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Trends in All-Cause and Cause – Specific Mortality in the Kurdistan Region of Iraq (2020 -2023)

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Background: Population-based mortality data are crucial for health planning, and these data are currently lacking in the Kurdistan Region of Iraq. This paper examined the trends and patterns in all-cause and cause-specific mortality between 2020 and 2023 through population-based forensic registries. Methods: This population-based observational study utilized mortality records from the Department of Forensic Medicine for the years 2020–2023. Mortality patterns were assessed and compared according to age, sex, cause of death, and geographic area. Mid-year population estimates were utilized to compute crude mortality rates and age-standardized mortality rates (ASMRs). The temporal trends were evaluated using log-linear regression to determine the annual percent change (APC) with 95% confidence intervals (CIs). Results: Annual deaths ranged from 14,193 to 16,891. The crude mortality rate declined from 2.63 per 1,000 population in 2020 to 2.24 per 1,000 population in 2023. The age-standardized mortality rate (ASMR) declined to 2.14 per 1,000 population (APC = −5.2%; 95% CI: −11.9 to 1.9; p = 0.12) during the study period. The mortality rate increased markedly with age, and a higher rate was observed among males in comparison to females (2.41 vs. 2.05 per 1,000 population in 2023). More than two-thirds of all deaths were attributed to non-communicable diseases, with cardiovascular diseases (23%) and cancers (22%) representing the leading causes of mortality. External causes accounted for 6.6% of all deaths, with road traffic injuries and suicide being the leading contributors. Geographical disparities were identified, with a higher mortality rate observed in Duhok and Erbil. Conclusions: Mortality declined during the study period, although the downward trend did not reach statistical significance. Non-communicable diseases remained the leading causes of death, while substantial regional disparities in mortality were observed. These findings highlight the need to strengthen chronic disease prevention and control, enhance injury prevention strategies, and support evidence-based health planning at the subnational level. Strengthening mortality surveillance systems is essential for informing public health policy and monitoring future mortality trends.

Keywords: *Mortality trends; Non-communicable diseases; COVID-19; Premature mortality; Kurdistan*

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Introduction

Mortality data are among the most relevant health indicators within the performance of the primary health care system. Assessment of mortality trends provides crucial insight into the burden of disease, the effectiveness of healthcare delivery mechanisms, environmental and social disturbances, and major health outcomes within the community (Mathers et al., 2015; World Health Organization, 2014). Consequently, its effect will extend to dependable mortality data for evidence-based public health strategies, the evaluation of health initiative priorities, and the evaluation of policies at both regional and national levels (AbouZahr et al., 2015). The mortality pattern has changed dramatically on a global scale in recent years, with higher deaths due to communicable diseases and an increasing burden of chronic diseases, age-related diseases, and injuries, particularly in low and middle-income countries expressing rapid epidemiological and transition disease (Omran, 1998; GBD, 2019). The unexpected event like coronavirus in 2019 (COVID-19) pandemic, has complicated the trends of mortality, which had several influences on the other causes of death, such as shutdown of the health system, postponing the diagnosis, and changes in health-seeking behaviors (Beaney, 2020; Woolf, 2020; Bilinski and Emanuel, 2020). The years 2020–2023, which include the start, peak, and later stages of the COVID-19 pandemic, are relevant in terms of epidemiology because they are affected by larger social, economic, and healthcare system pressures (Karlinsky and Kobak, 2021; Kontis et al., 2020; Islam, 2021).

It's important to remember that the higher death rate hasn't just been caused by COVID-19. It's also been caused by heart diseases, cancers, accidents, and other conditions that are harder to treat and cause social problems (De Filippo, 2020). In the international literature, there is a big lack of population-level mortality data from the Eastern Mediterranean Region, especially from Iraq and the Kurdistan Region. This is true even though the region has seen a lot of population growth, changes to its healthcare systems, and long-lasting political, economic, and public health problems (World Health Organization, 2018; Setel, 2007). Existing studies from this area are often limited to hospital-based data, short-term time frames, or certain diseases, which means it doesn't provide a good picture of overall mortality trends at the population level (Roth, 2018). Another thing is that not many studies have used forensic or civil death registration records to look at death rates consistently over several years during the COVID-19 era.

Many factors, such as inconsistent access to health care services across various cities, the magnitude of the communicable disease, increasing of the non-communicable disease, and trauma-related mortality in the Kurdistan region of Iraq, make it the most epidemiological landscape to be studied. Also, understanding these data will enhance the surveillance system and provide the health policies for the needs of the community, and understanding also provides the policy makers insight of the mortality trends. It is important to mention that the development of the statistical phase in the Kurdistan region is still in its early phase; therefore, accessing the data from the forensic records is considered a vital opportunity and later for that development. On the basis of the current situation, the current study aims to analyze the trend of the mortality from 2020 to 2023 of Kurdistan region of Iraq using the data of the Forensic Department.

