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Research Article

Childhood Mortality in Saudi Arabia: Analysis of 50 Years (1973–2022)

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Abstract

Background: Infant mortality rate (IMR) refers to the likelihood that a newborn will not survive to their first birthday; it is expressed per 1000 live births. Globally, the IMR represents a considerable proportion of under-five mortality. This study aimed to investigate and compare IMR trends and patterns in Saudi Arabia by decade and sex over 50 years.

Methods: Data on the IMR in Saudi Arabia from 1973 to 2022 were extracted from the UNICEF database. The mean mortality rates every 10 years were calculated and then compared over decades between males and females using a chi-square test. A two-sided *P*-value <0.05 was deemed statistically significant.

Results: The IMR was highest in 1973 (102.9 per 1000 live births; 107.3 males vs 98.1 females) and lowest in 2022 (5.4 per 1000 live births; 5.6 males vs 5.3 females). The statistical analysis results revealed a significant decline in the mean IMR from 1973 to 2022 ($P < 0.01$), with no difference between male and female IMR in any of the five decades.

Conclusion: Saudi Arabia's success in reaching the SDG for infant mortality reflects decades of improvements in healthcare, driven by the Vision 2030 framework. This effort has continuously decreased infant and under-five mortality rates due to improved medical services, including enhanced access to maternal and child healthcare, advanced neonatal care, and comprehensive immunization programs.

Keywords: infant, mortality, neonate, UNICEF, Saudi Arabia

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1. Introduction

The infant mortality rate (IMR) refers to the likelihood that a newborn will not survive to their first birthday [1]. The IMR includes all deaths during the neonatal period (0 to 27 days) and the postneonatal period (28 days to 12 months) per 1000 live births. Globally, the IMR represents a considerable proportion of under-five mortality [2, 3]. In the Middle East and North Africa (MENA), most deaths among children under five years old have been attributed to infant deaths, accounting for 75.9% in 1990 and 81.8% in 2019 [3]. The World Health Organization (WHO) has estimated that neonatal deaths (i.e., child death within the first 28 days) account for 54% of all under-five mortality [4]. Neonatal disorders, congenital anomalies, and lower respiratory infections are the three primary causes of mortality among neonates, infants, and children in nearly all MENA countries, including Saudi Arabia [3, 5]. Globally, neonatal disorders were the leading cause of under-five mortality in 2019, with lower respiratory infections, diarrheal diseases, congenital anomalies, and malaria following closely behind [6]. The IMR serves as an indicator of child health and reflects the overall development and well-being of the population [7, 8]. Many studies have highlighted the sociodemographic and health factors that significantly impact infant morbidity and mortality in the Gulf countries [7, 9]. The sociodemographic factors include education, employment, socioeconomic status, early marriage, and consanguineous marriage [7, 9]. The health factors include the availability of healthcare workers' vaccination coverage, health insurance, infant complications, maternal complications, and lack of access to healthcare services [10–14]. Although previous studies have reported infant mortality at different levels and times, such as at the global level [10] and in the Arab countries [7], Gulf countries [15], and Saudi Arabia [16, 17], none of these studies have analyzed the trends in the IMR rate over decades in Saudi Arabia with a broader scope and greater depth. The United Nations International Children's Emergency Fund (UNICEF) data on IMRs provide reliable information on trends at the country level. In addition, in the Gulf countries, including Saudi Arabia, birth and death statistics are well registered [18, 19], reinforcing the integrity of the UNICEF data. The present study aimed to investigate the IMR trends and patterns in Saudi Arabia during a fifty-year (1973–2022) period and to compare differences between the mortality rates of both males and females during this period.

2. Materials and Methods

Data on the IMR for 1973–2022 were extracted from the UNICEF database [20]; previous studies have used the World Bank database for a similar purpose [21]. The mean mortality rates every 10 years were calculated and compared between decades and between males and females using a chi-square test. A two-sided *P*-value <0.05 was deemed statistically significant.

Saudi Arabia is the largest Gulf country, with 13 regions and Riyadh as its capital. Its population is 31.5 million, of whom the majority live in urban areas, with only 17% living in rural areas [18]. According to the WHO, the under-five population accounts for 3.2 million of the country's population (i.e., one-third of the total population) [10].

