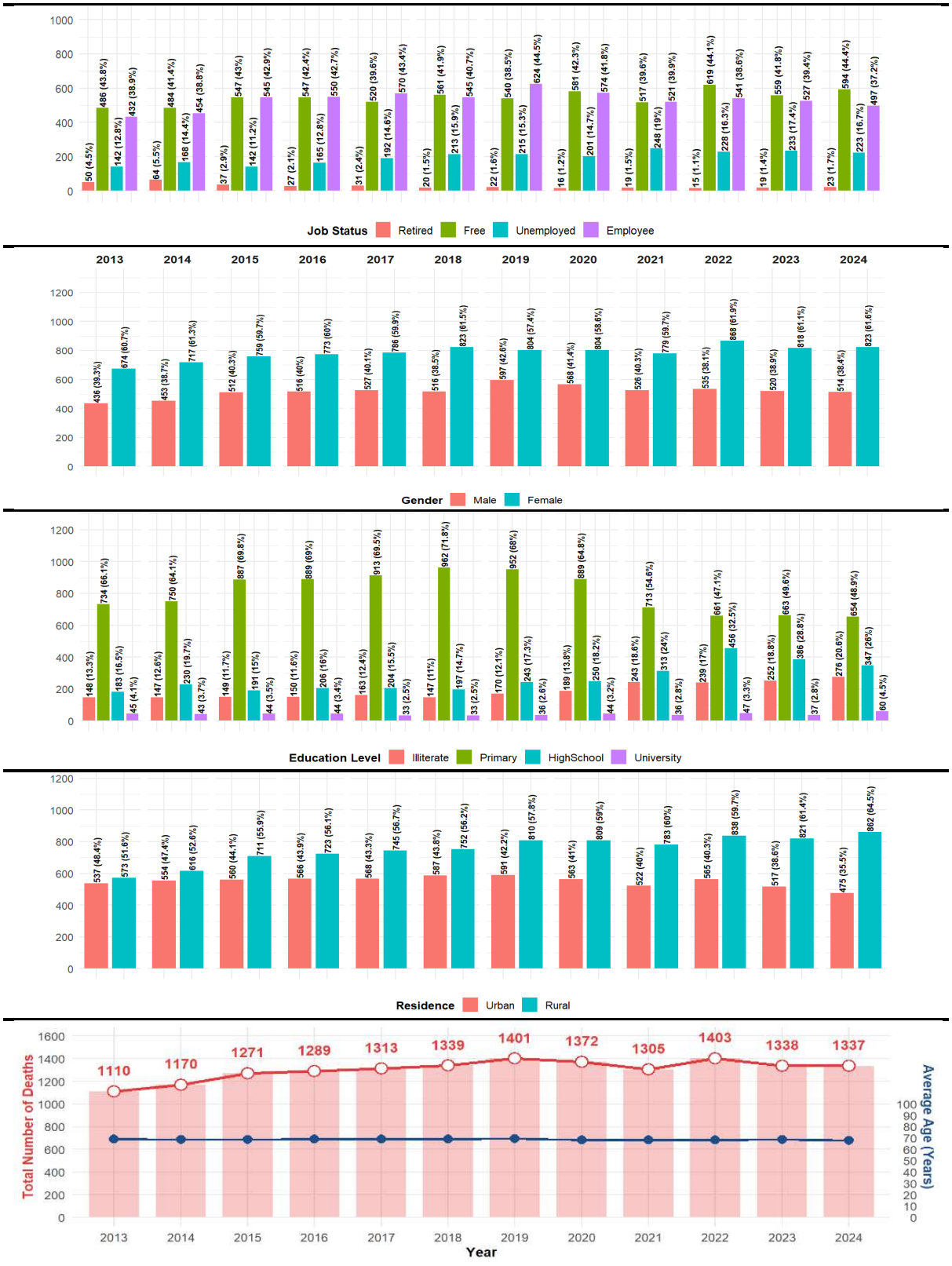


Figure 1: Mortality trends due to Malignant Neoplasms of the gastrointestinal cancers, Demographic factors in West Azerbaijan Province, 2013-2024

