

## Prevalence of Brucellosis in the Sultanate of Oman with Reference to Some Middle-East Countries

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**Abstract:** Brucellosis is a worldwide zoonotic disease with special impact on the Middle East including Oman where it is significantly prevalent in Dhofar region. The disease has been reported in most species in the country but surveys and investigations are sporadic. The prevalence of the disease is of particular importance in goats, camels and sheep where higher rates have been reported. In humans, children constitute the most vulnerable sector of the population. The disease is prevalent in neighboring countries in a pattern similar to that in Oman, though some countries in the Middle-East show significantly higher rates. Available data reflect that Oman is at higher risk considering prevalence rates in bordering countries and other regions with higher prevalence. This issue is of special importance due to increasing international agro-economical trade and travel which may lead to a change in the pattern of brucellosis prevalence. A regional strategy would provide timely data and accurate information on prevalence and help in control measures. This review was intended to highlight the need for further investigations on the disease prevalence in view of future agricultural development plans.

**Key words:** Disease, middle-east, sporadic, plans, regions, Oman

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### INTRODUCTION

Brucellosis is a well documented zoonosis worldwide posing serious public health problems and extensive economic losses (Neta *et al.*, 2010). The landscape of the disease is in flux with emergence or reemergence of new foci (Pappas *et al.*, 2006; Seleem *et al.*, 2010) and that existing *Brucella* species adapt to changing social and agricultural environments (Godfroid *et al.*, 2005). Climatic conditions and increasing international travel and trade as well as sanitary factors play an important role in the prevalence and geographic redistribution of the disease (Pappas *et al.*, 2006; Gul and Khan, 2007). Brucellosis is considered a reemerging disease of special importance in the Middle East, north and east Africa, the Mediterranean countries, south and central Asia and Central and South America (Maurin, 2005; Corbel and WHO, 2006). Moreover, recent reports add zones as far apart as the Republic of Korea (Lee *et al.*, 2009) and Zimbabwe (Matope *et al.*, 2011) as foci representing the wide potential hazard. The Middle-East is further confirmed endemic for the disease (Shareef, 2006, Vaishnavi and Kumar, 2007) and that the situation is worsening in some countries in this region (Pappas *et al.*, 2006) though reports about the prevalence of the disease in Oman and the Middle-East are scanty (Samaha *et al.*, 2009).

Brucellosis is caused by members of the genus *Brucella*, more commonly by *Brucella abortus* in cattle, *B. melitensis* or *B. ovis* in small ruminants, *B. suis* in pigs and *B. canis* in dogs (The Center for Food Security and Public Health, 2009). However, recent reports indicate that *Brucella melitensis* is the most prevalent agent of brucellosis globally (Mantur and Amarnath, 2008; Seleem *et al.*, 2010). Brucellosis affects various species of domesticated animals (Pappas *et al.*, 2006) and wild life (Cross *et al.*, 2010; Van Campen and Rhyan, 2010). In addition to its emerging importance in camels (Al-Majali *et al.*, 2008; Musa *et al.*, 2008; Ghanem *et al.*, 2009; Abo-Shehada, 2009) and equids (Refai, 2002; Abo-Shehada, 2009) as well as marine mammals (Godfroid *et al.*, 2005; Van Bresseem *et al.*, 2009) and fresh water fish (El-Tras *et al.*, 2010).

Against a backdrop of rapidly increasing livestock production due to increasing demand for animal products, brucellosis economic impact is one of increasing significance. Moreover, it is generally agreed that the impact of the disease in small ruminants is greater in terms of the adverse effects it may have on human health in the rural population due to the traditional mode of consumption of sheep and goat animal products, especially that these animals harbor the more virulent species *B. melitensis* (Pappas *et al.*, 2006).

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The disease is transmitted from animals to humans by ingestion of raw milk and milk products, raw liver and close contact with infected animals or handling of materials from such animals. Brucellosis surveys are complicated by the fact that most species of *Brucella* can infect animals other than their habitual hosts when they come in close contact as in case of an outbreak of *Brucella canis* in humans handling infected breeding dogs in Argentina (Lucero *et al.*, 2010) and in case of Catfish from contaminated Nile water which were found to be positive for *Brucella melitensis* (El-Tras *et al.*, 2010).

