

Mortality Trends and Leading Causes of Death in Najaf Governorate, Iraq: A Comprehensive Analysis (2019-2022)

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Abstract: This study aimed to analyze the leading causes of mortality in the Najaf Governorate, Iraq, from 2019 to 2022, using data from the Iraq Health Information System (HIS), local hospitals, and Al-Sadr Medical City. The research focused on the most prevalent categories, represented by ICD-10 codes. The results revealed that ischemic heart diseases and chronic kidney disease were consistently among the top causes of death during the study period, with COVID-19-related mortality also becoming prominent in 2020 and 2021. The age distribution of deaths showed a high risk of death for infants aged 0 years across all three years, highlighting the need for improved maternal and child healthcare services. Additionally, differences in mortality rates between males and females were observed, with certain causes of death, such as hypertensive diseases, being more prevalent in females, while car occupant injuries in transport accidents and malignant neoplasms of the bronchus and lung were more common in males. The study recommends strengthening the Health Information System, implementing targeted prevention and management strategies for non-communicable diseases, addressing infant mortality, and developing gender-specific health interventions. Collaboration with international organizations and further research are also suggested to inform evidence-based policies and programs tailored to the needs of the Najaf Governorate.

keywords: Najaf Governorate, Mortality rates, Leading causes of death, Age distribution, Infant mortality, Gender differences, ICD-10 codes, Cardiovascular diseases, Chronic kidney disease, COVID-19 pandemic.

INTRODUCTION

INTRODUCTION Differences in mortality patterns among regions and countries highlight the need for precise, up-to-date cause-specific mortality data to inform successful public health strategies [1]. The Iraq Health Information System (HIS), similar to many health systems in lower-middle-income countries, encounters issues such as insufficient vital registration systems, inadequate healthcare professional training, and limited inter-agency cooperation. As a result, unreliable and incomplete cause of death (CoD) data impede the creation of focused interventions and policies [2].

The Najaf Governorate in central and southern Iraq has attracted public health researchers' attention due to its unique demographic and health features. Nevertheless, data on the area's primary causes of death are limited [3]. Identifying prevalent mortality causes is crucial for healthcare planning, resource allocation, and targeted intervention strategies. Our study examines the main mortality causes in the Najaf Governorate from 2019 to 2022, focusing on the most common categories denoted by ICD-10 codes [4]. This examination will reveal the specific health challenges faced by the Najaf Governorate population and pinpoint potential areas for intervention and policy enhancement.

Iraq's health system continues to grapple with the repercussions of war, sanctions, loss of health workers, looting, and political interference. Health facilities and workforce distribution are uneven, posing significant obstacles to meeting the nation's health requirements. Although the Ministry of Health is attempting to rectify these disparities, achieving equal healthcare access across Iraq remains a difficult and intricate task [5, 6].

The prevailing health strategy is fragile and disjointed, focusing mainly on clinical services, while critical public health issues like smoking, obesity, and non-communicable diseases are insufficiently addressed [7]. Additionally, healthcare financing and the role of private healthcare have only recently started to be tackled, signifying urgent concerns for the health sector [8,9].

In Iraq, protecting children's well-being is crucial, as they represent any nation's future growth and development potential. Ensuring their health and safety is a vital responsibility that transcends cultural and geographical boundaries [10]. Our research, centered on Najaf in Iraq, aims to offer valuable insights into the leading mortality causes. By analyzing mortality patterns and identifying areas needing immediate attention, this study intends to contribute to the creation of targeted public health interventions and policies that improve children's health and well-being in Iraq. In doing so, it highlights the importance of investing in children's health to nurture a more resilient and prosperous society for future generations.

This research expands the existing knowledge of mortality patterns in Iraq, supporting the development of more focused and effective public health policies and interventions. By providing an extensive analysis of the leading causes of death in the Najaf Governorate between 2019 and 2022, our study addresses a critical knowledge gap and contributes to wider efforts to reinforce the Iraq Health Information System (HIS) and improve its ability to guide evidence-based policymaking. Ultimately, our findings will direct the development of targeted public health

interventions and policies, promoting collaboration among local, national, and international stakeholders in tackling the identified health challenges.

Methodology:

Study Setting: The study was conducted in Najaf Governorate, a region in central Iraq. The focus was on analyzing the leading causes of mortality in the area from 2019 to 2022. The governorate's population and healthcare system were considered to better understand the context in which the data was collected and analyzed.

Data Collection and Analysis: This study employed a combination of data sources to analyze the number of deaths and their causes in the Najaf Governorate. Mortality data were collected from the Najaf Health Department, local hospitals, and Al-Sadr Medical City. For the years 2019, 2020, and 2021, data were obtained and cleaned to remove missing information. In 2019, the total number of recorded deaths was 6,733, which was reduced to 5,948 after data cleaning. In 2020, there were 8,356 recorded deaths, and in 2021, there were 8,838 recorded deaths. In 2022, data were collected from Al-Sadr Medical City in Najaf, totaling 2,299 deaths.

Causes of death were categorized based on the International Classification of Diseases, 10th Revision (ICD-10) codes. The study focused on the top five causes of death for each year and their respective percentages of the total mortality rate. Age distribution and gender differences in mortality rates were also analyzed. The results were analyzed using SPSS v29 and Microsoft Excel software to process and visualize the data.

