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Epidemiology of human Brucellosis in rural South Africa: Household survey of seroprevalence and risk factors, 2022–2023

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INTRODUCTION

- Brucellosis is a widespread zoonotic disease of major public health importance, with ~500,000 new human cases reported annually, though true incidence may reach 1.6–2.1 million worldwide [1].
- The disease is caused by *Brucella* spp., which infects cattle, small ruminants, pigs, and other animals.
- Transmission to humans occurs via direct contact with infected animals, aborted foetuses, or contaminated tissues, and through consumption of unpasteurised milk, dairy products, or undercooked meat.
- Bovine brucellosis in South Africa occurs in all nine provinces, concentrated in the central and Highveld areas. Poor compliance with vaccination and testing raises risk of acquiring infected cattle [2].
- Human brucellosis was first recorded in southern Africa in 1894; the most recent official incidence data for South Africa (0.1–0.3 per 100,000) dates back to 1977–1984 [3].
- Despite being notifiable, the disease remains underdiagnosed and underreported due to non specific symptoms, limited diagnostic capacity, and lack of clinical familiarity.
- Studies in South Africa highlight poor awareness and high risk practices among communal cattle keepers and abattoir workers, underscoring the need for better education and biosecurity [4,5].
- Reported *Brucella* IgG seroprevalence in South Africa varies by province, from 1.4% in acute febrile patients to 7.8–20.9% in high risk occupational groups [6–10].

AIM

- This study aimed to assess Brucellosis seroprevalence in a rural community and examine exposure factors among livestock-owning and non-livestock households.

STUDY AREA

- The study was conducted in the Jozini and uMhlabuyalingana municipalities of the uMkhanyakude District, KwaZulu-Natal Province, South Africa (Figure 1).

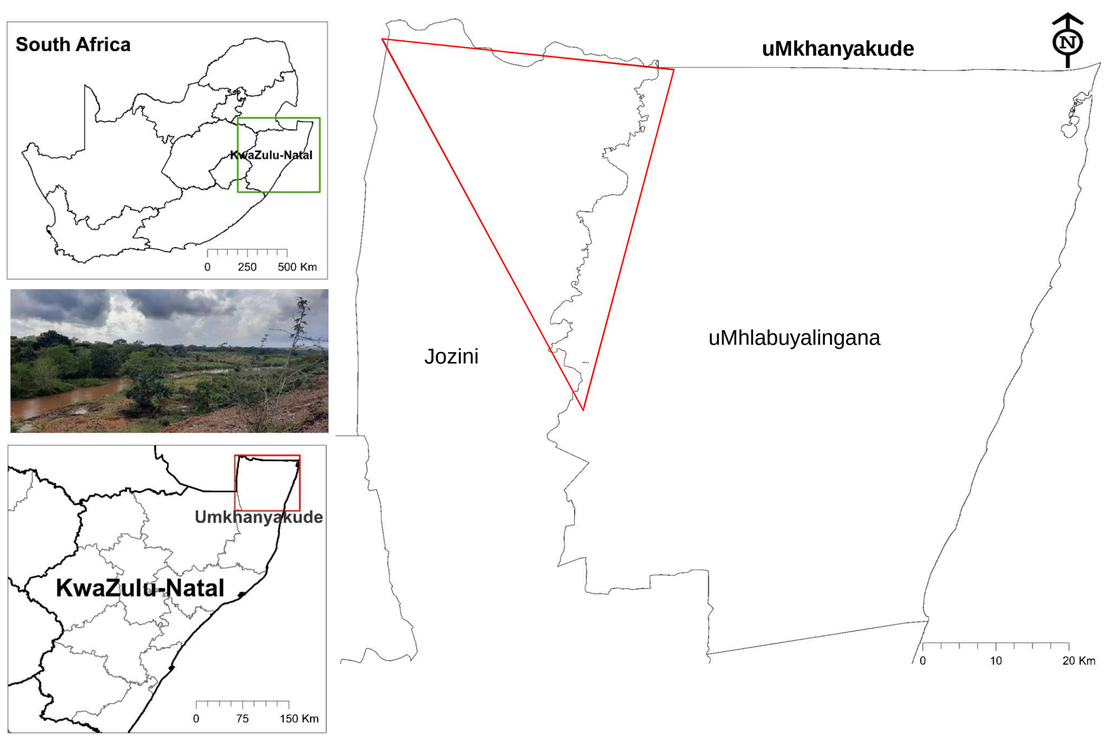

Figure 1: Map showing the study area (red triangle) within the north-western region of the uMkhanyakude District, KwaZulu-Natal Province, South Africa.

METHOD

- **Study design and setting:** A cross-sectional, cluster-randomized household survey conducted between June 2022 and May 2023.
- **Ethics:** The study obtained approval from the Wits Human Research Ethics Committee (no. M190817), the Mathenjwa Traditional Council, and the KwaZulu-Natal and local health authorities. Household participants aged ≥12 years provided informed consent before participation.
- **Data collection:** Household interviews were conducted using pre-tested standardized electronic questionnaires (via Open Data Kit on tablets) to gather information on risk factors associated with *Brucella* seroprevalence.
- **Laboratory analysis:** Serum samples from 688 household interviewees were tested for anti-*Brucella* IgG antibodies using the Vircell *Brucella* IgG enzyme-linked immunosorbent assay (ELISA) kit (Vircell S.L., Granada, Spain).
- **Software used:** Epidemiological and IgG status data were analyzed using Stata v18.0 (StataCorp, College Station, TX, USA).
- **Data analysis:** Associations between categorical variables and IgG serostatus were tested with two-sided Fisher's exact tests. Variables with *P* value < 0.2 in univariable analysis were entered into a logistic regression model using backward selection. Wald's test and likelihood ratio test assessed predictor significance, and model fit was evaluated with the Hosmer–Lemeshow test.