Most surveys for prevalence of brucellosis are based on a number of standardized serological tests (Hesterberg *et al.*, 2008; Hernandez-Mora *et al.*, 2009; Samaha *et al.*, 2009; Welch and Litwin, 2010). Rose Bengal test has been widely used (Cho *et al.*, 2010) and shown to be of significant sensitivity compared to other sensitive tests however, some surveys apply more confirmatory tests in addition to demonstration of *Brucella* in culture. Most species of *Brucella* are maintained in a number of reservoir hosts which include cattle, bison, water buffalo (*Bubalus bubalus*), African buffalo (*Syncerus caffer*), elk and camels (The Center for Food Security and Public Health, 2009). Recently feral pig population was reported to maintain *B. abortus* in the U.S. In addition, *B. melitensis* occurs in farmed red deer (*Odocoileus virginianus*) in New Zealand and *B. canis* is maintained in dogs and *B. neotomae* in rodents (The Center for Food Security and Public Health, 2009).

#### PREVALENCE OF BRUCELLOSIS IN ANIMALS

Oman shares borders with Saudi Arabia, Yemen and United Arab Emirates in which the disease is a public health hazard. However, this region is not isolated from other countries in the Middle-East as trade in animals and animal products are active. Moreover, socioeconomic activities and demographic impact in Oman and the Middle-East set the region in a potential highway of animal disease transmission through India, Pakistan, Turkey, Syria, Iraq and Iran and links further to East African and East Asian countries. Considering strategic control plans, brucellosis prevalence in Somalia in camels (Ghanem *et al.*, 2009) and in Ethiopia in bovine (Jergerfa *et al.*, 2009; Mekonnen *et al.*, 2010) is important where management and rearing systems bear similarity to that in the Middle-East and given their geographical location and links to the southern part of the Arabian peninsula. Of particular importance also is the high prevalence in livestock of the disease in Palestine, Egypt, Pakistan (Gul and Khan, 2007) and in the Indian subcontinent where brucellosis is rampant (Mantur and Amarnath, 2008) with high prevalence rate (>22%) in dairy farms (Trangadia *et al.*, 2010).

Brucellosis in Oman warrants special attention in view of current animal raising systems and future of agricultural development. The system of animal rearing is related to the style of living and prevalent grazing systems. The main systems are nomadic based on camels and goats on dry rangelands and transhumance where cattle, camels and goats are raised under partial or full dependence on natural pastures supported by supplementary feeding of forages, concentrates and dried sardines. In all systems of animal management, mating is uncontrolled and takes place throughout the year without defined kidding or lambing season (Sultanate of Oman Ministry of Health, 1993) and human and animal contact is close. At the backdrop of such styles of animal management and considering the potential of spread of brucellosis to diverse species, including marine life, it is important to review the prevalence of the disease as a step towards strategic planning for control of the disease.

Brucellosis was generally known to affect farm animals but until 1984, the status of brucellosis in Oman was undefined due to lack of diagnostic facilities and an organized surveillance programme. An extensive serologic survey of domestic animals was conducted in 1985-86 (Ismaily *et al.*, 1988) revealed that *Brucella* seropositives were primarily located in the Dhofar region of Southern Oman. In their study, the researchers surveyed the disease by testing for *Brucella* antibodies in serum from goats, sheep, cattle and camels applying Rose Bengal (RBPT) test then confirmatory tests with the card test, Serum Agglutination Test (SAT) and ravinol test (Ismaily *et al.*, 1988). It was found that all tests gave a positive reaction in all species however, with RBPT, higher percentage of positives was detectable with camels showing 3.6%, cattle 2.9%, sheep 1.6% and goats 0.9%. Of interest and importance was the high prevalence rate of the disease in camels where RBPT revealed 8% positive camels in 250 tested camel in Dhofar region (Ismaily *et al.*, 1988). Moreover, camels and goats are herded together and therefore the latter researchers assumed that camels become infected from goats and that *Brucella* organisms are excreted in the milk of camels with subsequent human infections. The clinical effects among camels are largely unknown but a case of orchitis was found in a seropositive camel and was suspected by the latter authors to be caused by *Brucella melitensis*. Isolates of *Brucella* in Oman were commonly *B. melitensis* biovar 1 while *Brucella melitensis* biovar 3 was commonly reported in Egypt, Jordan, Tunisia and Turkey; *B. melitensis* biovar 2 in Turkey and Saudi Arabia (Refai, 2002).