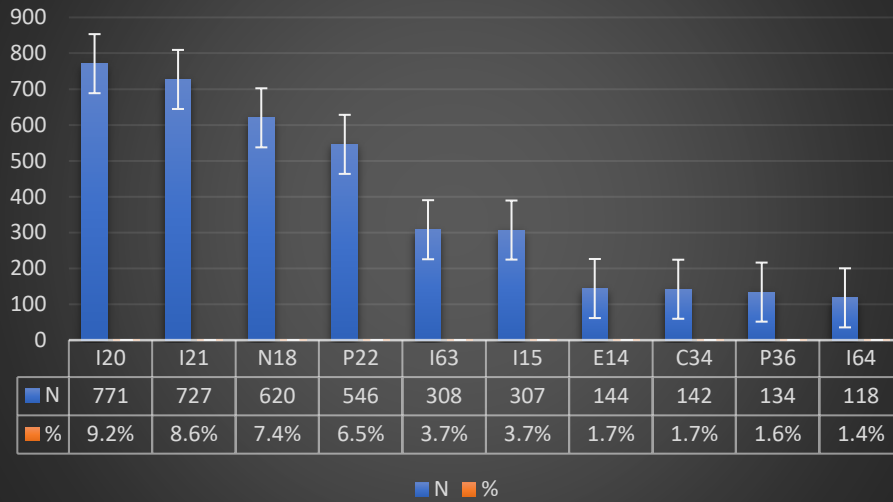
During the data collection process, challenges were encountered, including time constraints and the reluctance of some hospitals to provide information. These limitations were taken into account when interpreting and discussing the results of the study.

Results:

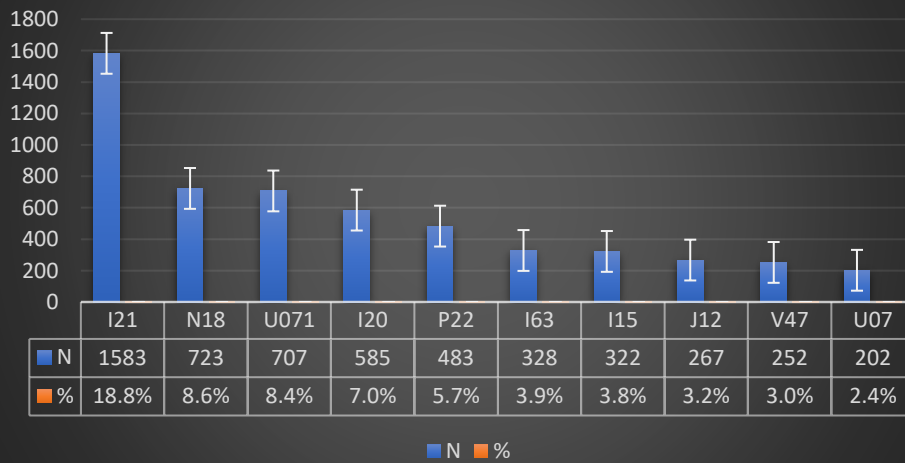
In this section, we present the results of our analysis of the leading causes of death, age distribution of mortality, and the gender differences in mortality rates in the Najaf Governorate from 2019 to 2022. Four chart groups have been included to visually represent the findings. The results presented here serve as a foundation for further research, facilitating the identification of potential areas for intervention and policy improvements, ultimately supporting the overall goal of enhancing health outcomes in the Najaf Governorate and across Iraq.

Leading Causes of Mortality per Year Chart Title: "Leading Causes of Mortality per Year (2019-2022)"

2019



2020





These charts illustrate the leading causes of mortality for each year, with each cause represented by a different color in the stacked bar chart. The data used to create this chart is based on the ICD-10 codes and corresponding death frequencies provided earlier in the research.

Based on the provided data, the leading causes of death in the Najaf Governorate between 2019 and 2022, as per the ICD-10 codes, can be analyzed as follows:

In 2019, the top causes of death were:

1. I20 (Ischemic heart disease) at 9.2%
2. I21 (Acute myocardial infarction) at 8.6%

3. N18 (Chronic kidney disease) at 7.4%
4. P22 (Respiratory distress of newborn) at 6.5%
5. I63 (Cerebral infarction) at 3.7% These top five causes constituted 35.4% of total deaths in 2019.

In 2020, the leading causes of death were:

1. I21 (Acute myocardial infarction) at 18.8%
2. N18 (Chronic kidney disease) at 8.6%
3. U071 (COVID-19 virus identified) at 8.4%
4. I20 (Ischemic heart disease) at 7.0%
5. P22 (Respiratory distress of newborn) at 5.7% These top five causes made up 48.5% of total deaths in 2020.

In 2021, the primary causes of death were:

1. I21 (Acute myocardial infarction) at 17.2%
2. U071 (COVID-19 virus identified) at 12.5%
3. I20 (Ischemic heart disease) at 9.2%
4. N18 (Chronic kidney disease) at 7.6%
5. P22 (Respiratory distress of newborn) at 4.9% These top five causes accounted for 51.4% of total deaths in 2021.

