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ORIGINAL ARTICLE

Epidemiological profile of human brucellosis in Bisha governorate, Asir region, Kingdom of Saudi Arabia: a retrospective study (2012-2019)

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ABSTRACT

Background: Human brucellosis is a zoonotic disease with universal distribution, especially in the Middle East. It is of public health concern with high morbidity and greatly varied clinical presentations. This study aimed to assess the epidemiological profile of the disease at the governorate level in Bisha governorate, Asir region, Saudi Arabia.

Methodology: A retrospective study was conducted on the reported brucellosis cases in the study area. The targeted population was patients diagnosed with brucellosis from January 1, 2012, to December 31, 2019, in the study area. Variables including gender, age, nationality, geographical sector, and epidemiological month were analyzed.

Results: A total 1,700 cases of brucellosis were reported in Bisha, Saudi Arabia. The majority of cases were of males (75.5%). Saudi patients (63.9%) were significantly higher than non-Saudi. Patients aged 16-45 years showed the highest prevalence (54.9%). The highest incidence rate (IR) was reported in 2018 [92.56; confidence interval (CI) 95% = 83.4-102.6], while the lowest IR was reported in 2013 (28.6; CI 95% = 23.3-34.7).

Conclusion: The study area showed a high IR, where all the geographical sectors were involved; all age groups had varying rates, where the 16-45 years age group had the highest incidence. Saudi citizens and males were the dominantly infected categories.

Keywords: Human brucellosis, Bisha governorate, KSA, zoonosis, public health.

Introduction

Human brucellosis (synonyms are Malta fever, undulant fever, or Mediterranean fever) is a bacterial zoonotic disease caused by various *Brucella* species, which mainly infect cattle, swine, goats, sheep, and dogs. Direct contact with infected animals, eating, or drinking contaminated animal products and inhaling airborne agents are the possible risks of transmitting the infection to humans. Ingesting unpasteurized milk or cheese from *Brucella*-infected animals is considered as the major risk factors (e.g., sheep, cattle, camels, pigs, and dogs). Person-to-person transmission is rare. The disease causes flu-like symptoms, including fever, weakness, malaise, and weight loss [1-4].

Annually, there are >500,000 new brucellosis cases reported worldwide. The zoonotic nature of the disease laid a negative impact on the economic, agricultural,

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and health sectors globally. Although it is distributed worldwide, it is rare in most industrialized countries and more common in developing ones [5].

This disease in Kingdom Saudi Arabia (KSA) is an endemic notifiable disease. As per the regulations of the Ministry of Health (MoH), local health departments in different regions of the country should notify the Infectious Disease Department, when there are suspected or confirmed cases. In addition, the cooperation between the Ministry of Agriculture and the MoH contributed to the decrease in reported cases of the disease.

Many reasons claimed to contribute to the still reporting of the disease. Camel herders and owners prefer to drink the camel's milk directly after been squeezed from the udder and also provide it to their guests. Moreover, sheep and goat raisers in the rural areas follow the same tradition. In addition, KSA imports live animals and animal products to face the demands of the Muslims who rush to the country for Umrah and Hajj annually [1-4].

The present investigation aimed to study the epidemiological profile of human brucellosis at the governorate level in Bisha governorate, Asir region, KSA.

Subjects and Methods

Bisha is one of the sixteen Asir region governorates in Southwestern Saudi Arabia (SA). Bisha city is the capital of the governorate. It stands at an altitude of approximately 610 meters (2,000 ft.) above sea level. It is located at 20°0′0″N 42°36′0″E (Figure 1).

This was a retrospective descriptive epidemiological study. The targeted population was patients diagnosed with brucellosis from January 1, 2012, to December 31, 2019, in Bisha governorate, Asir area, KSA. Data were obtained from the Public Health Department (PHD), Bisha Health Directorate (BHD), MoH.

The following variables were studied: gender (male and female); age in years grouped as 0-1, 2-5, 6-15, 16-45, and 46 or more years; nationality (Saudi and non-Saudi), year of diagnosis, and geographical sector.

Data were entered and analyzed using Microsoft Excel 2016 (Mac, Impressa Systems, Santa Rosa, CA, 2016) to organize the data sets and for developing graphs. Statistical Package for the Social Sciences version 25.0 (IBM, Armonk, NY) was used for descriptive statistics as well as predicting the significant differences using one sample binomial test, Pearson's sample, chi-squared test, and one sample Kolmogorov-Smirnov test. *P*-value was considered significant at $p < 0.05$. Moreover, the incidence rate (IR) and seasonal epidemiology were computed using WinPepi (Version 11.65, J.H. Abramson, BioMed Central Ltd).

Results

IR was computed using WinPepi software, based on 100,000 persons of the total population of Bisha governorate throughout the study period (2012-2019). The observed IR pattern showed a slight decrease from 2012 to 2013; afterward, it showed a steady increase up to 2018, where it reached a peak, and thereafter from 2018 to 2019, it showed an abrupt decrease (Table 1).