Other surveys in Oman show that prevalence of brucellosis increased significantly among goats (Gul and Khan, 2007) with *Brucella melitensis* as the main species.

In neighboring Yemen, the existence of brucellosis was confirmed in indigenous animals; the highest prevalence being in goats (1.3%) compared with the rate among other species tested (0.34%) (Al-Shamahy, 1999). However, brucellosis prevalence was significantly higher among other animals imported to Yemen from Somalia and other African countries (Al-Shamahy, 1999).

Goats are the most dominant animals in Oman and comprise two thirds of the total livestock in the country (Sultanate of Oman Ministry of Health, 1993) yet the predominance of goat population in Oman did not reflect high prevalence of brucellosis compared to some countries in the region, e.g., Jordan where >27% of goats were seropositive for Brucella (Al-Majali, 2005).

Generally, brucellosis in countries of the Middle East has been reported in almost all domestic animals but it is particularly rampant in goats and camels (Table 1). The prevalence rates among goats (6.4%) and sheep (1.6%) is significantly higher than those reported in neighboring Yemen being only 1.3% for goats and 0.6% for sheep (Al-Shamahy, 1999).

Compared to Oman and Yemen, the prevalence of the disease in sheep and goats in Saudi Arabia was markedly lower. The prevalence rate of brucellosis in cattle in the Republic of Yemen (0.06%) was lower than those reported in either Oman (3.3%) or Saudi Arabia (3.6%) (Al-Shamahy, 1999). However, the prevalence rates for Saudi Arabia shown in Table 1 are significantly higher than these values.

Data for prevalence as recently reviewed for some countries in the Middle-East (Gul and Khan, 2007) show significantly high rates for brucellosis in Egypt (Table 1) especially in mules and cattle. According to this table, the prevalence rate for cattle, sheep and goats in Saudi Arabia are significantly higher compared to the values previously presented (Al-Shamahy, 1999).

In a recent study carried out in animals from different districts in Egypt (Samaha *et al.*, 2008), the prevalence rates were 5.44-7.77 for cattle, 4.11-6.93 for buffaloes, 5.4-6.9 for sheep and 3.55-6.35 for goats. In their study (Samaha *et al.*, 2008) different serologic tests were used in the investigation which gave more or less similar results that were further confirmed by isolating Brucella from milk and tissues; the isolates were all *B. melitensis* biovar 3. This study shows that the data presented for Egypt in Table 1 (Gul and Khan, 2007) at the last page are markedly skewed. In Iraq, the prevalence rates are significantly higher for camels and sheep.

In wild life, there is paucity of data regarding the prevalence of brucellosis in the Middle-East. However, the disease has been reported in ungulates in Dubai (Ofner *et al.*, 2007) where *B. melitensis* was detected in a

Table 1: Prevalence of brucellosis in some countries in the Middle-East (Gul and Khan, 2007)

Country	Species	Prevalence (%)	<i>Brucella</i> sp.
Oman	Camel	8.00	<i>B. abortus</i>
	Cattle	1.30	-
	Sheep	1.60	-
	Goat	6.40	-
Saudi Arabia	Camel	8.00	<i>B. melitensis</i>
	Cattle	18.70	-
	Sheep	6.50	-
	Goat	9.70	-
UAE	Camel	2.00	<i>B. abortus</i> biovar 3
	Cattle	1.30	-
	Sheep	2.00	-
	Goat	3.40	-
Iraq	Camel	17.20	-
	Cattle	3.00	<i>B. abortus</i>
	Sheep	15.00	<i>B. melitensis</i>
Iran	Camel	8.00	-
	Cattle	0.80	<i>B. abortus</i>
	Goat	10.80	-
	Sheep	10.00	<i>B. abortus</i>
Egypt	Buffalo	10.00	<i>B. abortus</i>
	Cattle	23.30	<i>B. melitensis</i> biovar 3
	Donkey	7.30	-
	Horse	5.88	-
	Mule	71.42	-

male Nubian Ibex (*Capra ibex nubiana*) affected with orchitis and a similar was detected in an Arabian Oryx in Saudi Arabia.