In 2022, the highest causes of death were:

1. I20 (Ischemic heart disease) at 5.8%
2. N18 (Chronic kidney disease) at 5.0%
3. I15 (Hypertensive heart disease) at 3.9%
4. E14 (Unspecified diabetes mellitus) at 2.7%
5. I63 (Cerebral infarction) at 1.7% These top five causes represented 19.1% of total deaths in 2022.

Please note that the percentages for 2022 should still be interpreted with caution, as the data was derived from a single source (Al-Sadr Medical City) and does not encompass all recorded deaths within the Najaf Governorate.

From these results, it can be observed that ischemic heart disease (I20) and acute myocardial infarction (I21) consistently ranked among the top causes of death across all four years. Furthermore, chronic kidney disease (N18) and respiratory distress of the newborn (P22) were

also among the leading causes in most years. COVID-19 (U071) emerged as a major cause of death in 2020 and 2021, highlighting the impact of the pandemic on mortality in the region.

Table 1: Trend causes of deaths (2019-2022).

2019	Percentage1	2020	Percentage2	2021	Percentage3	2022	Percentage4
I20	9.2%	I21	18.8%	I21	17.2%	I20	5.8%
I21	8.6%	N18	8.6%	U071	12.5%	N18	5.0%
N18	7.4%	U071	8.4%	I20	9.2%	I15	3.9%
P22	6.5%	I20	7.0%	N18	7.6%	E14	2.7%
I63	3.7%	P22	5.7%	P22	4.9%	I63	1.7%
I15	3.7%	I63	3.9%	I63	3.8%	I21	1.2%
E14	1.7%	I15	3.8%	V47	3.5%	J80	1.2%
C34	1.7%	J12	3.2%	I15	2.8%	C34	0.7%
P36	1.6%	V47	3.0%	J80	2.5%	I68	0.6%
I64	1.4%	U07	2.4%	I68	2.3%	J18	0.4%
Total	45.4%		64.9%		66.5%		23.1%

The analysis of the leading causes of death in the Najaf Governorate from 2019 to 2022 reveals several important trends and insights that can inform healthcare policy and resource allocation.

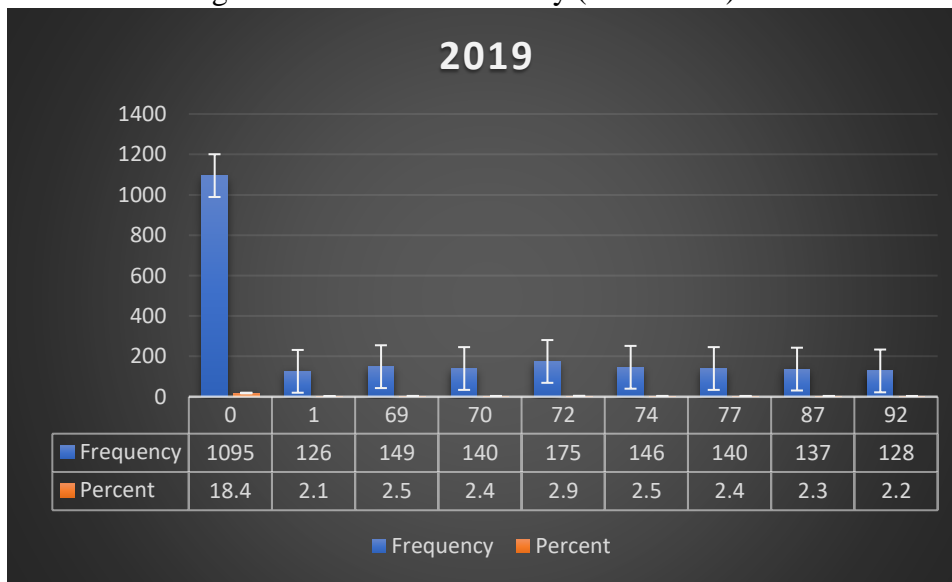
1. **Cardiovascular diseases:** Ischemic heart disease (I20) and acute myocardial infarction (I21) consistently ranked among the top causes of death across all four years. This highlights the significant burden of cardiovascular diseases in the Najaf Governorate. It suggests that more targeted public health interventions, such as promoting healthy lifestyles, early screening, and better access to healthcare, are needed to reduce the prevalence of these diseases.
2. **Chronic kidney disease (N18):** Chronic kidney disease emerged as a leading cause of death in most years, indicating that it is another area of concern for public health. Factors contributing to chronic kidney disease may include diabetes, hypertension, and lifestyle factors. Improving the management of these conditions and increasing awareness about kidney health could help reduce the burden of chronic kidney disease in the region.
3. **Respiratory distress of the newborn (P22):** Respiratory distress of the newborn was among the top causes of death in 2019, 2020, and 2021. This highlights the need for improved neonatal care and the importance of addressing underlying factors such as maternal health, prenatal care, and access to healthcare facilities for expecting mothers and newborns.
4. **COVID-19 pandemic (U071):** COVID-19 emerged as a major cause of death in 2020 and 2021, illustrating the significant impact of the pandemic on mortality in the Najaf Governorate. This emphasizes the importance of effective public health measures, such as vaccination, early detection, and appropriate management of cases, to mitigate the impact of infectious diseases on the population.

