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

Background: *Mortality population-level data is critical to health planning, and these data are still lacking in the Kurdistan Region of Iraq, especially at the time of COVID-19. This paper looked at the trends and patterns in all-cause and cause-specific mortality between 2020 and 2023 through population-based forensic registries.* ***Methods:*** *The study is a population-based observational study based on death records of the Department of Forensic Medicine, 2020-2023. Deaths were compared in terms of age, sex, cause of death and geographic area. The mid-year population estimates were used to compute crude mortality rates and age-standardized mortality rates (ASMR). The temporal trends were evaluated by log-linear regression to determine the annual percent change (APC) with the 95 percent confidence intervals.* ***Results:*** *Annual deaths ranged from 14,193 to 16,891. Crude death rate decreased to 2.24 in 2023 and it was 2.63 in 2020. ASMR declined to 2.14/1,000/year (APC=−5.2%) (95% CI -11.9 to 1.9; p=0.12)) during the period of study. The death rate was growing very significantly with age, and was higher in the male population in comparison to the female population (2.41 to. 2.05 per 1,000 in 2023). More than two-thirds of the deaths were caused by non-communicable diseases, cardiovascular diseases (23%) and cancers (22%) being the most common. Outside factors especially road trauma injuries and suicide were still significant contributors to early deaths. The difference in geography was also noted, as the mortality was more prevalent in Duhok and Erbil.* ***Conclusions:*** *During the COVID-19, the mortality was highest followed by a decline, which was not statistically significant. Subordination of non-communicable diseases, chronic low-level mortality and inequalities in the regions underscore the necessity to reinforce the control of chronic diseases, prevention of injuries, and health planning on a subnational level. Evidence-based health policy needs to be supported by strengthened mortality surveillance.*

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

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 [1,2]. 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 [3]. The mortality pattern has changed dramatically on a global scale in recent years, with fewer 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 diseases [4,5]. 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 [6–8]. 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. [9–11].

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. [12]. 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 [13,14]. 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 [15]. 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 is the first study in the Kurdistan region of Iraq to analyze the mortality trends using a population-based study based on the existing data, following the international checklist Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The data was supported by the Department of Forensic Medicine at the regional government for a period of four years (2020- 2023). The Kurdistan region is composed of multiple provinces and districts with multi

diversity population and varies in access to the services of health care. The forensic department is a source of the registry death certificate with medical and legal investigation. The department officially records all the data systematically according to the standard protocol. Data for the current study were collected with complete anonymity without any access to the personal identifier.

Data source and Study population

The study population comprised every death recorded on the forensic mortality registry during the study period. The mortality data were collected anonymously and without access to personal identifiers. No exclusions were made based on age, sex or cause of death. For variables that were mismatched or with missing data, observations were excluded only for certain categorical stratified analysis. Population denominator data: Population denominator data including population estimates for each year of study, as well as age specific population structures, was taken from the Kurdistan Regional Statistics Office.

The study variables and their definition

The final analysis were done on the following variables; age at death, years of the death, gender, where possible the place of death whether in provinces or district, cause of the death based on internation classification (ICD-10) tenth revision, or the department protocol, status of the death as, natural, homicide, accident, or undetermined, also the place of death whether home, hospital, or anywhere. For the analysis, the cause of death was categorized based on major categories, including non-communicable or communicable disease, injuries, or 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 software was applied to analyze the data. First, there were descriptive statistics to show the mortality rate and numbers based on sex, age, and cause of death. The mortality rate was in terms of 100.00 population. The direct standardization methodology was used to calculate the age-standardized mortality rate, which is comprise of a standard reference population. The annual percent change trend analysis was used to evaluate the trend mortality

complemented with a confidence interval. The run of the differential mortality pattern was made on the basis of stratification of the mortality on the basis of age groups, sex and the principal cause of death. The paper taken into account P-values less than 0.05 as significant.

Data quality and bias

All mortality data were obtained from the registered system of the official forensic registry to avoid information bias using a uniform death reporting system that used throughout the Kurdistan Region. The documents were inspected for completeness and coherence; inconsistent or missing data led to exclusion during subgroup analysis by variable exclusion.

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).

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) full in a negative direction but not significant statistically.

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

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

Age and Sex Patterns of Mortality

The rate of mortality grew significantly with age (Table 2). The rates were very low in children and adolescents (<0.3 per 1,000), however, after 45, the rates increased dramatically to 16.4 per 1,000 among those aged between 65 and 74 years and 14.9 per 1,000 among those aged 75 and above. Patients aged 55 years and above contributed over 50 percent of all mortalities.

As of 2023, men were more likely to die than women with the rates of 2.41 and 2.05 per 1,000, respectively, and male-to-female mortality rate ratio equals 1.18. Most adult age groups are found to have excess male mortality.

Deaths among the older age groups and excess male mortality represent the growing population of chronic diseases and behavioural risk factors.