### PREVALENCE OF HUMAN BRUCELLOSIS IN OMAN

Human brucellosis is detected worldwide with more than half a million cases of human reported annually (Seleem *et al.*, 2010). Oman is one of the countries with the highest incidence of human brucellosis together with Saudi Arabia, Iran, Palestine, Syria, Jordan though Bahrain is reported to be free of the disease (Refai, 2002; Kwaasi *et al.*, 2005). However, the pattern of the disease may vary as indicated by recent reports from Pakistan which show that 19.4% of patients attending out-patients clinics with atypical symptoms (muscular pain, back pain and arthritis) were actually infected with Brucella. Moreover, clinical or subclinical peripheral neuropathy was reported in Turkey (Kutlu *et al.*, 2009). Other countries which have a potential impact on Oman include the Indian subcontinent where the disease is rampant with varying prevalence rates reported (Vaishnavi and Kumar, 2007). Also in significant rates of human seropositivity for brucellosis were reported from India in samples of high risk individuals, consisting of veterinarians and para-veterinarians, shepherds, butchers and animal owners (Agasthya *et al.*, 2007).

In Egypt, prevalence rate was shown to vary between 5-8% (Samaha *et al.*, 2009). In Oman, the Dhofar region harbors 95% of the total cases of brucellosis annually

reported in the country and that brucellosis constitutes a significant prevalence rate relative to other communicable diseases notified from the region (Sahil, 1998). In Oman, brucellosis is endemic Dhofar region (Scrimgeour *et al.*, 1999) where it was detected in children; ingestion of raw milk and milk products being responsible for transmitting the disease in 63% of the cases while 83% had history of direct contact with animals, mainly cattle (El-Amin *et al.*, 2001). The disease is mostly prevalent in the mountainous and green areas where Salalah Wilaya comprises the highest share (38.7%) of the cases with a rate of about 70% in children under the age of 10 (Sahil, 1998). A similar pattern of brucellosis prevalence was observed in neighboring Saudi Arabia where 92% of human cases admitted with brucellosis in Southwestern Saudi Arabia were children (Benjamin and Annobil, 1992) and more recently 6% of patients aged 13-40 were seropositive in the northern part of the kingdom (Fallatah *et al.*, 2005). In Jordan, 30% of the patients admitted with brucellosis were children between 5-14 years old (Abu Shaqra, 2000) and recent reports show seropositivity of 11.9% in Jordanian children samples (Al-Majali and Shorman, 2009). Most human cases are caused by *B. melitensis* (Mantur and Amarnath, 2008) though there is no clear record about the number of *Brucella* species involved in Oman. In the endemic Southern Province human cases increased from 12 in 1981-219 in 1985 as diagnosed by the SAT (Ismaily *et al.*, 1988). In the region, *B. abortus* has been responsible for an increasing number of cases in recent years e.g., in Yemen where *B. abortus* was identified in 45 cases and *B. melitensis* in 7 cases out of 330 cultures performed in 1995 (Al-Shamahy, 1999). This appears to be a reflection of the nomadic based system where camels and goats and cattle are in close contact with humans during grazing and transhumance on rangelands and natural pastures. A report by the Ministry of Health has shown that the number of cases of human brucellosis reported annually from hospitals all over Oman is increasing but the problem is mainly confined to the southern region with Salalah city showing an increasing number of cases (Sultanate of Oman Ministry of Health, 1993).

### CONCLUSION

It can be concluded that brucellosis is endemic in Oman especially Dhofar region. The higher prevalence of the disease in goats and camels is of special concern. Reports from Oman and other countries in the Middle-East indicate that children are the most vulnerable sector of the population to brucellosis. In Oman it appears

that human cases of brucellosis are related to the animal management system and people habits. The reported high prevalence in the Middle-East region and neighboring countries puts Oman at a critical position regarding control and eradication programs. Further research is needed to identify foci of the disease in a timely manner with a regional strategy for surveys and epidemiological studies.

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