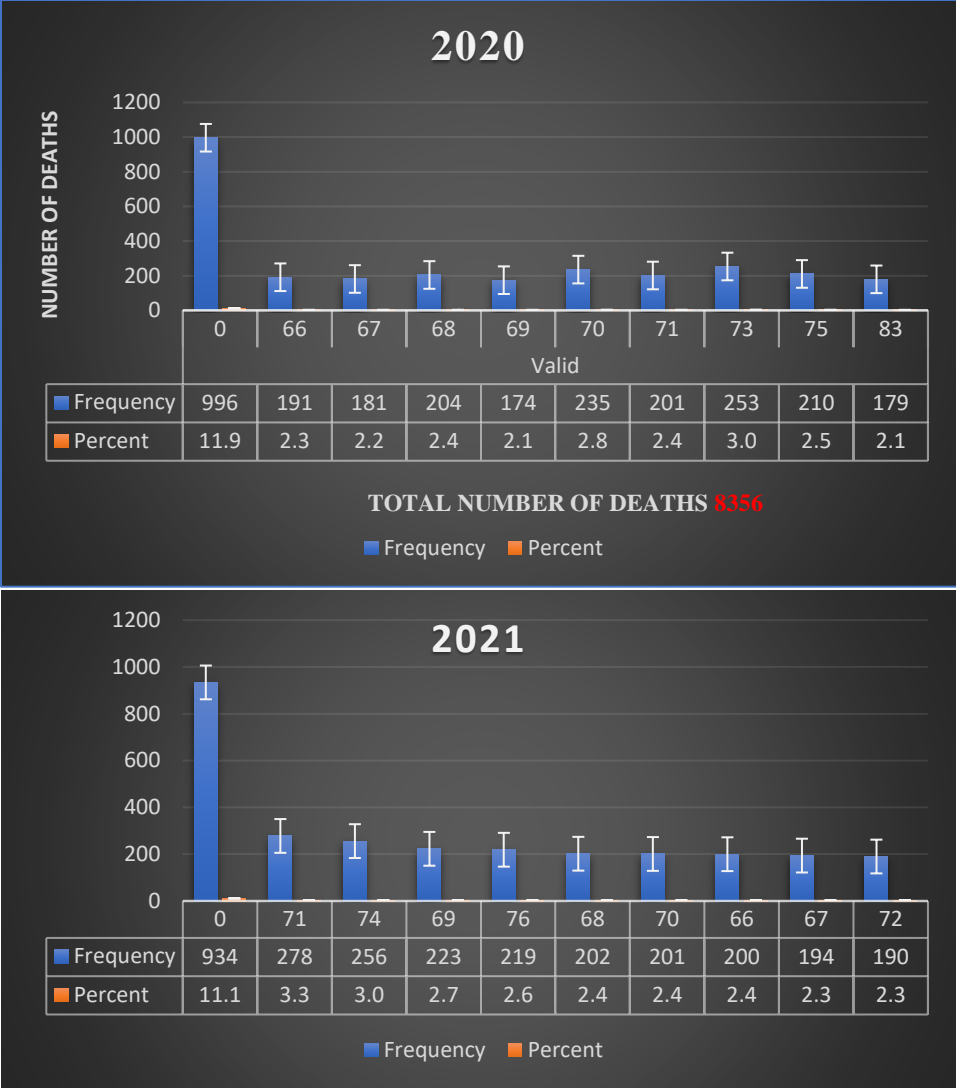
- Differences in data sources: The data for 2022, derived from Al-Sadr Medical City, only accounted for a portion of the recorded deaths within the Najaf Governorate. Therefore, the results for 2022 should be interpreted with caution, as they may not accurately represent the overall mortality trends in the region.

Overall, these results demonstrate the importance of understanding the leading causes of death to inform healthcare policy and resource allocation in the Najaf Governorate. Focusing on addressing the major causes of mortality, such as cardiovascular diseases, chronic kidney disease, and respiratory distress in newborns, can help improve overall public health outcomes. Moreover, continued monitoring of mortality trends is essential to evaluate the impact of public health interventions and identify emerging health challenges, such as the COVID-19 pandemic.

Age Distribution of Mortality (Chart 2 group)

Charts Title: "Age Distribution of Mortality (2019-2021)"





These charts show the age distribution of mortality for each year. This helps to visually demonstrate the age groups with the highest mortality rates.

The analysis of the age distribution of deaths in the Najaf Governorate across the years 2019, 2020, and 2021 highlights a concerning trend: the highest risk of death is observed in the 0-year age category, which includes infants and newborns.

2019: In 2019, there were 1,095 deaths (18.4%) in the 0-year age category out of the total 5,948 recorded deaths. This indicates that nearly one in five deaths occurred in the infant age group, suggesting a pressing need to address factors contributing to high infant mortality rates.

2020: In 2020, the 0-year age category accounted for 996 deaths (11.9%) out of the total 8,356 recorded deaths. Although the percentage decreased from 2019, it still represents a significant proportion of all deaths, reinforcing the importance of addressing infant mortality.

2021: In 2021, the 0-year age category experienced 934 deaths (11.1%) out of the total 8,838 recorded deaths. This continued decline in the percentage of infant deaths compared to the

previous years is a positive trend. However, it is still a concerning figure, as more than one in ten deaths occurred in this age group.

