Seroprevalence and associated risk factors of human *Brucella* infection in selected provinces in Sri Lanka

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Abstract

Brucellosis is a systemic zoonotic bacterial infection. We studied the seroprevalence and risk factors for human *Brucella* infection in 1,294 healthy people from 4 provinces: Central, North-Western, North-Central and Western Provinces. Farmers in contact with farm-animals, veterinary staff, abattoir workers, and non-contact urban-dwellers were tested against *B. abortus* and *B. melitensis* antigens by SAT. Seroprevalence was 8.4% of the study population. Farm-animal owners and working full-time with livestock have a significantly higher risk of acquiring *Brucella* infection. Enhanced laboratory support and surveillance is necessary to control brucellosis in Sri Lanka. This is the first report on human *Brucella* infection.

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Introduction

Brucellosis is a systemic bacterial zoonosis. It is transmitted by ingestion through food products, direct contact with infected animals and inhalation of aerosols. Transmission through blood transfusion or tissue transplantation and sexual transmission are rare possibilities. Although the disease has been well known for decades, it continues to be a major public health issue worldwide [1].

The true incidence of human brucellosis is unknown globally, as many countries known to be endemic for brucellosis, such as India and South Africa, do not have reliable data on the disease [2].

Brucella are small aerobic intracellular coccobacilli, that live mainly in the reproductive organs of wild and domestic animals. There are 8 species identified, but *B. melitensis, B. suis, B. abortus* and *B. canis* cause disease in humans. Although *B. melitensis* is thought to be the most virulent species, *B. abortus* is the most commonly distributed species worldwide [1]. Livestock farmers, slaughterhouse workers and veterinarians are at high risk of developing the disease. Travelers and urban residents usually acquire the infection through the consumption of contaminated food especially raw milk or milk products [3]. The disease was introduced to Sri Lanka during the second world war, through the importation of cattle. The first clinical outbreak in livestock was reported in 1956 [4,5]. The North-Western and North-Central Provinces with the highest density of cattle, were implicated as endemic areas for brucellosis[4]. However, a meta-analysis in 2013 has shown that data is not available for human brucellosis in Sri Lanka[6].

We studied the seroprevalence of human *Brucella* infection and associated risk factors among high-risk occupations such as farmers, veterinarians and abattoir workers in Central (CP), North-Western (NWP), North-Central (NCP) and Western (WP) Provinces.

Methods

The study was conducted in 2014/2015 among 9 districts in the 4 Provinces. The 41 veterinary divisions and their farms were randomly selected by probability-proportional-to-size sampling technique. Veterinary staff, abattoir workers and non-contact urban-dwellers were recruited by convenient sampling.

A total of 1,294 blood samples were collected from farmers in contact with farm animals (818), veterinary staff (190), abattoir workers (137) risk categories and non-contact urban-dwellers (149). The study used a non-random purposive sampling method. Standard tube Agglutination Test (SAT) was performed using *B. abortus* and *B. melitensis* antigens (MAST™ Assure febrile stained antigen, UK) according to manufacturer's guidelines at clinical bacteriology laboratory, Medical

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Research Institute. A titer of 1:80 was considered for seropositivity (past infection). Socio-demographic data were collected using an interviewer-administered questionnaire.

Statistical analysis

Data entry and statistical analyses were performed using SPSS version 21. Quantitative data were obtained in the form of percentages and figures. Cross tabulations were generated between seroprevalence and socio-demographic factors, and the Pearson χ^2 test was used to express the statistical significance of any associations. P-values of 0.05 or less were considered to be significant. The potential risk factors for seropositivity were also assessed using bivariate analyses and presented as Odds Ratio (OR).