Methods

Study Setting and Design

This was the first population-based study of mortality trends in the Kurdistan Region of Iraq using routinely collected data on mortality to be undertaken and published (reporting of this research has followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines on von Elm et al., 2007). Data on mortality were available from the Department of Forensic Medicine of the Kurdistan Regional Government (KRG) for the years 2020–2023. The population of the current study included governorates of the Kurdistan Region of Iraq, as well as peripheral districts with diverse populations and access to healthcare. The Department of Forensic Medicine acts as the official Registrar of Deaths in the region, and death registration occurs through structured medical/legal procedures. All data had been anonymized before the analysis, and no personal details had been obtained.

Data Source and Study Population

The study population was all deaths in the forensic mortality registry recorded throughout the course of the study. Mortality data were gathered anonymously and no personal identifiers were obtained. No deaths were excluded because of age, sex, or cause of death. For variables with missing or inconsistent data only observations with missing data were excluded from the appropriate stratified analyses. Population denominator data (annual population estimates, table of age structure) were obtained from the Kurdistan Regional Statistics Office.

The Study Variables and their Definition

The variables used in the final analysis were age at death, year of death, sex, place of residence (province/district, when available), cause of death, manner of death, and place of death. Causes of death were defined as per the ICD-10 [19] or the Department of Forensic Medicine classification protocol. Manner of death was categorized as natural, homicide, accident, or undetermined. Places of death were home, hospital, or other locations. Major groups of causes of death (for the final analysis) were non-communicable diseases, communicable diseases, injuries, and external causes.

Population Denominator

Crude mortality rates (CMRs) were derived by dividing the total number of deaths during the period by the mid-year population at risk, expressed as the number of deaths per 1,000 population. Observed death rates (ASMRs) were estimated by the direct standardization method (WHO world standard population) for age-specific and sex-specific mortality rates, so that a comparison could be made to years unaffected by changes in age structure. Age-specific mortalities were derived for predefined age bands.

Statistical Analysis

Statistical analyses were performed using appropriate statistical software. Descriptive statistics were applied to summarize mortality counts and rates according to age, sex, and cause of death. Mortality rates were expressed per 1000 population. Age-standardized mortality rates (ASMRs) were calculated using the direct standardization method based on a standard reference population. Temporal trends in mortality were evaluated using annual percent change (APC) analysis with corresponding 95% confidence intervals (CIs). Mortality patterns were further assessed through stratified analyses according to age group, sex, and major causes of death. A p-value of <0.05 was considered statistically significant.

Data Quality and Bias

All mortality information was collected from the official forensic mortality registry, which presents a uniform death registration system throughout the Kurdistan Region. Before analysis, records were examined for accuracy and completeness in order to reduce information bias. Records that had missing or inconsistent data were excluded just from the respective subset analyses.

Ethical Consideration

The Ministry of Health of the Kurdistan Region provided the ethical approval. Besides, the Department of Forensic Medicine was accepted to submit the data to be used in the current investigation. In the present study, no face-to-face contact with the participant was present. The research was done under the international standard of medical research ethics concerning data privacy.

Results

Overall Mortality Trends (2020–2023)

In the Kurdistan Region, the number of deaths per year between 2020 and 2023 was between 14,193 to 16,891 or between 2.21 and 2.63 in terms of crude death rates per 1,000 population (Table 1). In 2020, the highest mortality (2.63 per 1,000) was recorded and this was followed by a significant decrease in 2021 (2.60) and a minor rise in 2022 (2.21).

Table 1. *All-cause Mortality Trends in the Kurdistan Region, 2020–2023*

Year	Total deaths	Population	Crude death rate (per 1,000)	ASMR (per 1,000)
2020	16,891	6,100,000	2.63	2.51
2021	16,706	6,250,000	2.60	2.47
2022	14,193	6,350,000	2.21	2.11
2023	14,363	6,420,105	2.24	2.14

The same was also observed in age-standardized mortality rates (ASMR), which had declined to 2.51 per 1,000 in 2020, 2.11 in 2022, but increased slightly to 2.14 in 2023. Log-linear trend analysis showed an average change (APC) of percent of 5.2 per year (95% CI: -11.9 to 1.9; p=0.12) in a negative direction but not statistically significant.

Total mortality fell by around 14% in 2021-23, which is an indication that excess mortality caused by the pandemic had recovered. At a geographical level, there was always more crude mortality in Duhok and Halabja, compared to Raparin and Garmian.