3. Results

The IMR was highest in 1973 (102.9 per 1000 live births; 107.3 males vs 98.1 females) and lowest in

2022 (5.4 per 1000 live births; 5.6 males vs 5.3 females). Figure **1** shows the overall gradual decline in the IMR from the first to the fifth decade among males and females. The IMR was highest in the first decade (1973–1982), at 79.76 (83.69 males vs 75.61 females), and declined in the subsequent decades, at 42.81 (45.23 males vs 40.29 females) in the second decade (1983–1992), 22.20 (23.30 males vs 21.02 females) in the third decade (1993–2002), 12.39 (12.83 males vs 11.94 females) in the fourth decade (2003–2012), and 6.89 (7.06 males vs 6.71 females) in the fifth decade (2013–2022).

Table **1** shows the IMR for males and females over five decades (1973–2022). There was a significant decline in the mean IMR among both males and females over the five decades ($P < 0.01$), with no difference between the IMR of males and females in each decade indicated by a chi-square test ($P > 0.05$).

4. Discussion

The primary finding of this review was the remarkable decline in Saudi Arabia's IMR over the last 50 years among both males and females. This agrees with the conclusions of regional contexts in the MENA [3, 5], Arab countries [7], Gulf countries [15], and Saudi Arabia [16, 17]. Al-Mazrou *et al.* revealed a marked decline in infant and child mortality during 1994–2004 in Saudi Arabia. He reported that the IMR decreased from 22 per 1000 live births in 1994 to 17 per 1000 live births in 2004 [16]. The decline in the IMR found in this study agrees with the global trend in IMRs from 1990 to 2017, including in the Eastern Mediterranean Region [10]. According to researchers, this achievement has been driven mainly by the sustained commitment of governments, organizations, healthcare workers, local communities, and families [11, 22]. The significant reduction in infant mortality will contribute to Saudi Arabia's meeting the proposed Sustainable Development Goal (SDG) target for child mortality, which is to lower the neonatal death rate to <12 deaths per 1000 live births and the under-five mortality rate to at least 25 deaths per 1000 live births. Similarly, Shawky reported a decline in the IMR in Arab countries, including Saudi Arabia, from 75 per 1000 in 1978 to 23 per 1000 in 1999 (a declining rate of 69.3%) [23]. However, the observed IMR in Saudi Arabia (during 2013–2022: 6.89 per 1000 births) was higher compared with the rates in other member countries of the Organization for Economic Cooperation and Development (OECD), such as Australia and Japan (IMR <4 per 1000 births) [24].

Several factors, such as improvements in education, socioeconomic status, and health services, may account for the significant decline in the IMR in Saudi Arabia [7, 21]. Additionally, factors such as public health expenditure, the number of healthcare workers, globalization, economic development, education, and effective governance have been identified as the primary factors influencing infant and child mortality in African countries [25]. There is an inverse association between the IMR and the Human Development Index (HDI); a region with a higher HDI has a lower IMR and vice versa [10]. Abuqamar *et al.* reported that infant mortality was inversely associated with literacy and socioeconomic status in the Arab world [7]. Eltayib *et al.* revealed a substantial impact of health status and resources (HSR) on the IMR in neighboring Oman. The primary factors that indicated the HSR were the vaccination rates for measles, tuberculosis, polio, and tetanus [9]. In Saudi Arabia, to further improve children's and women's health, more healthcare workers have been recruited to ensure high-quality care for