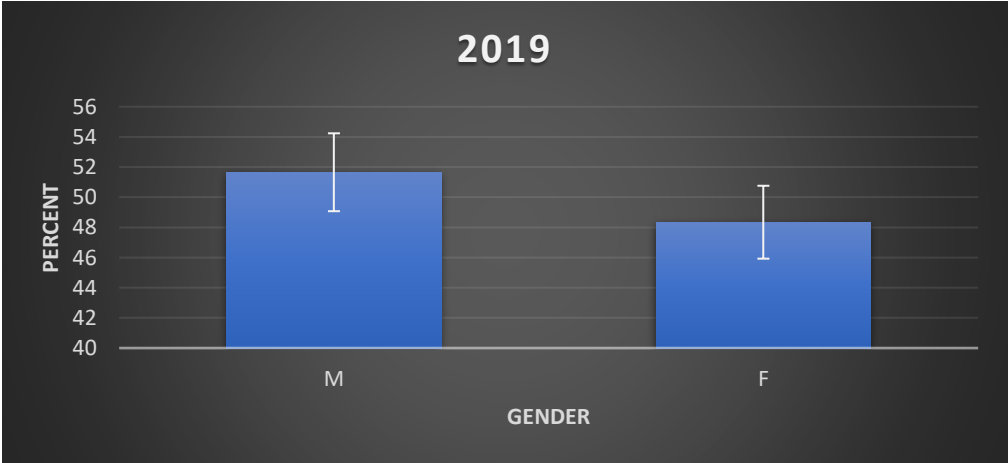
The consistently high proportion of deaths in the 0-year age category across all three years underscores the need for targeted interventions to reduce infant mortality in the Najaf Governorate. Potential areas of focus include:

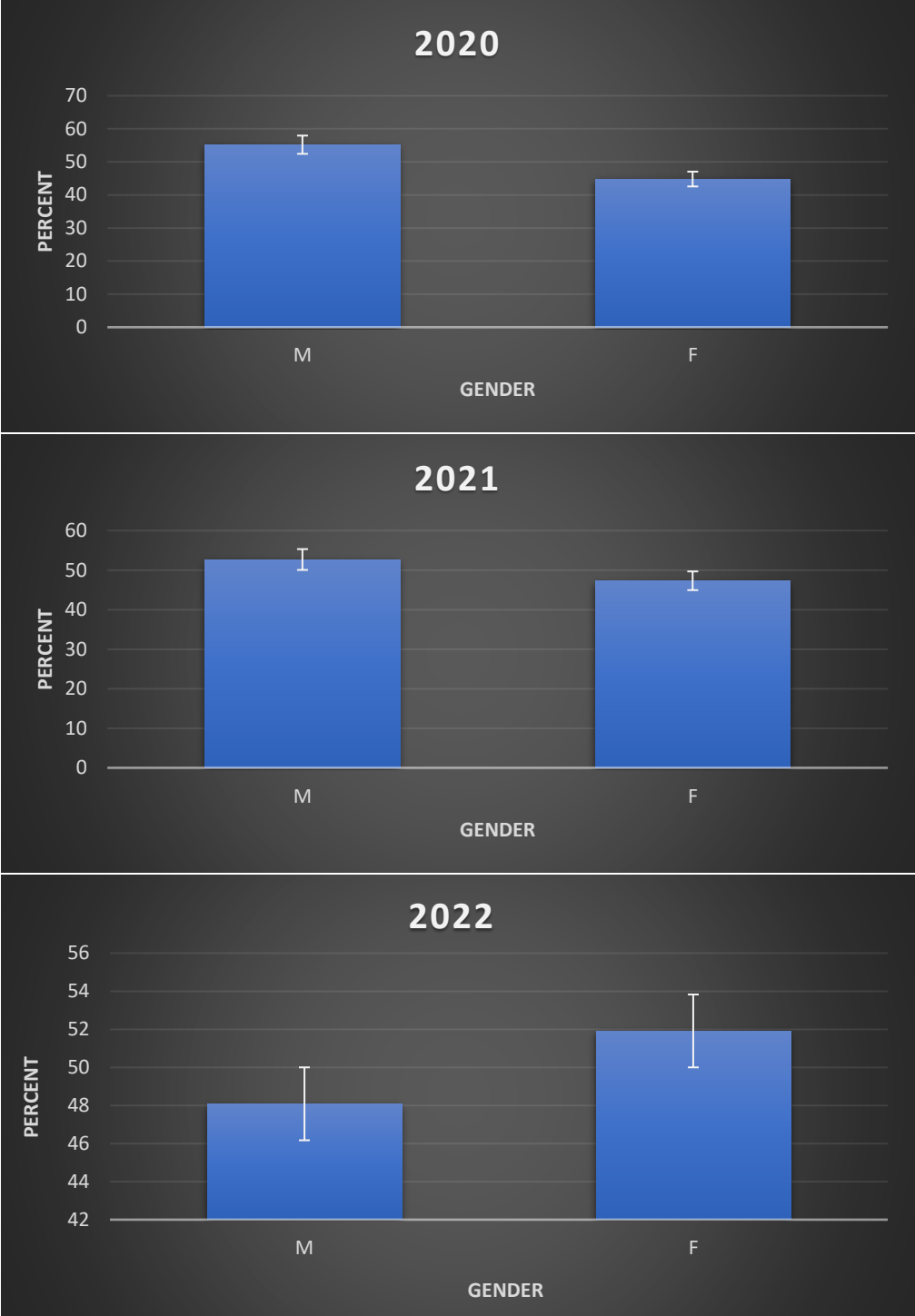
- 1. Improving maternal health: Ensuring proper prenatal care, managing high-risk pregnancies, and promoting healthy behaviors during pregnancy can significantly impact infant health outcomes.
- 2. Enhancing neonatal care: Providing adequate resources, training, and staffing for neonatal care units, as well as implementing evidence-based practices to manage common newborn complications, can contribute to reduced infant mortality rates.
- 3. Expanding access to healthcare services: Ensuring that expecting mothers and infants have access to quality healthcare facilities and providers can greatly improve health outcomes in the 0-year age category.
- 4. Addressing socio-economic factors: Tackling underlying factors such as poverty, education, and access to clean water and sanitation can have a lasting impact on reducing infant mortality rates.