Stomach cancer remained the leading cause of death throughout the study period, declining slightly from 520 to 485 cases (6.7% decrease). Colon cancer showed the most alarming increase, rising from 100 to 192 deaths (92% increase), while pancreatic cancer demonstrated the highest relative growth from 67 to 147 deaths (119.4% increase). Liver cancer increased modestly from 171 to 197 deaths (15.2%), and esophageal cancer fluctuated but increased from 126 to 140 deaths (11.1%). Small intestine cancer rose from 55 to 69 deaths (25.5%), whereas gallbladder and rectal cancers declined by 25% and 29%, respectively (**Figure 2)**.

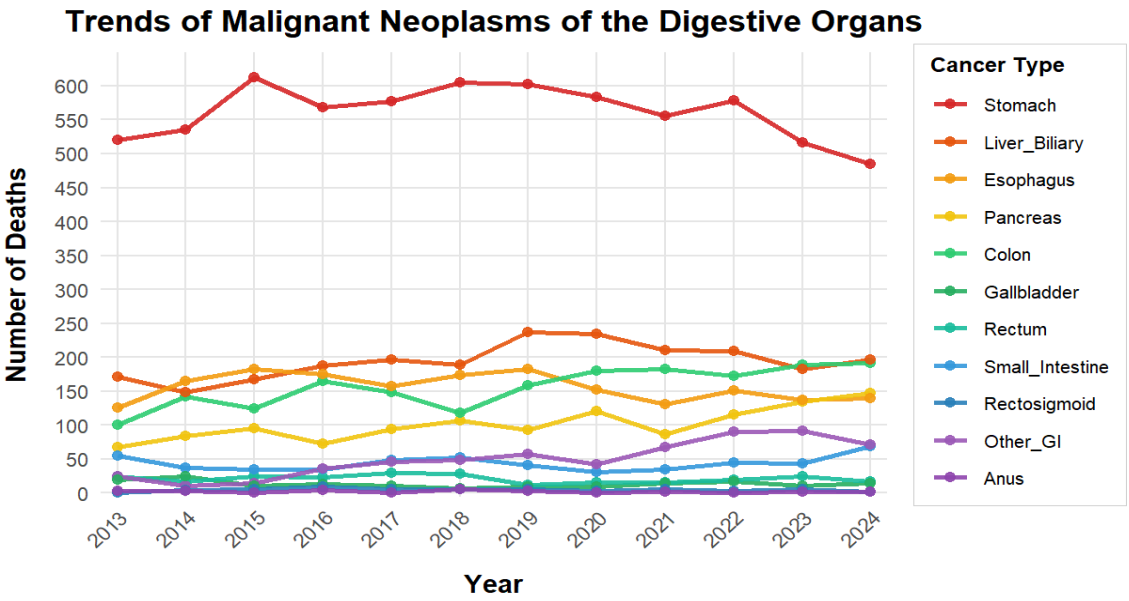


Figure 2. Mortality trends of gastrointestinal cancers by anatomical site in West Azerbaijan Province, 2013-2024

As shown, total deaths (blue bars) increased gradually from 2013 to 2019, followed by a sharp rise in 2020–2021, before declining but remaining above pre-pandemic levels. Deaths due to malignant neoplasms of the digestive organs (red bars) rose gradually until 2019 (peaking at 1,401 cases) and then remained relatively stable. These deaths constituted 8.0–8.9% of total mortality in most years. The proportional mortality rate (green dashed line) declined markedly to 6.1–6.4% in 2020–2021 (**Figure 3)**.