Males were found to have a significantly higher rate than females, with an overall percentile of 75.5% (n = 1,284) (one sample binomial test, p = 0.000). Furthermore, the age category of 16-45 years showed the highest significant frequency of 54.9% (n = 933), whereas 27.6% of the study population were aged 46 years or older. Those who were categorized in the 2-5 years group showed the lowest frequency of 1.7% (n = 29). The age groups >46 showed the second highest prevalence of 27.6% (n = 470), followed by the age group of 6-15 years, which scored 13.6% (n = 232), whereas the age group 1 year or less reported a rate of 2.1% (n = 36; mean = 34 years; SD ± 18.7 years) (one sample Kolmogorov-Smirnov test, p = 0.000). Moreover, Saudi patients significantly showed the highest prevalence of 63.9% (n = 1,087), while the rest were non-Saudi with a rate of 36.1% (n = 613) (one sample binomial test, p = 0.000). Additionally, the

Table 1. *IRs of human brucellosis cases reported in Bisha governorate, KSA (2012-2019).*

Year	Population[a] per year	Number of cases (IR[b])	95% confidence interval (CI)[c]
2012	348,552	115 (33)	27.2-39.6
2013	356,836	102 (28.6)	23.3-34.7
2014	365,120	128(35.1)	29. 2-41.7
2015	373,404	161(43.1)	36.7-50.3
2016	381,688	270 (70.7)	62.6-79.7
2017	389,972	322 (82.6)	73.8-92.1
2018	398,256	369 (92.56)	83.4-102.6
2019	406,540	222 (54.6)	47.7-62.3

[a]Population per year was calculated according to the growth rate of the 2018 Saudi yearly statistical book.
[b]IR = incidence rate per 100,000.
[c]CI = Confidence interval.

Table 2. *Socio-demographic characteristics of 1,700 brucellosis patients, Bisha, KSA (2012-2019).*

Variable	Characteristic	Number	Percentage	Statistical Significance (*p*-value)
Gender	Males	1.284	75.5%	0.000* One sample binomial test
	Females	416	24.5%	
	Total	1,700	100%	
Age distribution	0-1 year	36	2.1%	0.000* One sample Kolmogor-ov-Smirnov test Mean = 34 years SD = 18.7 years
	2-5 years	29	1.7%	
	6-15 years	232	13.6%	
	16-45 years	933	54,9%	
	More than 46 years	470	27.6	
	Total	1,700	100%	
Nationality	Saudi	1,087	63.9%	0.000* One sample binomial test
	Non-Saudi	613	36.1%	
	Total	1,700	100%	
Distribution within Bisha sectors	North sector	376	22.1%	0.000* One sample chi-squared test
	South sector	204	12.0%	
	Almedina sector	175	10.3%	
	Tathleeth sector	100	5.9%	
	Alalaya sector	38	2.2%	
	Alamwah sector	29	1.7%	
	Albashyer sector	1	0.1%	
	Undetermined sector	777	45.7%	
	Total	1,700	100%	

*Statistically significant

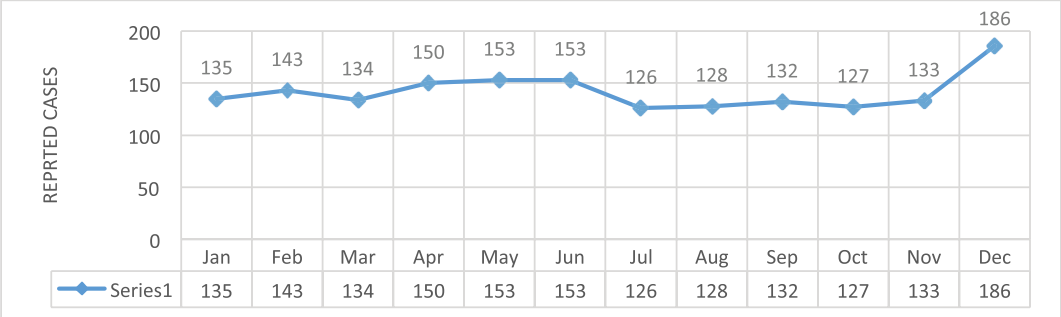

Figure 1. *Seasonal variation of human brucellosis in Bisha governorate, KSA.*

distribution of the disease throughout the different sectors of the governorate showed considerable variations where the northern sector significantly showed the highest prevalence rate of 40.7% ($n = 376$), while the Albashayer sector showed the lowest score of 0.1% ($n = 1$) (one sample chi-square) (Table 2).

