



## RESEARCH ARTICLE

### EPIDEMIOLOGICAL BURDEN OF DENGUE FEVER IN SAUDI ARABIA 2022

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#### ABSTRACT

Dengue fever (DF) is considered a life-threatening re-emerging infectious condition. Gainor *et al.* (2022) claim that the first cases of the disease were recorded in the African continent in 1779, and from then on, there have been many outbreaks across the world for all the four main variants (DENV-1-DENV-4), including Comoros, Somalia, Tanzania, Angola, Cape Verde, Benin, and enya (Simo *et al.*, 2019). Alfsnes and colleagues explain that based on epidemiological records that date back to the 16th century, the coastal towns of North, Central, and South America and the Caribbean Islands describe disease-bearing dengue fever symptoms (Alfsnes *et al.*, 2021). These symptoms were found in people aboard commercial vessels arriving from Africa and the Old World. The cargo aboard these ships primarily originated from Africa. Around the same time, epidemiologically similar disease outbreaks were recorded throughout South East Asia, Japan, Egypt, India, and Zanzibar Islands (Alfsnes *et al.*, 2021). Therefore, for many years, a condition fitting the epidemiological and clinical features of the disease currently known as dengue fever was most probably introduced eastwards from the African continent on the returning commercial routes across the Asian sub-tropics.

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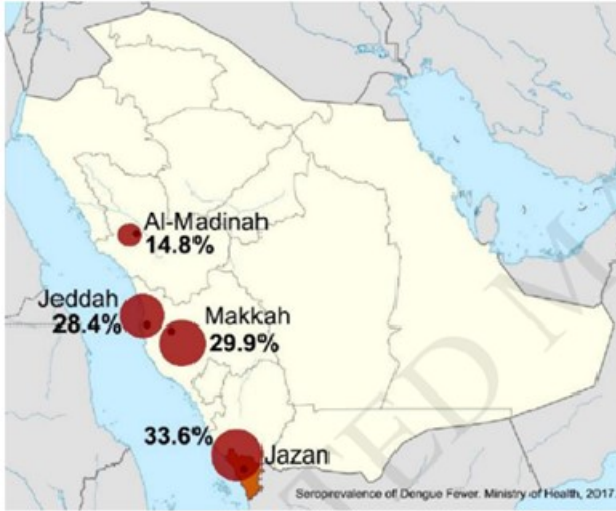
## INTRODUCTION

**History of Dengue Fever in Saudi Arabia:** Dengue virus was first recorded in the Kingdom of Saudi Arabia in 1994 (Melebari *et al.*, 2021) in the city of Jeddah (Hashem *et al.*, 2018). At that time, the first and the second variants of dengue fever viruses (DENV-1 and DENV-2) were the most common. DENV-2 is attributed to the serious epidemic that engulfed the city of Jeddah in 1994, with over 289 confirmed cases of dengue fever (Melebari *et al.*, 2021). Hashem *et al.* (2018) contend that the third variant, DENV-3, was later observed in 1997, and the virus continued to circulate in the country until it was detected and isolated from the first and the second variants for the second time in 2004. In 2004, the city of Makkah recorded the first outbreak of dengue fever caused by DENV-1 and DENV-3 variants (Hashem *et al.*, 2018). Hashem *et al.* (2018) report that there were other outbreaks in the city of Jeddah in 2005 and 2006 and in the city of Medinah in 2008. Between 2010 and 2015, the first three variants of dengue fever (DENV-1, DENV-2, DENV-3) were reported in the two cities of Makkah and Jeddah based on data collected and analyzed at the time (Hashem *et al.*, 2018).

**Prevalence Rates:** Melebari *et al.* (2021) report that today, the disease has spread to over 100 countries, with nearly 2.5 billion people exposed to the risk of infection. The World Health

