



Trends of reported human cases of brucellosis, Kingdom of Saudi Arabia, 2004–2012

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Received 6 January 2015; received in revised form 27 August 2015; accepted 3 September 2015
Available online 1 October 2015

KEYWORDS

Brucellosis;
Saudi Arabia;
Global health;
Zoonotic;
One Health

Abstract Human brucellosis is an important zoonotic disease and is especially concerning in the Kingdom of Saudi Arabia (KSA), where livestock importation is significant. We analyzed reported human brucellosis disease trends in KSA over time to help policymakers understand the magnitude of the disease and guide the design of prevention and control measures. By using data from the national registry from 2004 to 2012, we calculated the cumulative numbers by age group and months. Trends of incidence rates (IRs) by gender, nationality, and region were also calculated. We found that there was a greater number of cases (19,130) in the 15–44 years age group than in any other age group. The IRs significantly decreased from 22.9 in 2004 [95% confidence interval (CI) = 22.3, 23.5] to 12.5 in 2012 (95% CI = 12.1, 13). Males had a significantly greater IR than females. Most cases were reported during spring and summer seasons. The IR of Saudi citizens was significantly greater than that of non-Saudis, but this difference reduced over time. The IRs of Al-Qassim, Aseer, and Hail were in the highest 25th percentile. Young, male Saudi citizens living in highly endemic areas were at greatest risk of acquiring brucellosis. We recommend vaccinating susceptible animals against brucellosis and increasing the public's awareness of preventive measures. © 2015 Ministry of Health, Saudi Arabia. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Brucellosis is a major bacterial zoonotic infectious disease, meaning that infected animals are the

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source of infection. Annually, there are >500,000 new brucellosis cases worldwide [1]. Since brucellosis affects both humans and animals, it negatively impacts the economic, agricultural, and health sectors. Its effects are influenced by its worldwide distribution; it is rare in most industrialized countries and more common in developing ones. However, the threat exists that brucellosis will expand globally as countries' borders become more porous. This threat is higher in countries like the Kingdom of Saudi Arabia (KSA), which hosts a myriad of travelers and imports high numbers of livestock. The emergence of brucellosis can be expected in any country that does not apply critical disease prevention protocols. In KSA, which represents a significant focus of human brucellosis, this disease still constitutes a major health problem.

Brucellosis, also known as Malta fever, undulant fever, or Mediterranean fever, is a systemic infectious disease that is transmitted to humans through the ingestion of the unpasteurized or raw milk and cheese of animals infected with *Brucella* organisms (e.g., sheep, cattle, camels, pigs, and dogs) or via contact with infected animals. Ingestion of the undercooked meat of infected animals is an uncommon route of transmission. Brucellosis is considered one of the most common laboratory-transmitted infectious diseases. Transmission usually occurs when a laboratory technician accidentally inhales the bacteria [2].

Although KSA is a country that has undergone rapid modernization over the past 40 years, maintaining traditions remains important. The combination of the modern and the traditional is a hallmark of Saudi Arabian life. Raising camels is an essential part of the history of KSA. Camel owners are proud to have them and take care of their dynasties. Also, they derive many benefits from camels, including the consumption of their milk and meat. Those who own and tend camels usually prefer to drink camel milk in its unpasteurized state, when it is frothy and warm, directly after squeezing it from a mother. Passersby also commonly enjoy camel milk, preferring to get it fresh directly from shepherds. People who live in rural areas often raise sheep and goats and serve their unpasteurized milk to guests.

KSA is the seat of Islam, home of the Two Holy Mosques, Haram Mosque and the Prophet's Mosque, which are precious to every Muslim. Millions of pilgrims flock to these mosques to perform the Hajj rituals. Part of this ritual is the slaughter of goats, sheep, or other types of cattle. Muslims who are not doing Hajj also have cattle slaughtered, as it is part of the observance of the Hajj Holy days. In 1998 alone, the total number of imported livestock

was 3.8 million animals, including goats, sheep, camels, and cows [3]. In 2010, the total value of live animal and animal product importation was more than \$2.7 billion [4]. In 2013 during the Hajj season, 3.2 million goats, sheep, camels, and other cattle filled the Saudi markets. Of those livestock, 75% were imported and 25% were raised locally [5].

Although there has been a noticeable decrease in the incidence and prevalence of brucellosis worldwide, it remains a public health concern for local and international health agencies. Most cases occur during the spring and summer seasons among those aged 20–45 years [6]. KSA had the highest incidence of human brucellosis in the Middle East during the late 1990s, but the rate has decreased in recent years due to the implementation of regulations by the Saudi Ministry of Agriculture that make brucellosis vaccinations for cattle compulsory, improved control of imported livestock, and enhanced cooperation between veterinarians and the public health sector [7,8]. Even though its incidence has dropped, brucellosis is still considered endemic in KSA.

Because of its endemicity in KSA, the Ministry of Health (MoH) classified brucellosis as a notifiable disease. Local health departments must notify the Infectious Disease Department (IDD) of the MoH when cases are suspected or confirmed. A blood culture test can detect the disease, and this is how 40–70% of the cases are diagnosed; others are mainly diagnosed with a standard agglutination test [9]. Brucellosis cases present mainly with bouts of fever and musculoskeletal pain. Because of the nonspecific manifestation of its presentation, brucellosis diagnosis is challenging, which likely leads to underestimation and underreporting of brucellosis cases [10]. Endemicity varies across the regions of KSA; it is higher in rural areas, where people live in contact with animals [7].

According to the MoH, all brucellosis cases should be reported monthly-including number of cases, nationality, region, gender, and test result diagnosis-to the IDD. Every suspected case is investigated using a standard agglutination test, culture (blood or bone marrow, cerebrospinal fluid), enzyme-linked immunosorbent assay, or other tests if they are available. Along with the laboratory results, every reported case form includes all patient identification and disease data: name, age, sex, occupation, nationality, and contact information; physician in charge; time of reporting; travel history; history of animal contact; state of the ingested milk; and previous attacks of brucellosis [11].

Although brucellosis trends have been studied in KSA among different regions, this research extends

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