The ratchet circular scan was used to predict the short seasonal peak, where a 3-month peak was observed between December to February (27.3% of the events; test statistic = 2.47; $p < 0.1$). Moreover, the seasonal peak predicted using Hewitt's rank sum test, where a 4-month peak was observed between November to February (Rank sum: 34; $p > 0.089$) (Figure 2).

Discussion

The observed IR pattern showed a slight decrease from 2012 to 2013; afterward, it showed a steady increase up to 2018 where it reached a peak, and thereafter from 2018 to 2019, it showed an abrupt decrease. This reported IR/100,000 in years 2012, 2013, and 2014 (33, 28.6, and 35.1, respectively) was almost similar to that reported by Elbeltagy in Tabuk (IR of 34/100,000) [6]. Moreover, the overall IR ranges from 28.6 to 92.56 throughout the study period were higher than that reported by Al-Tawfiq and AbuKhamsin [2], who reported a range from 10 to 70/100,000 in Eastern Saudi Arabia. It was also

higher than that documented by Aloufi et al. [4], who investigated the reported case in KSA during the period from 2004 to 2012. Regarding gender involvement, male dominance in this investigation (75.5%; *n* = 1,284) was in agreement with many reports all over the Kingdom [7-9]. The frequent contact of men with their animals, consumption of raw unpasteurized milk when they are out in the fields, or when camping out in the desert with their herds, are possible explanations for this dominance.

The age category of 16-45 years showed the highest significant frequency of 54.9% (*n* = 933; mean = 34 years, SD ±18.7 years). This is almost in line with the findings of Malik [10], Fallatah et al. [9], Asaad and Alqahtani [8], and Aloufi et al. [4]. This group has the possibility of exposure to their infected animals more than the other categories, since they travel more and have more opportunities to drink raw milk. Furthermore; those aged 46 years or older (27.6%) came in the second rank of the study population in terms of the infection. They also had the possibility of coming in close contact with their animals, beside drinking unpasteurized or raw milk (often from camels) and which is considered as the major route of transmitting the infection [11,12]. The third rank was 6-15 years (*n* = 232; 13.6%), followed by the infants and childhood categories: 1 year or less (2.1%; *n* = 36) and 2-5 years (*n* = 29; 1.7%), respectively. Infants' involvement could be explained by either congenital transfer or through breast feeding, which were reported recently by Cacace et al. [13] and Vilchez et al. [14]. Benjamin and Annobil previously documented the childhood problem in Southwestern Saudi Arabia in 1992. They emphasized that the problem should be considered in every child from an endemic area presented with a febrile illness and a history of animal contact [15].

Considering the nationality, Saudi citizens significantly showed a highest prevalence of 63.9% (*n* = 1,087), in comparison to the non-Saudi residents with a prevalence of 36.1% (*n* = 613). The possibility of being in the direct contact with their livestock, consumption of unpasteurized dairy products, and eating raw camel liver are the common risk factors considered. Animal species of concern were sheep and goats, as well as camels and cattle [16].

With regard to geographical distribution of the disease in the different sectors of Bisha governorate, considerable variation was observed where the northern sector significantly showed the highest prevalence rate of 40.7% (*n* = 376), while Albashayer sector showed the lowest score of 0.1%. The density of livestock in the northern part of the governorate is much higher than that in the southern parts, where camels are the leading species. The owners live near their animals, which furnishes daily contact with the animal, in addition to the tradition of drinking unpasteurized animal products, e.g., milk, laban, butter, and ghee, in line with rest of the Kingdom.

Considering the seasonal prevalence, the disease is prevalent throughout the year. However, a 4-month seasonal peak occurred between Novembers to February. The prevalence throughout the year was in agreement with that reported by Al-Ballaa et al. [17], who stated the extension of the disease throughout the year with the majority of cases occurring during spring, summer, and early fall. In contrast to Al-Ballaa et al.'s [17] report, the peak in this study was observed in the winter months from November to February.

It is worth saying that some study limitations need to be outlined. Data such as occupation, role of milk collection, and contact with animals were not found in the registry of PHD of BHD.

Conclusion

The generated results showed that the study area had a high IR in comparison with other areas in the Kingdom. All the geographical sectors were involved; all age groups had varying rates and extension throughout the year, Saudi citizens and males were the dominantly infected categories. This in turn suggested a major health concern due to a single disease with multiple complications, which necessitates prompt actions for the control of the problem. It is highly recommended to raise the efforts on reducing the IR among humans and infection sources. Extensive awareness campaigns for the public are prerequisite in the control and prevention of further spread in the study area.

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List of Abbreviations

PHD	Public Health Department
BHD	Bisha Health Directorate

Conflict of interest
The authors declare that there is no conflict of interest in the publication of this article.

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Consent for participation
Not required.

Ethical approval
Ethical approval was obtained from the Research Ethics Local Committee, College of Medicine, University of Bisha [Ref No. UBCOM/H-06-BH-087(03/100)].

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