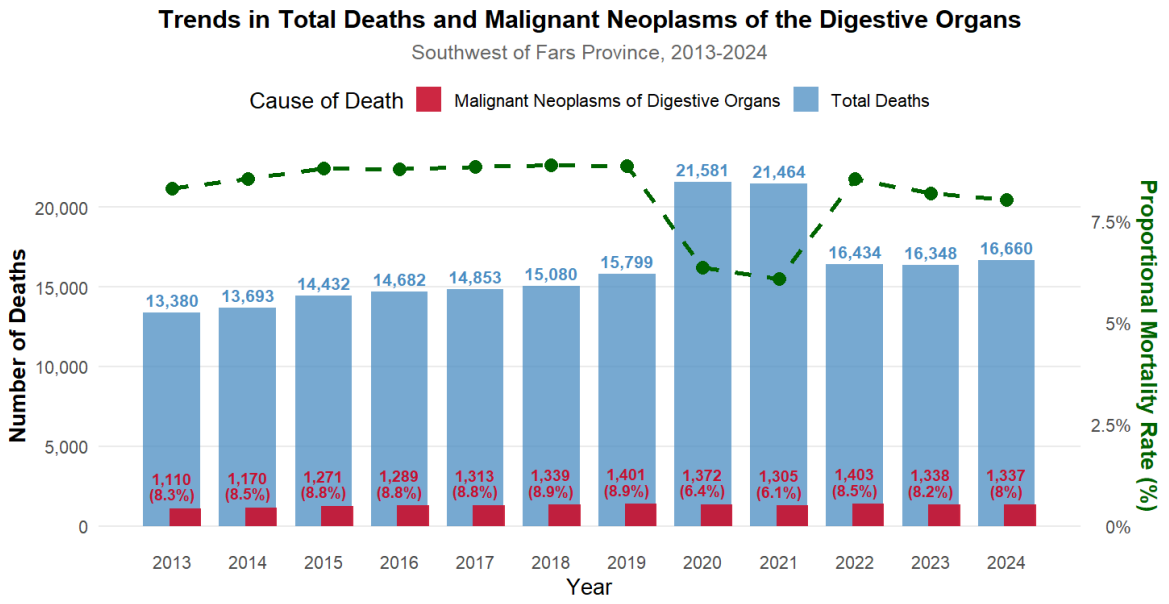


Figure 3. Trends in deaths due to malignant neoplasms of the gastrointestinal cancers, and proportional mortality rate in the West Azerbaijan Province, 2013–2024.

Age-standardized mortality rate (ASMR) increased from 4.8 in 2013 to 5.4 in 2024, indicating the total trend of mortality rate due to gastrointestinal cancers was increasing over 12 years. Furthermore, throughout the study period, ASMR among men was significantly higher than among women. For instance, in 2024, ASMR in men and women was 6.6 and 4.2, respectively. The total number of YLL increased from 6,026 in 2013 to 7,361 in 2024. Overall, 83,146 YLL were recorded during the study period, with more among men (49,470 YLL) than among women (33,739 YLL). Despite the fluctuations in the number of deaths and YLL, the YLL indicator per 1,000 population remained relatively stable from 2013 to 2024 (2 years per 1,000 population), suggesting that this index has been proportional to population growth (**Table 1**).

Table 1: Crude and standardized mortality rate and years of life lost due to gastrointestinal cancers by sex and year in West Azerbaijan province, 2013-2024

Year	No. death			Crude mortality rate per 10,000			ASR (95%CI) Per (100,000 population)			No. YLL			YLL Per (1000)		
	Male	Female	Both sex	Male	Female	Both sex	Male	Female	Both sex	Male	Female	Both sex	Male	Female	Both sex
2013	674	436	1110	4	3	4	5.7(5.3-6.1)	3.8(3.4-4.2)	4.8(4.6-4.9)	3598	2428	6026	2	2	2
2014	717	453	1170	4	3	4	6.0(5.6-6.5)	3.9(3.6-4.3)	5.0(4.9-5.1)	3908	2490	6398	2	2	2
2015	759	512	1271	5	3	4	6.3(5.9-6.8)	4.4(4.0-4.8)	5.4(5.3-5.5)	4013	2725	6738	2	2	2
2016	773	516	1289	5	3	4	6.4(6.0-6.9)	4.5(4.1-4.8)	5.5(5.3-5.6)	4112	2860	6973	2	2	2
2017	786	527	1313	5	3	4	6.5(6.0-6.9)	4.5(4.1-4.9)	5.5(5.4-5.6)	4162	2882	7044	2	2	2
2018	823	516	1339	5	3	4	6.7(6.2-7.2)	4.4(4.0-4.7)	5.6(5.4-5.7)	4125	2864	6989	2	2	2
2019	804	597	1401	5	4	4	6.5(6.1-7.0)	5.0(4.6-5.4)	5.8(5.6-5.9)	3990	2878	6868	2	2	2
2020	804	568	1372	5	3	4	6.5(6.0-6.9)	4.8(4.4-5.1)	5.6(5.5-5.8)	4316	3021	7337	2	2	2
2021	779	526	1305	4	3	4	6.3(5.8-6.7)	4.4(4.0-4.8)	5.3(5.2-5.5)	4082	3065	7147	2	2	2
2022	868	535	1403	5	3	4	6.9(6.5-7.4)	4.4(4.1-4.8)	5.7(5.6-5.8)	4502	2918	7419	3	2	2
2023	818	520	1338	5	3	4	6.5(6.1-7.0)	4.3(3.9-4.7)	5.4(5.3-5.6)	4075	2773	6847	2	2	2
2024	823	514	1337	5	3	4	6.6(6.1-7.0)	4.2(3.9-4.6)	5.4(5.3-5.5)	4525	2836	7361	3	2	2
Total	9428	6220	15648	5	3	4	6.4(6.3-6.5)	4.4(4.3-4.5)	5.4(5.3-5.5)	49407	33739	83146	2	2	2