Organization (WHO) further reports that every year, there could be over 50 million cases of dengue fever across the world (Melebari *et al.*, 2021). In Saudi Arabia, three cities bear the brunt of the disease. These are the cities of Makkah, Medinah, and Jeddah. All three cities have had a series of dengue virus outbreaks over the years. In the year 2009, the Saudi Ministry of Health reported over 3,350 cases of dengue virus and about 4.6 people for every 1,000 succumbed to the illness (Ali *et al.*, 2022). In 2015, the same entity reported a total of 4,312 lab-confirmed cases in the three cities, and over 73% of the cases were in Jeddah, which was the most endemic city of the three (Hashem *et al.*, 2018). Al-Raddadi *et al.* (2018) conducted a study seeking to know the seroprevalence of dengue fever and the associated causative factors in four cities, namely Makkah, Medinah, Jeddah, and Jizan, in the Kingdom of Saudi Arabia. The researchers established that the highest seroprevalence of Anti-dengue IgG antibodies was in Jizan, with a prevalence of 33.6%, while the lowest was in Madinah, with a prevalence rate of 14.8%. The researchers further analyzed the results according to districts, and the following were the results: Madinah - Al Juwairiyat (49.0%) and Al Amariyya (76.9%); Makkah - Zahir (66.7%); Al Assila (66.7%), Umm Aljoud (67.6%), and Jaarana (77.8%). These are the districts that met the seroprevalence threshold of  $\geq 50\%$  (Al-

Raddadi *et al.*, 2018). Melebari *et al.* (2021) compared both confirmed and suspected cases of dengue fever in Makkah for the years 2017-2019. The researchers established a spike in dengue fever cases in 2019, with a total of 1571 confirmed cases. This was significantly higher than the rates in 2017 and 2018, which were a total of 1,004 and 752 cases, respectively. These results were collected from blood samples from Makkah Hospital for all suspected cases.



Source: Adopted from Al-Raddadi *et al.* (2018)

Figure 1. Seroprevalence of Dengue Fever

This therefore translates to a diagnostic positive test rate of 47.6% in 2019, which is high by any standards and higher than what was recorded in 2017 and 2018. Al-Nefaie *et al.* (2022) conducted a study on Temporal and spatial patterns of dengue geographical distribution in Jeddah. The researchers procured a sample of 1458 cases from the Dengue Active Surveillance System. The researchers established a prevalence rate of 38.1% confirmed cases and 61.9% suspected cases, which means that most cases participants did not have the condition, despite showing significant qualifying symptoms (Al-Nefaie *et al.*, 2022). Most confirmed cases in Jeddah were found in the central districts, and most of those found with the condition were male. Table 1 shows the distribution of dengue fever cases in Jeddah.

Variable		N	%	Mean±SD
Dengue infection	Suspected	680	61.9	
	Confirmed	418	38.1	
Age				36.15±16.46
	<15 years	121	11.2	
	15-24 years	104	9.7	
	25-44 years	549	51	
	45-65 years	256	23.8	
	>65 years	46	4.3	
Gender				
	Male	946	77	
	Female	252	23	
Occupation				
	Not worker	317	28.9	
	Health worker	28	2.6	
	Non-health worker	691	62.9	
Nationality				
	Saudi	395	36	
	Non-Saudi	703	64	
Language				
	Arabic	862	78.5	
	Non-Arabic	236	21.5	
District				
	North	187	22.7	
	East	230	27.9	
	Middle	288	34.9	
	South	120	14.5	

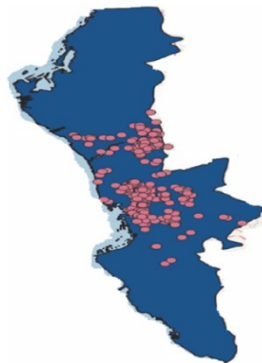


Figure 2. Distribution of Dengue Confirmed Cases in Jeddah

Melebari *et al.* (2021) report that Makkah rates for dengue fever have been significantly high such that the area is identified as dengue-endemic. The case profiles in 2004 for hospitalized patients at a single centre in the course of eh outbreak were 159 dengue fever cases from 2006-2008. The researchers further report that these cases were identified during early summer and spring when temperatures are favorable for the condition to thrive.

The researchers later reported that that number increased to 4,187 between 2008 and 2012 with increased construction work. Increased construction led to a rise in stagnant water (Melebari *et al.*, 2021).

**Causes and Risk Factors of Dengue Fever:** It is not clear exactly what causes this disease, although the changing dynamics of dengue incidence could be attributed to changes in the public health infrastructures and sociodemographic changes of affected countries over the past few decades. Dengue fever can cause dengue hemorrhagic fever (Wang *et al.*, 2020), dengue syndrome shock (Ningrum, 2022), and classic dengue fever (Morales-Vargas *et al.*, 2020).