Results

A total of 1,294 healthy adults were screened. Sample size was sufficient to estimate sero-prevalence of brucellosis at 50% in the study population. The level of precision is 95% with confidence interval 3% and the non-response rates was 15%. Males constituted 81.9% and the mean age was 45.6 years (Table 1). SAT was negative in 1,185 (91.6%) of the study population and positive in 104 (8.4%). The overall seroprevalence for human *Brucella* infection was 8.4%. SAT showed seropositivity of 7.5% for *B. abortus* and 3.2% for *B. melitensis*. The risk occupations had a significant seropositivity compared to non-contact residents (p=0.04). Farm animal owners showed a significant seropositivity, in comparison to non-contact residents (OR=3.0, p<0.05) [Table 2,3]. Analysis of specific high-risk behaviors such as assisting in animal delivery, duration and degree of animal contact, and consumption of raw milk did not show significant associations with seropositivity. Individuals with full-time exposure to animals (p=0.01) had a significantly higher risk of developing the *Brucella* infection than part-time workers. Being a livestock farmer with animal contact (p=0.03) yielded a significantly higher risk than for veterinary staff or abattoir workers [Table 2,3].

Table 1. Distribution and composition of the study sample

Description	*Number (n) participated*	*%*
Province		
WP	403	31.1
CP	166	12.8
NWP	356	27.5
NCP	369	28.5
Risk categories		
Animal-husbandry owners	596	46
Part-time animal handlers	216	16.6
Veterinary staff	192	14
Abattoir workers	141	10.8
Urban-dwellers	149	11.5

Table 2. Distribution of seropositivity to *Brucella* infection according to socio-demographic and occupational characteristics (n=1294)

	Characteristic	*Seropositivity (n)*	*%*	*Total*	*Chi-square*	*P value*
Gender	Male	83	7.8%	1060	2.7	0.102
	Female	26	11.1%	234		
Age category	<30	15	11.8%	127	11.6	0.020
(in years)	31-40	21	7.1%	297		
	41-50	44	10.0%	438		
	51-60	14	4.6%	304		
	>60	15	11.7%	128		
Risk Occupations	Animal husbandry owner	65	10.9%	596	10.9	0.027
	Handling farm animals (part-time)	12	5.6%	216		
	Veterinary staff	15	7.8%	192		
	Abattoir workers	11	7.8%	141		
	Non-contact persons	6	4.0%	149		

(Continued)

	Characteristic	*Seropositivity (n)*	*%*	*Total*	*Chi-square*	*P value*
Duration of	0-10 years	44	9.6%	460	1.6	0.813
risk occupation	11-20 years	37	7.7%	483		
	21-30 years	19	8.0%	238		
	31-40 years	8	8.7%	92		
	41-50 years	1	4.8%	21		
Risk Occupation vs.	Risk occupations	103	9.0%	1145	4.2	0.040
Urban-dwellers	Non-contact group	6	4.0%	149		
Working in	Yes	12	7.8%	154	.090	0.764
slaughter house	No	97	8.5%	1140		
Type of livestock	Cattle only	50	8.3%	602	4.5	0.337
	Water buffaloes only	5	14.7%	34		
	Goat only	2	10.5%	19		
	Swine only	1	16.7%	6		
	Mix herd	24	12.6%	190		
Working with livestock	Full time	51	10.8%	474	6.9	.032
	Part time	34	8.3%	410		
	No	24	5.9%	410		
Degree of contact	Habitual contact	85	8.7%	982	3.5	0.320
	Frequent contact	10	10.3%	97		
	Less frequent contact	5	11.9%	42		
	No contact	9	5.2%	173		
Duration of Contact	No contact	9	5.5%	163	3.8	0.705
with animals	>20 years	34	8.9%	382		
	15-19 years	14	8.6%	162		
	10-14 years	11	6.6%	167		
	5-9 years	22	9.3%	236		
	1-4 years	16	10.3%	155		
	<1 year	3	10.7%	28		
Drinking raw milk	Yes	4	7.5%	53	0.06	0.815
	No	105	8.5%	1241		
Study Prevalence			8.40%	1294		

Table 3. Univariate regression analysis for being seropositive to *Brucella* infection: Odds ratio for socio-demographic and occupational risk factors (n=1294)