YLL analysis of gastrointestinal cancers by gender and age groups indicated that in both sexes, the greatest burden of mortality occurred in the 50–69 age range (50-54, 55-59, 60-64, 65-69). In addition, across most age groups, YLL was higher among men than among women. In particular, the analysis of the 55–64 age range (55-59, 60-64) showed that the burden of YLL among men was roughly twice that among women. This indicates a remarkable difference between the sexes in the age groups with the highest burden (**Figure 4**).

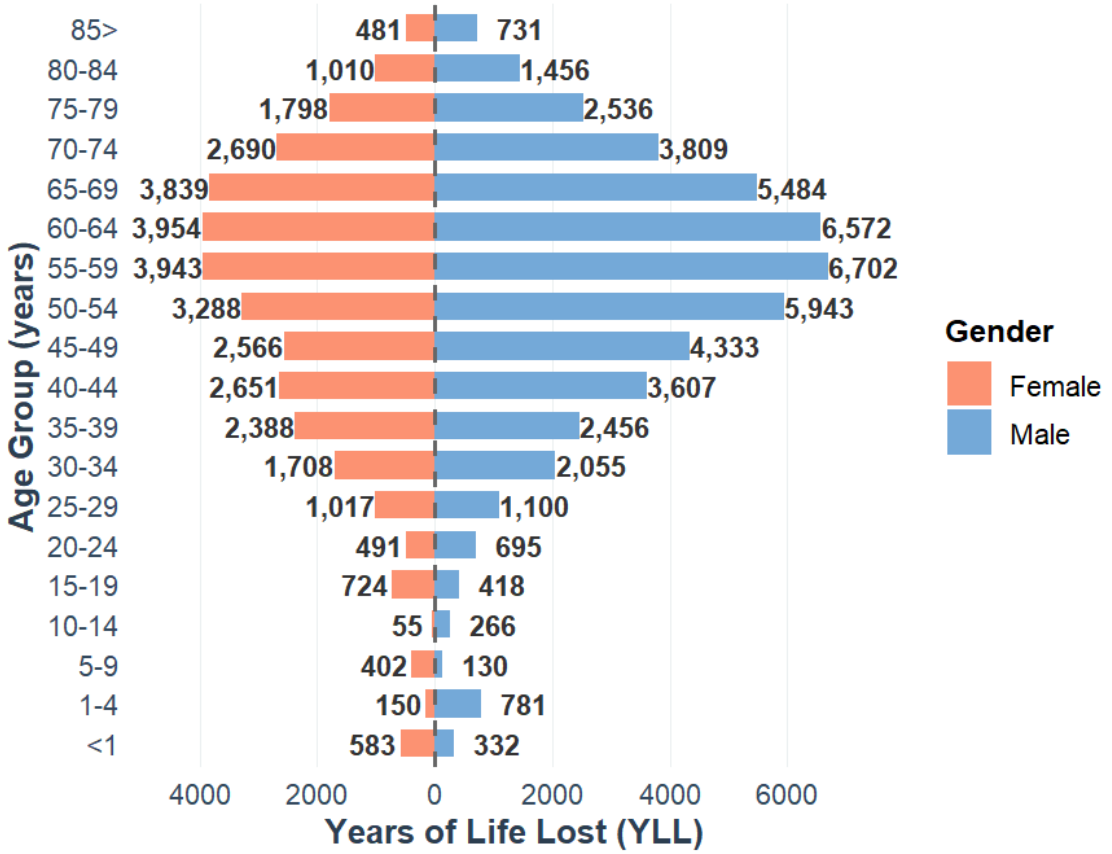


Figure 4. The total number of years of life lost due to gastrointestinal cancers in West Azerbaijan Province by gender in age groups

Based on the fitted GAM model (**Figure 5**), there was no statistically significant temporal trend in mortality due to malignant neoplasms of the digestive system between 2013 and 2024 (s(Time): $p = 0.822$), although