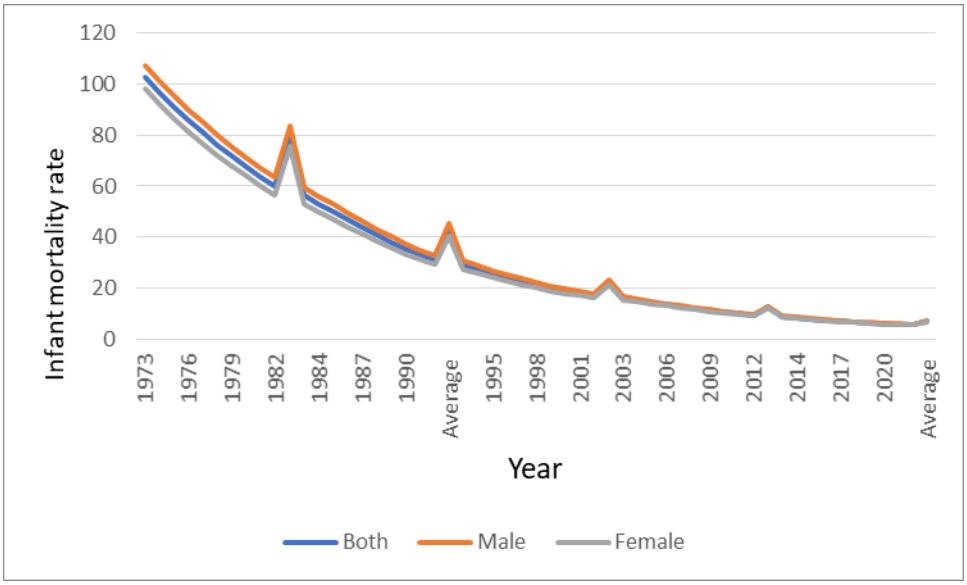

Figure 1: The infant mortality rate (IMR) in Saudi Arabia from 1973 to 2022.

Table 1: Infant mortality rate (IMR) of males and females in Saudi Arabia over five decades (1973–2022).

Decade	Total	Males	Females	*P*-value
1973–1982	79.76	83.69	75.61	0.224
1983–1992	42.81	45.23	40.29	0.567
1993–2002	22.2	23.3	21.02	0.865
2003–2012	12.39	12.83	11.94	0.999
2013–2022	6.89	7.06	6.71	0.999
P-value	<0.001	<0.001	<0.001	

mothers and children, especially in the early years. Today, 98.7% of births in Saudi Arabia are attended by healthcare workers [26].

This greater availability of healthcare workers could have contributed to expanding vaccine coverage in Saudi Arabia. Therefore, the observed decline in the IMR in the present study could be partially due to greater immunization coverage and improvements of healthcare systems [28]. Al-Busaidi *et al.* reported that the expansion in immunization coverage contributed significantly to preventing neonatal diseases and reducing the IMR in Saudi Arabia, Qatar, and the United Arab Emirates [15].

Additionally, the decline in the IMR in Saudi Arabia could be due to improvements in water, sanitation, and hygiene (WASH) services [10, 16, 23, 29]. The IMR is a reliable indicator of sanitary conditions, health, and living standards in many countries, including Saudi Arabia [8]. Salam and Al-Khraif attributed the steady decline in neonatal, infant, and under-five mortality rates since 1950 to significant budget allocations and investments in health system building, including WASH, nutrition, and lifestyle modifications [29]. Previously, lack of access to adequate WASH services was the main factor associated with infant mortality in Arab countries, including Saudi Arabia [23]. Healthcare spending in Saudi Arabia is 9.2% of the gross domestic product (GDP) [11]. Recently, Islam *et al.* emphasized the importance of prioritizing

healthcare investments to reduce IMR in Saudi Arabia [30].

This study found a decline in the IMR for both males and females. Some studies have reported that females have a higher risk of infant mortality during the overall infant period, particularly in countries with evidence of gender bias in healthcare services [32, 33]. In India, during the postneonatal period, female infants are at a greater risk of mortality than males [31]. The decline in the IMR among both males and females in Saudi Arabia may point to equability in the provision of healthcare to pregnant women and their children, regardless of the sex of the child.

Abu Srair *et al.* reported that the IMR in the Qatif area in 1992 was 21.06 per 1000 live births; the majority (70.3%) of infant deaths occurred in the neonatal period, and about 75% were preventable [34]. The primary reported causes of the IMR were premature delivery (39.1%), infections (25%), congenital disabilities (18.8%), and sudden infant death syndrome (SIDS) [34]. For the rural Riyadh region in Saudi Arabia, Al-Nahedh reported a neonatal mortality rate of 21.4 per 1000 live births, an IMR of 53.8 per 1000, and a postneonatal mortality rate of 32.5 per 1000 [17]. Furthermore, Al-Nahedh recommended improved prenatal and obstetric health services to reduce high neonatal mortality rates [17]. In the United Kingdom, a cohort study attributed the variations in the IMR to race and ethnicity [35]. In Saudi Arabia, the differences in infant mortality between rural and urban areas could lead to disparities in the health workforce [11]. To improve the health systems in Saudi Arabia, Young *et al.* recommended a continuous increase in the adoption of the health information system (HIS) and an expansion of the health workforce and healthcare facilities, especially in the rural areas [11].