		95% C.I. for OR		
Variable	*Unadjusted OR*	*Lower*	*Upper*	*P value*
Gender				
Female	1.000			
Male	.680	.427	1.082	.104
Age				
<30 yrs	1.000			
31-40	.568	.283	1.142	.112
41-50	.834	.447	1.554	.567
51-60	.360	.169	.771	.009
>60	.991	.463	2.123	.982
Occupation				
Non-contact persons	1.000			.033
Animal husbandry own	2.917	1.239	6.870	.014
Handling farm animals part-time	1.402	.514	3.822	.509
Veterinary staff	2.020	.764	5.339	.156
Abattoir workers	2.017	.725	5.608	.179
Duration of risk Occupation				
0-10 years	1.000			.816
11-20 years	.784	.497	1.239	.298
21-30 years	.820	.467	1.439	.490
1-40 years	.900	.409	1.982	.794
41-50 years	.473	.062	3.608	.470
Occupation risk				
Non-risk occupations	1.000			
Risk occupations	2.356	1.016	5.465	.046
Risk of animal exposure				
Non-contact	1.000			
Animal contact	2.497	1.067	5.841	.035
Vet staff	2.020	.764	5.339	.156
Abattoir	2.017	.725	5.608	.179
Working in slaughter house				
No	1.000			
Yes	1.101	.589	2.056	.764
Type of livestock				
Mix herd	1.000			
Cattle only	.627	.374	1.050	.076
Water buffaloes	1.193	.421	3.378	.740
Goat only	.814	.177	3.744	.791
Swine only	1.383	.155	12.351	.771
Working with livestock				
No	1.000			
Full-time	1.939	1.171	3.211	.010
Part-time	1.454	.846	2.499	.175
Degree of contact				
No contact	1.000			
Habitual contact	1.727	.852	3.501	.130
Frequent contact	2.095	.820	5.348	.122
Less frequent	2.462	.780	7.776	.125
Duration of contact				
No contact	1.000			
>20 years	1.672	.783	3.570	.184
15-19 years	1.619	.680	3.853	.276
10-14 years	1.207	.486	2.993	.685
5-9 years	1.759	.788	3.926	.168
1-4 years	1.970	.843	4.600	.117
<1 year	2.053	.520	8.107	.305
Drinking raw milk				
No	1.000			
Yes	.883	.313	2.495	.815

*Reference category is underlined

Discussion

Brucellosis has been recognized as a re-emerging zoonosis due to growing international tourism, migration and potential use as a biological weapon. In Sri Lanka, animal brucellosis is an endemic disease, causing economic impact to the livestock industry [4].

One clinically suspected case of human brucellosis has been briefly described in a Sri Lankan patient from Monaragala four-decades ago [7]. Since then, no reports were available on human disease in Sri Lanka. Our study shows a seroprevalence of 8.4% for human *Brucella* infection and the most common species detected serologically was *B. abortus*.

In animal brucellosis, *B. abortus* has been reported as the common species in Sri Lanka [4]. In the 1980s, cases of caprine brucellosis due to *B. melitensis* were reported and more recently, in swine in Sri Lanka [6,8]. High incidence of animal brucellosis was reported from Eastern, NCP and NWP [5].

Close contact with animals and raw milk ingestion has been attributed as the major risk factors in Karnataka in India [9]. In our study, farm animal owners and full-time handlers of livestock showed significant seropositivity than part-time livestock handlers and non-contact groups and only 53 persons ingested raw milk [Table 2,3]. This signifies the variations in risk factors for brucellosis in different countries.

In conclusion, the seroprevalence for human *Brucella* infection is 8.4%. Farm-animal owners and those working full-time with animal husbandry have a significantly high risk of acquiring the infection. This is the first report on human *Brucella* infection in Sri Lanka.

Awareness of the disease among clinicians, and enhanced laboratory diagnostic support and surveillance in human and animal brucellosis are recommended to control brucellosis in Sri Lanka.

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Conflicts of interests

The authors declare that they have no conflicts of interests.

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Declarations

Ethics approval and consent to participate:

Ethics approval was obtained from the Ethics Review Committee, Medical Research Institute, Sri Lanka (32/2011). Background data on farms were obtained from the District Veterinary Surgeons through the Director General of Animal Health and Production. Written consent was obtained from participants.

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