a very slight monotonic increase was observed in the fitted values, which likely reflects the smoothing structure of the model rather than a true epidemiological change. After simultaneous adjustment, none of the demographic variables (including sex, occupation, education, and place of residence) showed statistically significant associations with mortality (all $p > 0.05$), with only residence (urban/rural) showing a borderline effect that did not reach conventional significance levels. Overall, the findings suggest that

mortality counts remained relatively stable over time, and no strong independent associations were observed between demographic characteristics and mortality in this dataset after adjustment.

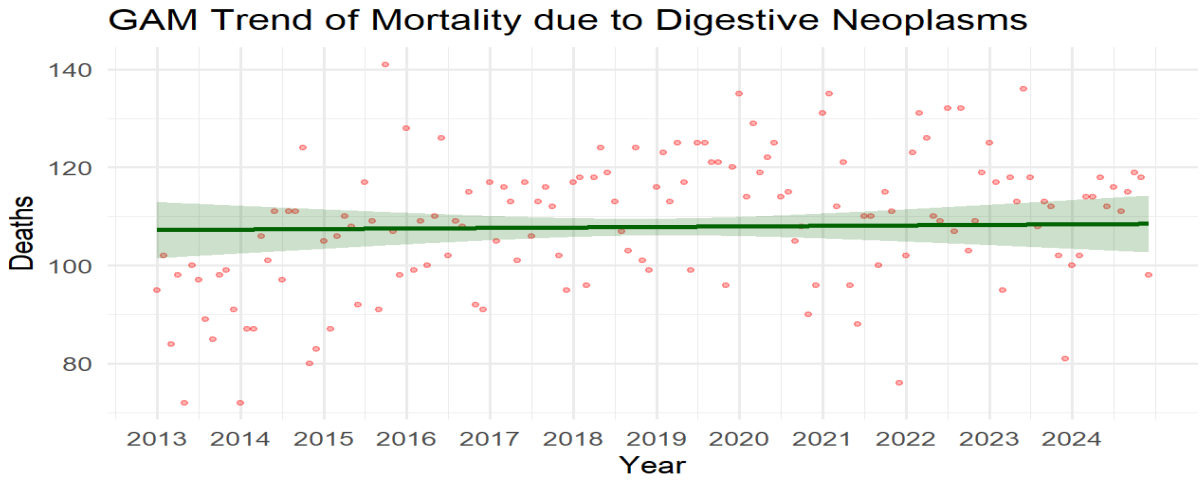


Figure 5. The trend of mortality due to malignant neoplasms of the gastrointestinal cancers between 2013 and 2024 in West Azerbaijan Province, GAM model