RESULTS & DISCUSSION

- **Study population:** A total of 688 participants from 320 households were enrolled. The median age was 36 years (IQR: 25–53; range 12–95), 98% identified as Black African and 59% were female. Poultry ownership was common (74% kept chickens), while 12% kept cattle, 16% goats, and 39% both bovids.
- **Seroprevalence:** Overall, 4.4% (30/688) of participants from 27 households were *Brucella* IgG seropositive (Figure 2), with a 95% CI of 3.0–6.3% after adjusting for household clustering.

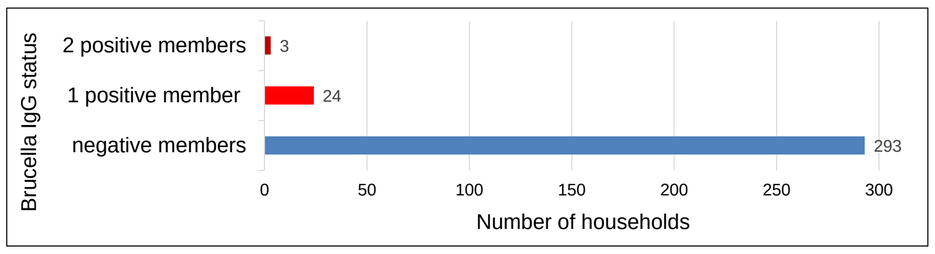

Figure 2. Distribution of households by *Brucella* IgG serostatus.

- **Univariable associations:** Significant associations were observed for gender, age, schooling, cattle/goat ownership, milk and amasi consumption, eating animals found dead, and wild animal hunting (Table 1).
- **Non-significant factors:** Human seropositivity showed no correlation with employment status or sector, ownership of hooved animals (other than cattle/goats) or chickens, or consumption of undercooked meat. Pet ownership (cats/dogs) was also non-significant when stratified by bovid keeping.

Table 1. Univariable Fisher's Exact test *p*-values for risk factors significantly associated with *Brucella* IgG seroprevalence.

Variable	n/N	%	*p*
Gender			0.000
Female	8/400	2.0%	
Male	22/280	7.9%	
Age group			0.090
12 – 36 years	8/341	2.4%	
37 – 95 years	21/333	6.3%	
Schooling			0.106
Primary/Secondary	15/218	6.9%	
Higher/TVET/Intermediate/Senior	14/461	3.0%	
Works with/Member of household that owns cattle or goats			0.000
No	1/231	0.4%	
Yes	29/457	6.4%	
Milk consumption			0.097
No	4/128	3.1%	
Yes, either always or usually boiled	20/488	4.1%	
Yes, either always or usually raw	5/48	10.4%	
Amasi (fermented milk) consumption			0.077
No	23/598	3.9%	
Yes	7/82	8.5%	
Eating animal after found dead			0.059
No	17/493	3.5%	
Yes	13/187	7.0%	
Wild animals hunting			0.069
No	18/523	3.4%	
Yes, min. 1 x in past year	9/129	7.0%	
Yes, frequently	3/26	11.5%	
Engaged in slaughtering			0.151
No	9/302	3.0%	
Yes, min. 1 x in past year	13/197	6.6%	
Yes, frequently	7/181	3.9%	
Abortions in animals at household			0.190
No	13/437	3.0%	
Yes	17/244	7.0%	

- **Multivariable analysis:** The variables abortion (p=0.946), milk choice (p=0.852), wild animal hunting (p=0.371), amasi consumption (p=0.189), and eating of animals found dead (p=0.150) were excluded from the final model. Slaughtering was also omitted due to collinearity with household cattle/goat ownership.
- **Final factors:** The remaining factors retained in the model were age group (per quartile), gender, and working with or being a member of a household that owns cattle or goats (Table 2). The logistic regression model demonstrated good fit (χ^2 test, p=0.283).

Table 2. Final multivariable model with predictors** and covariate* for *Brucella* IgG seroprevalence

Variables	OR	z	*p*>|z|	95% CI
age group*	1.32	1.52	0.128	0.92–1.90
gender**	3.43	2.75	0.006**	1.42–8.28
cattle or goats**	9.43	2.18	0.029**	1.25–71.06
constant	0.00	-5.77	<0.001	0.00–0.01

**predictors, *covariate

CONCLUSION

- This is the first household-level investigation of brucellosis in South Africa, providing new insights into community transmission.
- Overall seroprevalence (4.4%) was lower than previously reported in South Africa, suggesting regional variation and potentially lower exposure intensity in this community.
- Strengthening education, biosecurity, and surveillance is essential, with targeted interventions focused on farming households and safe livestock handling.

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