Continued monitoring of age distribution data and the implementation of targeted interventions can help reduce infant mortality rates in the Najaf Governorate, ultimately improving overall public health outcomes in the region.

Gender Proportion of Total Deaths per Year (Chart 3 group)

Charts Title: "Gender Proportion of Total Deaths per Year (2019-2022)"





This chart displays the proportion of male and female deaths for each year. This allows for a comparison of gender differences in mortality rates across the years.

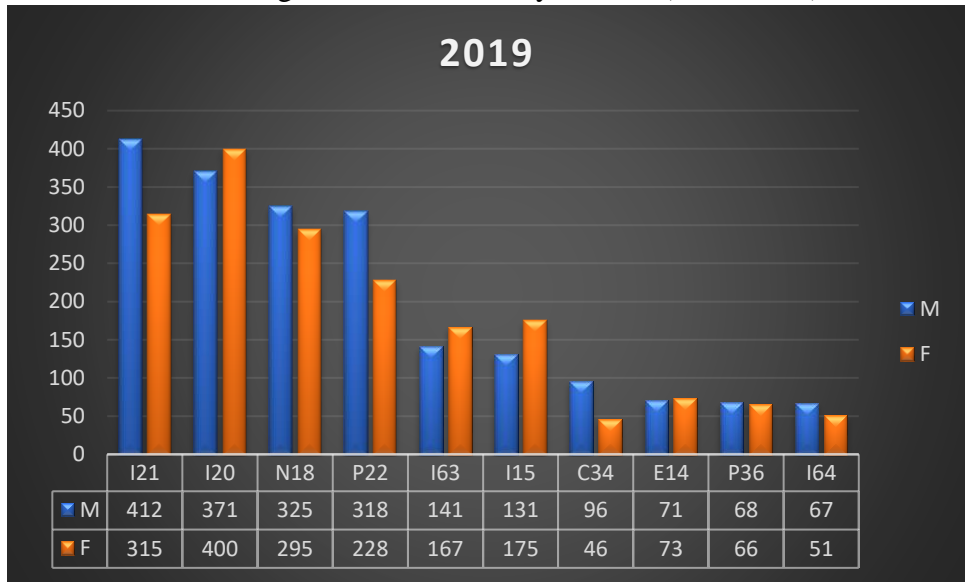
In the analysis of gender distribution in deaths for the years 2019, 2020, and 2021, it was observed that the percentage of male deaths was consistently higher than that of female deaths.

However, in 2022, the trend appeared to reverse, with female deaths surpassing male deaths in percentage. It is important to note that the data for 2022 is derived exclusively from Sadr Medical City and may not be representative of the entire Najaf Governorate. Therefore, caution should be exercised when interpreting the 2022 data.

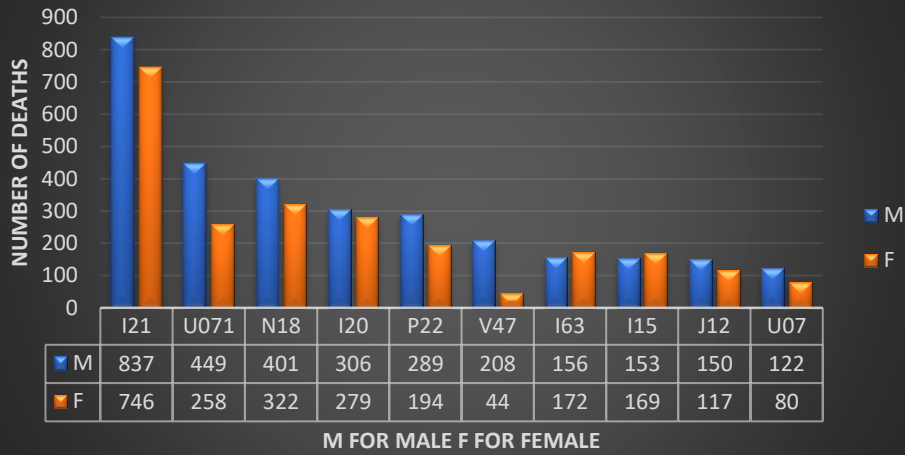
To provide a more comprehensive and accurate understanding of the gender distribution in deaths for the Najaf Governorate, further research and data collection from additional sources are recommended. This will help to determine whether the observed trend in 2022 is an anomaly or indicative of a broader shift in the gender distribution of deaths in the region.