During the 12-year study period, gastric cancer was the most common gastrointestinal malignancy, accounting for 43% of all gastrointestinal cancers, with an incidence rate of 16.6 per 100,000 population. Liver and biliary tract cancers ranked second, with an incidence rate of 5.8 per 100,000 population (15%), followed by colorectal cancers (4.6 per 100,000 population; 12%), esophageal cancer (4.6 per 100,000 population; 12%), and pancreatic cancer (3.0 per 100,000 population; 8%). Collectively, these five cancer types accounted for approximately 90% of the total burden of gastrointestinal cancers during the study period, with a cumulative incidence rate of 34.7 per 100,000 population. The spatial distribution map of gastrointestinal cancer incidence in West Azerbaijan Province revealed the highest incidence rates in Chaypareh, Poldasht, Shahindezh, and Takab counties, whereas the lowest rates were observed in Urmia, Maku, Piranshahr, and Sardasht counties. Overall, the spatial pattern indicated a concentration of higher incidence rates in the northern and southeastern parts of the province, while lower rates were predominantly observed in the central and southwestern regions (**Figure 6**).

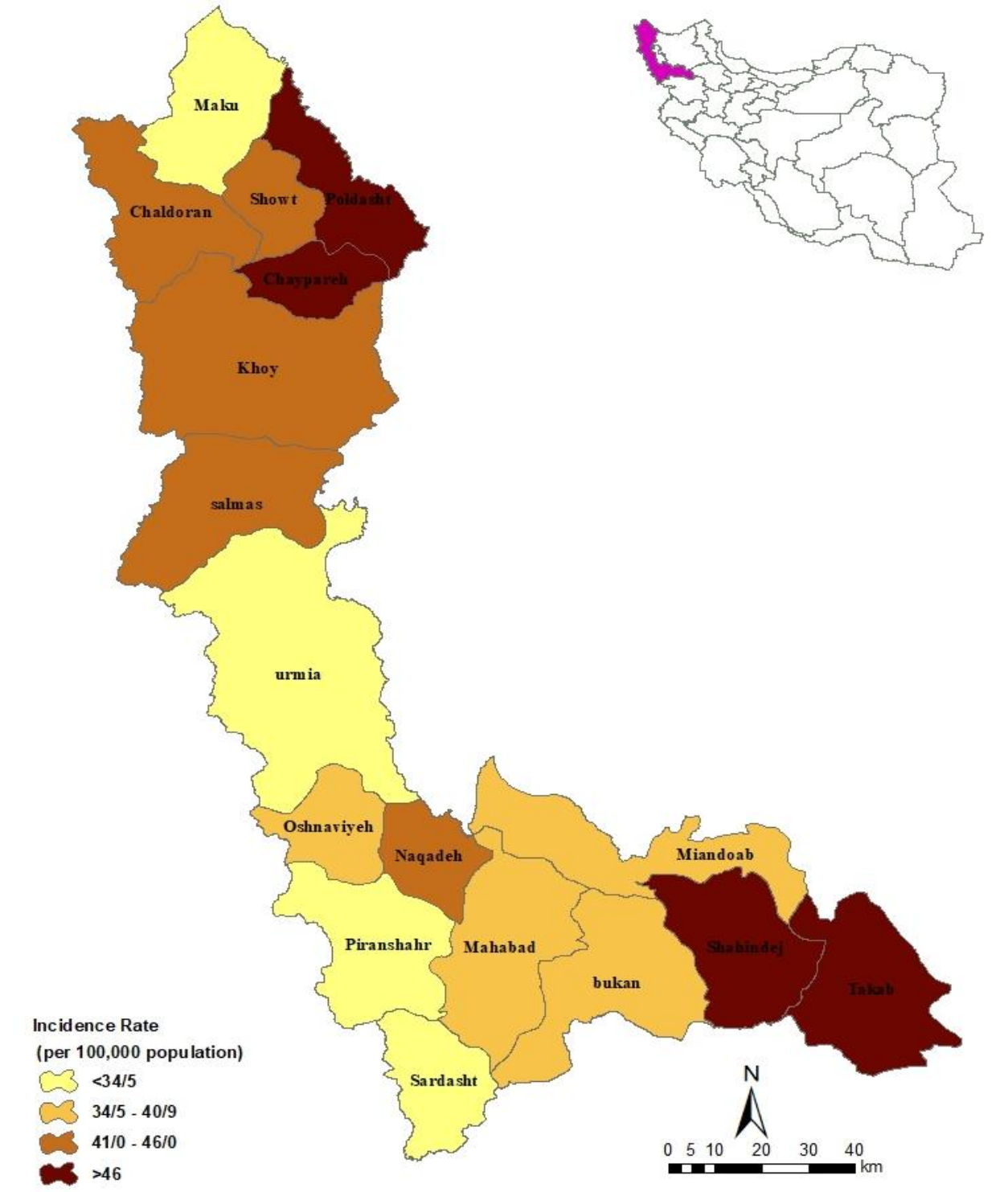


Figure 6. Spatial distribution map of gastrointestinal cancer incidence between 2013 and 2024 in West Azerbaijan Province

Discussion

The findings of the present study demonstrated that despite fluctuations in the crude number of deaths, the mortality burden due to gastrointestinal malignancies in West Azerbaijan did not effectively decrease between 2013 and 2024, and the ASMR showed a slight increasing trend. This pattern is consistent with the report by Danpanichkul et al., who, in their analysis of GBD 2021, showed that in 2021, approximately 3.70 million deaths occurred due to gastrointestinal cancers, with the highest burden related to colorectal, stomach, and pancreatic cancers (24). Furthermore, Wang et al. demonstrated that the lifetime risk of developing and dying from gastrointestinal cancers is higher in men than in women, and that the pattern of disease burden changes with increasing levels of human development (25). Lin et al. also reported that although the mortality trend for gastric cancer has decreased in many countries over the past decade, an absolute reduction in burden does not necessarily imply a true decrease in risk; following population growth and changes in age structure, the number of deaths remains high (26). In Iran, Shadmani et al. and Ebrahimi et al. have reported similar patterns of relative stability or a slight increase in the GI burden, which reinforces the interpretation of the present results (6, 27). This alignment indicates that a decrease or relative stability in rates should not be interpreted as satisfactory disease control. In fact, when the population is aging and underlying risk factors persist, the number of deaths and years of life lost can remain high.