Age and Sex Patterns of Mortality

Age-specific mortality rates increased substantially with age (Table 2). Mortality rates were low among children and young persons, from 0.10 per 1,000 population for age 5–14, to 0.19 per 1,000 population for age 15–24, and 0.56 per 1,000 population for age 25–34. Mortality rates increased gradually with increasing age: to 3.14 per 1,000 and 16.63 per 1,000 for 35–44 and 65–74 years, respectively; and to 13.68 per 1,000 among those aged 75 years and above. Over 50% of all recorded deaths occurred in the age group 55 years and above.

Table 2. *Age-specific mortality rates, Kurdistan Region, 2023*

Age group	Deaths	Population	Rate per 1,000
0–4	1,005	706,212	1.42
5–14	144	1,412,423	0.10
15–24	287	1,284,021	0.22
25–34	575	1,027,217	0.56
35–44	1,436	770,413	1.86
45–54	2,011	513,608	3.92
55–64	2,873	321,005	8.95
65–74	3,160	190,000	16.63
≥75	2,872	210,000	13.68

In 2023, the death rate of male is higher than that of females (2.41 and 2.05 per 1,000, respectively). The ratio of male-to-female mortality rate is 1.18. Male excess mortality can be observed in most of the adult age groups. The increase of deaths for older populations and male excess mortality can be explained by the increasing prevalence of chronic diseases and behavioural risk factors.

Cause-Specific Mortality Patterns

NCDs represented the highest proportion of mortality in 2023, making up more than 2/3 of all. Deaths (Table 3), with the main contributors being cardiovascular diseases (23%) and cancer (22%), contribute to almost half of all deaths. Additional causes of death were neurology (11%), respiratory diseases (9%), digestive diseases (8%), genitourinary diseases (6%), and endocrine diseases, including Diabetic Mellitus (5%). Such a pattern of death is typical of a more developed stage of the epidemiological transition.

Table 3. *Cause-specific Mortality Distribution, 2023*

Cause	Percentage of total deaths
Cardiovascular diseases	23%
Cancers	22%
Nervous system diseases	11%
Respiratory diseases	9%
Digestive diseases	8%
Genitourinary diseases	6%
Endocrine & diabetes	5%
Other causes	16%

External Causes of Death

Exposure to external factors was also a major cause of untimely deaths (Table 4). The number one external cause was road traffic injuries (RTIs) which reduced to 588 deaths in 2023, a 26 percent decrease since 2021. In the year 2023, suicide dropped to about 250 cases compared to over 430 in the year 2021. Minor but consistent causes of burden were firearm injuries, drowning, and burns or poisoning.

Even though the noted decrease was seen, the external causes were still disproportionately impacting younger adults and were a significant preventable factor of death.

Table 4. *External Causes of Death, 2021–2023*

Cause	2021	2022	2023
Road traffic injuries	795	694	588
Suicide (hanging)	>432	~300	~250
Firearm injuries	~97	~80	~60
Drowning	22	20	15
Burns/poisoning/electrocution	<50 each	<40 each	<30 each

Geographic Inequalities

Geographic variation was found to be tremendous within the region (Table 5). Duhok and Erbil always showed the highest rates of adult mortality and external-cause mortality, whereas Halabja and Raparin showed the lowest rates. These trends indicate that health risk, exposure to injuries and access to health services are unevenly distributed among directorates.

Table 5. *Geographic Disparities in Mortality Indicators, 2023*

Indicator	Highest directorates	Lowest directorates
Adult mortality	Duhok, Erbil	Raparin, Halabja
External causes	Erbil, Duhok	Halabja, Koya

Discussion

This study represents one of the first population-based reports of all-cause and cause-specific mortality trends in the Kurdistan Region of Iraq based on forensic mortality registry data. Three notable results were identified: (1) mortality patterns peaked in 2020 to 2021 and fell afterwards; (2) the mortality profile was characterized mainly by the presence of NCDs, especially CVDs and cancers; and (3) considerable geographically, age- and sex- related differences were witnessed in mortality across the region.

Mortality Trends and the Impact of COVID-19

Crude and age standardised mortality rates were highest in 2020–2021 followed by a decline, probably due to the effects of the COVID-19 pandemic. While mortality decreased over time during the study period, this decrease was not statistically significant (APC = 5.2% per year). This is in accordance with other studies reporting an increase in mortality during the COVID-19 pandemic followed by a slow return to baseline as vaccine coverage was increased and health systems adapted to the changing epidemiological landscape (World Health Organization, 2022; Karlinsky and Kobak, 2021).

The decrease seen after 2021 could be related to a decrease in COVID 19 death and recovery of pressures on the healthcare system, which were caused by the Pandemic. Several papers from previous studies have previously reported the increased indirect effects of the pandemic on the healthcare system and its influence on increased mortality from delays in diagnosis, demand for healthcare with chronic disease management for example, which caused excess deaths during pandemic years (Moynihan et al., 2021) and similar patterns of mortality were reported with other countries, where mortality levels gradually reduced after the peak of the pandemic (Woolf et al., 2021)

Epidemiological Transition and age pattern

Non-communicable diseases cause over two-thirds of all deaths, and cardiovascular diseases and cancers account for almost half of all deaths. Mortality rates started to skyrocket after 45 years, with the majority of deaths taking place among those aged 55 or older. This picture illustrates a clear case of an aging population and the advanced stage of epidemiological transition.