Leading Causes of Death by Gender (Chart 4 group)

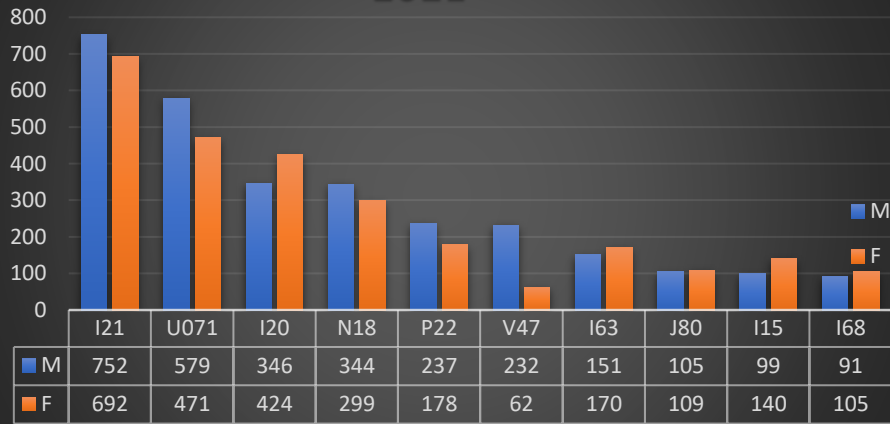
Charts Title: "Leading Causes of Death by Gender (2019-2022)"



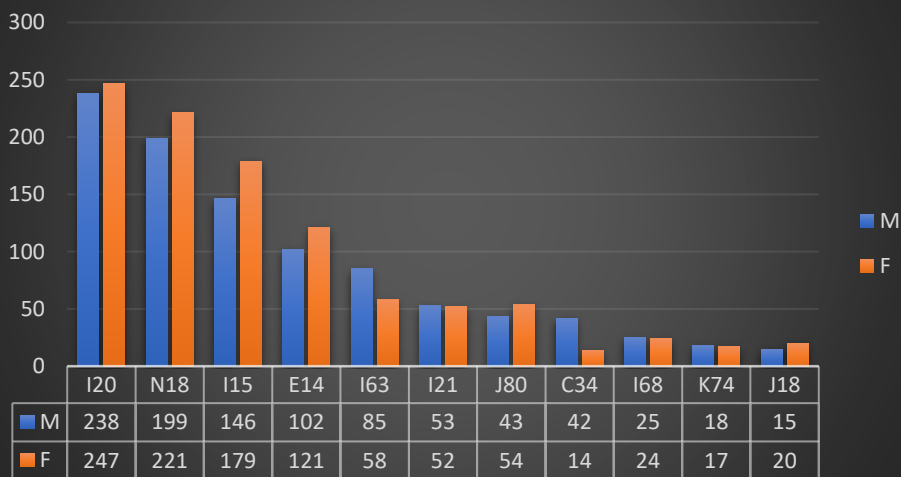
2020



2021



2022



These charts compare the leading causes of death for males and females, with each gender represented by a different color in the grouped bar chart. This provides a visual representation of the differences in the leading causes of death between males and females in the Najaf Governorate from 2019 to 2022.

The analysis of cause-specific mortality data by gender revealed that, for most causes of death, the male to female ratio was relatively similar across all years studied. However, some notable differences were identified.

For instance, it was observed that hypertensive disease (I15), a cause of death more prevalent among females, consistently exhibited a higher rate in females across all years. On the other hand, car occupant injured in transport accident (V47) and malignant neoplasm of bronchus and lung (C34) were found to be more common among males, with rates nearly double or more than those observed in females.

These results indicate that while the overall gender distribution of deaths was similar across most causes, specific causes such as hypertensive disease, car occupant injured in transport accident, and malignant neoplasm of bronchus and lung exhibited distinct differences between males and females. Further research is needed to better understand the factors contributing to these variations in gender-specific mortality rates for these particular causes of death.

Discussion

This study aimed to analyze the leading causes of death in the Najaf Governorate from 2019 to 2022, focusing on the most prevalent categories, represented by ICD-10 codes. The research results provide valuable insights into the mortality patterns in the region.

Leading causes of death: The analysis revealed that ischemic heart diseases (I20, I21) were among the top causes of death in all years, contributing significantly to the mortality rates in the region. Chronic kidney disease (N18) also ranked high in all years, highlighting the burden of non-communicable diseases in the Najaf Governorate. Notably, in 2020 and 2021, COVID-19 (U071) emerged as a significant cause of death, reflecting the global pandemic's impact on the region.

Age distribution of deaths: The age distribution of deaths showed that the 0-year age group was at the highest risk of death in 2019, 2020, and 2021. This finding indicates a high infant mortality rate in the region, which requires further investigation to determine the contributing factors and devise effective interventions to improve child survival rates.

Gender differences in mortality rates: In 2019, 2020, and 2021, the percentage of male deaths exceeded that of female deaths. However, in 2022, the percentage of female deaths surpassed that of males. It is essential to note that the 2022 data was solely sourced from Al-Sadr Medical City and may not be representative of the entire Najaf Governorate.