The predominance of mortality burden in men and the higher ASMR in men compared to women was a consistent finding of the present study and aligns with previous evidence. Wang et al., in their global analysis, showed that the risk of developing and dying from gastrointestinal cancers is higher in men than in women (25). Lo et al., in a county-level study on US counties, reported that counties with higher social vulnerability had higher GI mortality, and this ratio was more pronounced in men (28). In Iran, Farhood et al., in their review, clearly demonstrated that for most gastrointestinal cancers, the disease burden is higher in men than in women (29), and this pattern is consistent with previous national studies (6, 27). Overall, the observed sex difference in the present data may reflect a combination of behavioral and occupational exposures, delayed healthcare seeking, and inequalities in access to services. The predominance of disease burden in men is likely not merely a biological difference but rather the result of an accumulation of risk exposures and differing patterns of health service utilization. This issue should be taken seriously in preventive planning, and specific interventions for middle-aged and elderly men should be prioritized.

The concentration of the highest YLL in the 50–69-year age group is also consistent with international and regional studies. Arnold et al., in a comprehensive GBD analysis of five major gastrointestinal cancers, showed that the global burden of gastrointestinal cancers is mainly concentrated in older ages, although trends of younger onset are changing for some cancers (30). Tan et al., in an examination of the global

burden of early-onset gastric cancer, reported that although gastric cancer has become more significant in younger ages, the main burden is still observed in middle-aged and elderly age groups (31). Xia et al., for pancreatic cancer, showed that in the 15–59-year group, the disease burden is increasing in many regions, but the mortality pattern is still influenced by older ages (32). On the other hand, Danpanichkul et al. and Yu et al. have confirmed the increasing burden of pancreatic and some gastrointestinal cancers in recent GBD trends (24, 33). Therefore, the concentration of YLL in the 50–69-year age group in the present study is epidemiologically expected and highly important for policymaking. Thus, middle age is a point where cumulative exposures peak and the capacity to benefit from secondary prevention still exists. For this reason, early detection and targeted screening in this age group can prevent a large number of years of life lost.