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	192,603	16.40
≥75	2,872	192,603	14.91

Cause-Specific Mortality Patterns

In the mortality profile in 2023, the largest portion of total deaths (more than two-thirds of all mortality) fell into the category of non-communicable diseases (NCDs) (Table 3). The top causes were cardiovascular diseases (23%) and cancers (22) that had almost fifty percent of all deaths. Other largely contributing were neurological disorders (11%), respiratory diseases (9%), digestive diseases (8%), genitourinary diseases (6%), and endocrine diseases such as diabetes (5%). This distribution is indicative of an developed epidemiological transition with chronic and degenerative diseases being predominant.

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 1 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 paper presents the first population-based evaluation of all-cause and cause-specific mortality patterns in the Kurdistan Region in the COVID-19 era based on the data of forensic registries. Three significant results were obtained, including: (1) the largest mortality was observed in 20202021, (2) the mortality pattern was characterized by the prevalence of non-communicable diseases (NCDs), (3) significant geographic, age, and sex inequality was found.

Mortality trends and the impact of COVID-19

The crude and age-standardized mortality rates rose in 20202021 and decreased thereafter, which is a temporal effect of the COVID-19 pandemic. Despite the overall trend having a falling direction, it was not significantly different (APC was -5.2% per year). This trend is in line with worldwide trends of disproportionate mortality during the pandemic and the subsequent slow recovery with the rise of vaccine coverage and health system adjustments [16,17].

The reported decrease after 2021 can probably be explained by the direct impact of the decrease in COVID-19 mortality and indirect recovery due to the pandemic-related disruptions (when compared to the delay in diagnosis, a decrease in health-care usage, and disruptive effects on the chronic disease management) [18]. The same trend of stabilizing post-pandemic mortality has been observed in various middle-income countries, with excess mortality in part motivated by indirect effects on the health system [19].

Epidemiological transition and age pattern

NCDs contributed over two-thirds of the deaths, and almost half of all deaths were a result of cardiovascular diseases and cancers. Deaths rose dramatically beyond the age of 45 and most of the deaths were among those aged 55 and above. These results support the high level of epidemiological transition with aging of the population and increased chronic diseases.

This trend is similar to the evidence seen in the low-income and middle-income regions of the world, where urbanization, sedentary living, and changes in metabolic risk factors are driving changes in cardiovascular disease, diabetes, and cancer upward [2022]. The presence of high rates of premature adult death indicates the absence of early detection, sustainability of care, and control of long-term risk factors.

External causes and premature mortality

Exposure to external factors especially road traffic injuries and suicide continued to be significant factors contributing to premature deaths despite negative trends. This decrease in road accidents caused by traffic could be associated with mobility behavior shifts during the pandemic or slow shifts in

enforcement and road safety conditions. However, the persistence of burden indicates persistent problems associated with traffic control, infrastructure, and injury prevention [23].

The continuing incidences of suicide highlight the necessity of enhanced mental health and psychosocial services in the community. The same trends have been reported in those environments that have been influenced by economic stress and post-conflict states, with mental health requirements frequently under-acknowledged [24].

Geographic inequalities

Significant variances at the regional level were also noted, as the mortality was higher in Duhok and Erbil than in smaller directorates like Halabja and Raparin. Mortality is generally interrelated with geographic variation in socioeconomic conditions, population density, availability of health services, and environmental and occupational risk exposure [25]. Such findings underline the necessity of sub-regional planning of health and more balanced distribution of resources.

Sex differences in mortality

Male mortality rates were always higher as compared to female mortality, especially in working ages. Such a trend is in line with the evidence on a global level and it can be a result of increased exposure to behavioral risk factors, occupational hazards and injuries and reduced use of preventive health services by men [26]. Proper male-specific measures to deal with male health behaviors and work safety are thus justified.

Public health implications

The results state that the Kurdistan Region has three areas of priority:

1. 1.Primary health care can be used to strengthen prevention and management of NCDs.
2. 2.Development of injury prevention measures especially road safety and mental health services.
3. 3.Minimizing the inequality by geography with the help of selective distribution of resources and subnational monitoring.

The integration of civil registration and forensic data will be the important step to strengthening the mortality surveillance in terms of tracking trends and evidence-based health policy [27].

Limitations

This study has a number of limitations. To begin with, despite the wide coverage of the population by the forensic records, there is the possibility of misclassifying the cause of death, especially when it comes to chronic conditions. Second, certain variables such as place of death and socioeconomic indicators were not complete thus inhibiting further stratified analysis. Third, the study period and annual aggregation were relatively short and therefore did not have sufficient statistical power to identify significant changes over time. Lastly, the observational design is not suitable to make causal attributions of changes in mortality to particular health system or policy variables.

These limitations notwithstanding, important understanding of mortality patterns in a region which has had limited evidence is provided by using of multi-year population-level registry data.

Conclusion

During the COVID-19 period, the mortality in the Kurdistan Region was higher and decreased afterwards, but the negative trend was not statistically significant. The major causes of death are the non-communicable diseases, especially cardiovascular diseases and the cancers, and also the external causes play the significant role of premature death. There was the presence of significant geographic, age, and sex imbalances.

The priority should be put in strengthening chronic disease control, injury prevention, mental health services, and equity of the regional health system. Enhanced monitoring of mortality via unified registration systems will be of primary importance in evidence-based health planning and predicting the future epidemiological patterns.

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