Melebari *et al.* (2021) explain that dengue fever is an arthropod vector-borne disease. It is spread by female *Aedes* mosquitos, which come in different varieties. Nevertheless, Mubbashir *et al.* (2018) explain that the *Aedes aegypti* mosquito is the closest to human habitation and therefore is considered the most important vector in the spread of this disease. The dengue virus is found in sub-tropical and tropical climates in hot temperatures and high-humidity areas. These conditions are conducive to viral replication and lengthening the lifespan of the mosquito. The incubation period is approximately 3-14 days, although, in high-humidity environments, the incubation period reduces significantly (Melebari *et al.*, 2021). One of the causative factors leading to the high incidence rates of the new dengue fever variants in the identified areas is increased mobility between and within countries and cities (Akbar *et al.*, 2020; Ali *et al.*, 2022). Ali *et al.* (2022) claim that the Islamic faithful visit Saudi Arabia for Umrah and Hajj every year. A significant proportion of those visitors are from endemic regions, and this has exposed the three cities of Madinah, Makkah, and Jeddah to continuous cycles of the dengue virus (Ali *et al.*, 2022). Besides, there are internal factors, such as human behavior, that creates the right breeding environment for the virus to thrive and multiply (Khan *et al.*, 2022). In addition, urbanization (Kolimenakis *et al.*, 2021) and ecological changes (Bhatia *et al.*, 2022) have also worsened the situation, thus facilitating the spread of the main vector – *Ae aegypti*. There are other factors that have been associated with the disease. These include poor vector control (Buhler *et al.*, 2019) and international trade (Paixão *et al.*, 2018). The outbreak of the disease could also be hastened by the development of insecticide resistance in mosquitos (Gan *et al.*, 2021) and irregular insecticide spray (Hladish *et al.*, 2018).

**Symptoms of Dengue Fever:** The most common symptoms of dengue fever are rash, nausea and vomiting, joint pain and muscle pain, pain behind the eyes, severe headaches, and high fever. Other factors include swelling of the hands and feet, redness, nosebleeds, easy bruising, bleeding gums, diarrhea, swollen glands, and fatigue (Khosavanna *et al.*, 2021; Kularatne & Dalugama, 2022). In instances of severe dengue fever, people may experience dengue shock syndrome (Preeprem & Phumeetham, 2022) and dengue hemorrhagic fever (Harapan *et al.*, 2019). Researchers claim that severe dengue is an emergency. Both conditions are life-threatening where care is delayed.

**Prevention and Control:** It is important to ensure that the right measures are taken to prevent the possibility of getting infected by the virus. The risk of infection can be greatly minimized if appropriate infection-prevention measures are taken (Melebari *et al.*, 2021). The best and most effective prevention method is to avoid mosquito bites. There is no medication available to treat dengue fever. Nevertheless, the CDC (2023) states that there is a dengue vaccine that is only available for children aged 9-16. Individuals are advised to use mosquito repellent with active compounds that are known to repel insects. People are also advised to take proper control measures inside and outside their homes. Items that hold water should be cleaned at least once every

week, and screens and windows can additionally assist in preventing the entry of mosquitoes.

## CONCLUSION

Dengue fever (DF) is a re-emerging infectious condition. It originated from the African continent in the 18<sup>th</sup> century, and from then on, there have been many outbreaks across the world for all four main variants (DENV-1-DENV-4). Dengue virus was first recorded in the Kingdom of Saudi Arabia in 1994. DENV-2 is attributed to the serious epidemic that engulfed the city of Jeddah in 1994, with over 289 confirmed cases of dengue fever. There have been subsequent outbreaks in major cities such as Makkah in 2004, Jeddah in 2005 and 2006, and the city of Medinah in 2008. The disease has spread to over 100 countries, with nearly 2.5 billion people exposed to the risk of infection. The incubation period is approximately 3-14 days, although, in high-humidity environments, the incubation period reduces significantly. Makkah rates for dengue fever have been significantly high such that the area is identified as dengue-endemic. It is not clear exactly what causes this disease, although the changing dynamics of dengue incidence could be attributed to changes in the public health infrastructures and sociodemographic changes. The *Aedes aegypti* mosquito is the closest to human habitation and therefore is considered the most important vector in the spread of this disease. The best and most effective prevention method is to avoid mosquito bites. There is no medication available to treat dengue fever.

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