The less favorable pattern among illiterate individuals, self-employed and unemployed individuals, and the relative shift of burden towards urban areas indicates the role of social inequalities and access. Lo et al., in their socio-epidemiological study, showed that GI mortality is directly related to the social vulnerability of counties and is higher in more deprived areas (28). In Iran, Ghasemi et al., using shared spatial modeling, showed that mortality from gastric and esophageal cancers is higher in the northern half of the country, and this pattern can be explained by environmental inequalities and access (34). Faramarzi et al., in sex-based modeling of cancer incidence, reported a higher concentration of gastric cancer in the north and northwest of Iran (35). Studies by Pakzad et al. and Najafimehr et al. also support high-risk spatial clustering for gastric and esophageal cancer in the north and northwest of Iran (36, 37). Furthermore, Montaseri et al. showed that for colorectal cancer, high-risk clusters are concentrated in the central and northern regions of Iran, with behavioral and environmental factors playing a role (38). These findings indicate that mortality from gastrointestinal cancers is not solely a function of individual factors but is also shaped at the regional and social level. Therefore, effective intervention requires place-based planning, strengthening services in high-risk counties, and special attention to low-literacy and underprivileged groups.

Regarding the type of malignancy, the persistence of gastric cancer as the leading cause of death, along with a significant increase in colon and pancreatic cancers, demonstrates exactly the pattern observed in recent global and Iranian studies. Arnold et al. described the burden of the five major GI cancers worldwide and identified gastric cancer as still one of the main burdens (30). Danpanichkul et al., in GBD 2021, reported colorectal cancer with the highest burden, followed by stomach and pancreatic cancers (24). Lin et al. showed that although global gastric cancer mortality is decreasing in many countries, it still shows an increasing pattern in some younger populations (26). On the other hand, Yu et al. and Xia et al. have highlighted the increasing burden of pancreatic cancer, especially in middle-aged and younger populations

(32, 33). This alignment indicates that the pattern observed in West Azerbaijan is not an isolated phenomenon but part of broader epidemiological changes in gastrointestinal cancers. At the practical level, these results support the necessity of focusing simultaneously on gastric, colorectal, and pancreatic cancers, not just a single specific cancer. Particularly in high-risk provinces, screening programs, public education, reducing diagnostic delay, and strengthening referral systems should be designed in a coordinated and region-focused manner.

Conclusion

In summary, the findings of this study showed that the mortality burden due to gastrointestinal malignancies in West Azerbaijan Province between 2013 and 2024 has not only decreased but has shown a concerning increasing trend in some indicators such as ASMR and YLL. Gastric cancer remains the most important cause of death among gastrointestinal malignancies, but the significant increase in mortality from colon and pancreatic cancers indicates that the disease pattern is changing and that simultaneous attention to several major cancers is required. Furthermore, the concentration of disease burden in men, the 50–69-year age group, illiterate individuals, the unemployed, and the self-employed, along with spatial differences between counties, indicates that mortality from these cancers is influenced by social, demographic, and geographical factors and is not merely a biological phenomenon. Accordingly, it can be concluded that effective control of gastrointestinal cancers in the province requires a multi-level, targeted, evidence-based approach that covers both primary prevention and early detection.

Based on this, it is recommended that screening and health education programs be designed and implemented specifically for men, middle-aged and elderly individuals, and groups with lower educational levels, and that counties with higher rates be prioritized for interventions. Furthermore, strengthening the cancer registry system, monitoring temporal and spatial trends, and conducting further analytical studies to identify individual and environmental risk factors can aid in more precise decision-making. On the other hand, expanding access to diagnostic and therapeutic services, increasing public awareness of warning signs for gastric, colon, and pancreatic cancers, and promoting timely referral of patients at the primary levels of the health system can help reduce mortality and years of life lost.

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Authors' contributions

Research idea and study design: NA, MZ; data acquisition: ER, FB; data analysis/ interpretation: M.E, MN, FB; statistical analysis: M.E, MN, N.A; supervision or mentorship: NZ, MZ. The manuscript draft writing: KM, SM. All authors revised and approved the draft of the manuscript.

Data availability

The data that support the findings of this study are available from [Najaf Ahmadi Aghziarat], but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request and with permission of [Najaf Ahmadi Aghziarat].

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