To empower women, the countries of the MENA region including Saudi Arabia have focused on increasing girls' access to education over the past few decades [24]. As a result, there have been dramatic improvements in education for all, with several encouraging trends in the primary and secondary education of females [36]. These critical steps in improving girls' education might have contributed to the decline of IMR in Saudi Arabia, as found in this study. On the other hand, the lack of maternal education negatively impacts child morbidity and mortality, particularly among neonates and infants in many countries, including Saudi Arabia [16, 37–39]. Notably, the male-to-female literacy ratio declined from 1.52 in 1990 to 1.2 in 2009 in Saudi Arabia [7], and, since then, the Saudi government has put in place several initiatives to improve female education [40]. These include increasing girls' access to education and reducing the gender gap at higher educational levels [40]. A high maternal education level could contribute to a reduction in the IMR in several ways. It could lead to marriage at an older age, higher earning potential, and changes in residence preferences from rural to urban [16, 37]. In addition to maternal education, maternal employment and antenatal care (ANC) were identified as associated with infants' health in Saudi Arabia [41]. Ahinkorah reported that in sub-Saharan Africa, children of mothers who gave birth to their first child before the age of 20 were 11% more likely to die before reaching five years old compared to those whose mothers had their first childbirth at age 20 or older [42]. Contradictory results have been reported regarding the impact of parents' employment on infant mortality in the Gulf countries [15]. In those countries, the risk of IMR may be increased by factors such as less educated and unemployed parents and consanguineous marriages [9].

Furthermore, Saudi Arabia's remarkable achievements in IMR may be attributable to its universal health insurance and free access to healthcare services, especially for mothers and children [11]. A cohort study by Johnson *et al.* demonstrated that maternal private health insurance was linked to a reduced risk of infant mortality and adverse infant outcomes compared to Medicaid public health insurance in the United States [43]. Those with private insurance experienced a significantly lower risk of postneonatal mortality, low birth weight, preterm birth, and vaginal breech delivery, along with a higher likelihood of receiving first trimester ANC compared to those on Medicaid [43]. In Saudi Arabia, both extreme preterm birth and extreme low birth weight are associated with high mortality, reaching up to 38.4% until 2018 [44, 45]. Global optimum analysis suggests that the neonatal mortality rate could be lowered to as little as 0.80 (95% uncertainty interval 0.71–0.86) deaths per 1000 live births [6]. Although infant mortality is not categorized by age in the UNICEF database, neonatal mortality significantly contributes to it. In Saudi Arabia, Al-Abbas and Ahmed reported very slow changes in the IMR between 2003 and 2014 [12]. In the same study, in 2015, the IMR was 12.5 per 1000, the neonatal mortality rate was 7.9 per 1000, and the maternal mortality rate was 12 per 100,000. These figures indicate that more significant efforts are needed to improve child health, especially in the neonatal stage. However, this cannot be achieved without a greater focus on maternal health, specifically in the first 1000 days of life (i.e., nine months of pregnancy and the first two years of a child's life) [46]. While child mortality worldwide decreased by nearly half between 2000 and 2019, progress in reducing neonatal deaths has been slower; of the 204 countries, 65 (32%) mainly in sub-Saharan Africa and South Asia are not on track to achieve the SDG 3.2 target by 2030 [6].

The results of this study have important implications for maternal and infant health in Saudi Arabia. This study analyzed the IMR trend in Saudi Arabia, which revealed a remarkable decline during the study period. This success can encourage policymakers, healthcare workers, and local communities to continue their efforts to improve neonate and infant health. The collective efforts of the government and local communities have prevented millions of infant deaths since 1973. However, a further decline in the IMR can be achieved, especially for preventable child deaths. Sharrow *et al.* predicted 48.1 million under-five deaths worldwide between 2020 and 2030, especially during the neonatal period, if no further preventative actions were taken [47].