Gender differences in causes of death: The results showed that the male-to-female ratio in cause-specific mortality was relatively similar for most causes of death. However, there were some exceptions. Hypertensive disease (I15) was more prevalent among females in all years, while car occupant injured in transport accident (V47) and malignant neoplasm of bronchus and lung (C34) were more common among males, with rates nearly double or more than those observed in females.

These results provide a comprehensive understanding of the mortality patterns in the Najaf Governorate. The leading causes of death, age distribution, and gender differences in mortality rates offer essential information for healthcare policy and resource allocation. This information can be used to tailor public health interventions, prevention programs, and healthcare services to address the specific needs of the population.

It is crucial to recognize the limitations of the study, particularly the 2022 data, which was derived from a single source (Al-Sadr Medical City) and may not represent the entire governorate. Further research is needed to validate these findings and explore the underlying factors contributing to the observed mortality patterns. The identification of modifiable risk factors, such as lifestyle and environmental factors, will be instrumental in developing targeted interventions to reduce the burden of disease and improve the overall health of the population in the Najaf Governorate.

Conclusion

This study provided a detailed analysis of the leading causes of death in the Najaf Governorate from 2019 to 2022, using ICD-10 codes to classify the causes of mortality. The research findings offer valuable insights into the region's mortality patterns, which can inform healthcare policy and resource allocation decisions.

The main conclusions drawn from this study are as follows:

Ischemic heart diseases and chronic kidney disease were consistently among the top causes of death in the Najaf Governorate from 2019 to 2022. This finding highlights the significant burden of non-communicable diseases in the region and underscores the need for targeted prevention and management strategies.

COVID-19 emerged as a major cause of death in 2020 and 2021, reflecting the global pandemic's impact on the Najaf Governorate. This highlights the importance of continued efforts to control the spread of the virus, vaccinate the population, and strengthen the region's healthcare system.

The high mortality rate observed in the 0-year age group across the years indicates a pressing need to address infant mortality in the region. Efforts should focus on improving maternal and child health services, promoting immunization, and identifying and addressing the underlying factors contributing to infant mortality.

The observed gender differences in mortality rates and cause-specific mortality suggest that tailored interventions may be necessary to address the unique health needs of men and women in the Najaf Governorate. In particular, hypertensive disease was more common among females, while car occupant injuries in transport accidents and malignant neoplasms of the bronchus and lung were more prevalent among males.

The limitations of the study, particularly the 2022 data derived from a single source, emphasize the need for further research to validate these findings and explore the contributing factors to the observed mortality patterns. Identifying modifiable risk factors and developing targeted interventions will be crucial for reducing the burden of disease and improving the overall health of the population in the Najaf Governorate.

Overall, this study provides a comprehensive understanding of the mortality trends and leading causes of death in the Najaf Governorate from 2019 to 2022. These findings can serve as a foundation for future research and inform the development of public health interventions and healthcare policies to address the specific needs of the population in the region.

Recommendations

Based on the findings of this study, the following recommendations can be made to address the identified mortality patterns and improve public health in the Najaf Governorate:

1. **Strengthen the Health Information System:** The government should focus on enhancing the quality, accuracy, and comprehensiveness of the Health Information System in the Najaf Governorate. This includes establishing a formal inter-agency committee to facilitate better coordination and data sharing among various agencies.
2. **Address Non-Communicable Diseases:** Develop targeted prevention and management strategies for non-communicable diseases such as ischemic heart disease and chronic kidney disease, which were identified as significant causes of death in the region. This could include promoting healthy lifestyle behaviors, increasing access to healthcare services, and implementing screening programs.
3. **Tackle Infant Mortality:** Improve maternal and child healthcare services, with a focus on addressing infant mortality in the region. Strategies could include enhancing prenatal care, promoting breastfeeding, ensuring access to immunization, and implementing education programs for parents and caregivers.
4. **Implement Gender-Specific Interventions:** Design and execute gender-specific health interventions to address the unique health needs of men and women in the Najaf Governorate. This includes raising awareness about gender-specific risk factors and implementing targeted prevention and treatment programs.
5. **Maintain COVID-19 Control Measures:** Continue efforts to control the spread of COVID-19, emphasizing vaccination campaigns, public health education, and strengthening healthcare infrastructure to manage potential future outbreaks.
6. **Promote Road Safety Initiatives:** Develop and implement road safety initiatives to reduce the prevalence of car occupant injuries in transport accidents, particularly among males. This could involve improving road infrastructure, promoting driver education, and enforcing traffic regulations.
7. **Establish Comprehensive Cancer Control:** Develop a comprehensive cancer control strategy that focuses on prevention, early detection, and effective treatment for cancers.

such as malignant neoplasms of the bronchus and lung. This may include promoting awareness about cancer risk factors, implementing screening programs, and increasing access to specialized cancer care.

8. **Conduct Further Research:** Carry out additional research to validate the findings of this study, explore the factors contributing to the observed mortality patterns, and evaluate the effectiveness of implemented public health interventions in the Najaf Governorate.
9. **Collaborate with International Organizations:** Partner with international organizations and experts to learn from global best practices, access resources and technical assistance, and develop evidence-based policies and programs tailored to the needs of the Najaf Governorate.

By addressing these recommendations, the Najaf Governorate can work towards reducing the burden of disease, improving overall public health, and enhancing the quality of life for its population.

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