This trend is comparable to many other low and middle-income countries, as the transition towards urbanization and sedentarism, coupled with the increase in metabolic risk factors, has caused a rise in non-communicable diseases such as cardiovascular disease, diabetes, and cancer (GBD 2019 Risk Factors Collaborators, 2020; World Health Organization, 2022; Boutayeb, 2006). The large burden of premature adult mortality seen in this study may be indicative of problems with early disease identification, follow-up, and long-term management of risk factors.

External Causes and Premature Mortality

External causes, notably road traffic injuries and suicide, continued to be significant determinants of premature death even with an overall downward trend. The downward trend on death fell from road traffic injury may partly have been attributable to changes in the movement of the population during the COVID-19 pandemic, as well as the steady trend of road safety measures and traffic regulation for accident prevention. However, the persistent external causes of injury-related mortality revealed the importance of road safety, traffic infrastructure, traffic regulation, and injury control measures (World Health Organization, 2023).

The continued high levels of suicide-related mortality mean that there is a need to enhance community mental health and psychosocial services. Comparable trends have been indicated in circumstances where economic deprivation and post-conflict conditions have prevailed, with mental health needs not being fully understood and addressed (Reavley and Jorm, 2011).

Geographic Inequalities

Marked geographic variations in mortality within the Kurdistan Region were evident with higher mortality rates in Duhok and Erbil than in smaller administrative districts such as Raparin and Halabja. Variations in geographic mortality rates are usually thought to be associated with variations in socio-economic status, population density, access to health care, as well as environmental and occupational risks (Marmot, 2005). These data are a reminder of the need for sub-national health planning and distribution of health care resources in a more equitable fashion.

Sex Differences in Mortality

Mortality was consistently higher in males than in females, especially in the economically active population. As reported in the international literature, differences in male and female mortality may be due to increased exposure of men to risk factors from behaviors, work activities and injuries, and less use of preventative health services (Baker et al., 2014). These outcomes represent a significant challenge for public health prevention, to address the ill health of males, promote improvements in safety and reduce risk factors.

Public Health Implications

The findings of this study highlight three key public health priorities in the Kurdistan Region:

1. Upgrading of primary health care for the prevention, screening, and control of non-communicable diseases;
2. Improving prevention methods. In the contexts of prevention activities, such as road safety measures, or approaching mental health issues.
3. Minimizing the geographical inequalities using equitably distributed resources and robust subnational health information system. In addition, linking civil

registration and forensic mortality data has the potential to improve mortality surveillance systems, provide regular, reliable data on population health trends and inform health policy and planning (AbouZahr et al., 2015).

Limitations

There are several limitations to this study. Firstly, even though the forensic registry covers a large proportion of the population, misclassification of causes of death may have occurred, especially in morbidity-mortality in chronic diseases. Secondly, some variables, such as place of death and socioeconomic variables, had incomplete data, which prohibited more detailed stratified analysis. Thirdly, the study period was short, and the data were only available in annual time resolution, which might have impaired our statistical power to observe some possible significant temporal trends. Finally, the causal relationship cannot be obtained because of the observational design of this study.

Nevertheless, the study has some strengths. This study is one of the first population-based studies examining mortality trends in the Iraqi Kurdistan Region and draws on multiple years of registry data with excellent population coverage. The findings generate important evidence regarding mortality trends and patterns in a setting where population-based mortality data are scarce.

Conclusion

Mortality in the Kurdistan region demonstrated a declining trend during the study period, but this trend was not significant. Non-communicable diseases, especially CVDs and cancer, were still the predominant causes. However, external causes also played a major role in premature mortality. Several important regional-, age-, and sex-disparities in mortality were identified.

These findings also underscore the need to improve the prevention and control of chronic diseases, improve services for injury control and mental health, and address regional disparities in health. Strengthening mortality surveillance via integrated registration systems will be vital to provide the evidence for health planning and monitor future trends in epidemiology.

Ethics Approval and Consent to Participate

Ethical approval for this study was obtained from the Ministry of Health of the Kurdistan Region. The study used anonymized secondary data obtained from the Department of Forensic Medicine. No direct interaction with individuals occurred, and the requirement for informed consent was waived.

Data Availability

The data that support the findings of this study were obtained from the Department of Forensic Medicine, Kurdistan Regional Government. Data are not publicly available due to administrative restrictions, but are available from the corresponding author upon reasonable request and with permission from the relevant authority.

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