As shown by a literature review, there is little published research on the IMR in Saudi Arabia, despite the significant progress in the decline of the child mortality rate in recent years. There has been little change in the IMR compared to under-five mortality in Saudi Arabia [21], and neonatal deaths still account for more than half (54%) of under-five mortality worldwide [18]. Thus, more research is needed to explore the social determinants of infant mortality, especially those related to neonatal and maternal health. It is essential to recognize the common causes of infant mortality, such as congenital anomalies and SIDS, which have contributed significantly to both infant and under-five mortalities [5, 18, 48]. AlFaifi *et al.* reviewed the medical records of 250 infants undergoing surgery for congenital abnormalities. They revealed that the most prevalent ones were congenital heart defects (32%), neural tube defects (27%), and gastrointestinal malformations (17%) [48].

The current newborn screening program in Saudi Arabia includes 18 diseases [49].

In contrast, similar programs in other countries screen more diseases, such as the United States (38 core conditions), Japan (20 conditions), Australia (27 diseases), Canada (30 diseases), and Singapore (20 primary diseases) [49]. Expanding the newborn screening program in Saudi Arabia to include more diseases could be crucial in reducing its IMR and aligning it with other countries, as it may enable the early detection and treatment of various genetic and metabolic disorders before symptoms appear [49]. In addition, increasing family members' awareness of SIDS, especially that of rural areas, is crucial [50, 51].

5. Strengths and Limitations

The current review has several strengths. First, no previous study has utilized comprehensive data to analyze the trends in the IMR in Saudi Arabia between decades over 50 years and between males/females. Second, this study provides valuable information for decision-makers who aim to improve children's health, particularly infant health. Third, the findings of this study demonstrate that Saudi Arabia has achieved the SDG (Target 3.2) regarding infant mortality, which can benefit other countries. Fourth, this study addressed the importance of subcategorizing infant mortality into early neonatal, late neonatal, and postneonatal periods, as well as by gender, to gain a better understanding of the context for precise interventions.

The present study also has some limitations that must be noted to improve future research. First, it depended on secondary data on the IMR and did not include data on the place of residence (urban/rural), morbidity, or cause of death. It must be acknowledged that achieving the overall target of the SDG for child mortality does not rule out the possibility of pockets of high infant mortality in the studied country. For example, Al-Mazrou *et al.* observed regional variations in infant and child mortality in rural areas and the southern region in Saudi Arabia, which might indicate differences in accessibility to maternal healthcare services and socioeconomic status [16]. For example, this review showed an overall IMR of 42.81 per 1000 during 1983–1992, lower than the IMR of 53.8 per 1000 reported in 1987 in the rural Riyadh region of Saudi Arabia [17]. Saudi Arabia's neonatal household survey in 2016 showed different neonatal mortality rates by region, with the highest rate in Najran (5.91 per 1000) and the lowest in Riyadh (2.12 per 1000) [52]. Researchers have emphasized the importance of improving accessibility to healthcare services in rural areas and enhancing maternal education in Saudi Arabia [11, 21]. Second, the present review focused on infant mortality rather than morbidity, a key factor in mortality. In the 1990s, the most reported causes of infant mortality included respiratory problems, gastroenteritis, complications related to preterm birth, and congenital anomalies [17].

6. Conclusion

Saudi Arabia's success in reaching the SDG for infant mortality reflects decades of improvements in healthcare, driven by the Vision 2030 framework. This effort has continuously decreased infant and under-five mortality rates due to improved medical services, including enhanced access to maternal and child healthcare, advanced neonatal care, and comprehensive immunization programs.

Declarations

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Ethical Considerations

Ethical approval was not required for this study, as the data on under-five mortality in Saudi Arabia are available from the UNICEF website.

Competing Interests

None.

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Abbreviations and Symbols

IMR: Infant mortality rate

MENA: Middle East and North Africa

WHO: World Health Organization

UNICEF: United Nations International Children's Emergency Fund

SDG: Sustainable development goal

OECD: Organization for Economic Cooperation and Development

HDI: Human Development Index

HSR: Health status and resources

WASH: Water, sanitation, and hygiene

GDP: Gross domestic product

SIDS: Sudden infant death syndrome

HIS: Health information system

ANC: Antenatal care

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