

Seroprevalence of *Coxiella burnetii*, *Rickettsia* spp. and *Orientia tsutsugamushi* in indigenous tribes from the Santa Marta region, Colombia

R. Oakley^{1,2}, S. Kann³, G. Concha, M⁴. Plag¹, C. Meile^{1,5}, S. Poppert¹, S. Graves⁶, A. Dreyfus^{7,8}, D.H. Paris^{1,2}

¹Swiss Tropical and Public Health Institute, Allschwil, Switzerland; ²University of Basel, Basel, Switzerland; ³medmissio, Würzburg, Germany; ⁴Organización Wiwa Yugumaiun Bunkuanarua Tairona, Valledupar, Colombia; ⁵Rothen Medizinische Laboratorien AG, Basel, Switzerland; ⁶Australian Rickettsial Reference Laboratory, Geelong, Victoria, Australia; ⁷Vetsuisse Faculty, University of Zürich, Zurich; ⁸Institut Pasteur, Antananarivo, Madagascar

Introduction

The Wiwa and Koguis are indigenous tribes residing in remote regions of the Sierra Nevada de Santa Marta, Colombia, with limited contact to the outside world or medical services. While little is known of their healthcare needs or disease burden, a high proportion of zoonotic diseases was expected to be seen in the Wiwa and Koguis people due to their living in close contact with livestock, slaughtering of animals, and use of traditional agricultural methods (including top dressing)¹. *Coxiella burnetii*, *Rickettsia* spp. and *Orientia tsutsugamushi* are vector-borne zoonotic bacteria that can cause non-specific febrile illness in humans along with other complications²⁻⁴.

Objectives

- To determine the seroprevalence of *C. burnetii* in the Wiwa people
- To determine the seroprevalences of *Rickettsia* spp. (SFG & TG) and *O. tsutsugamushi* in the Wiwa and Koguis people
- To determine risk factors associated with *Rickettsia* spp. (SFG & TG) and *O. tsutsugamushi* exposure in the Wiwa people

Methods

We conducted a series of cross-sectional studies using data and samples collected during a program against Chagas disease. A subset of samples were sent to the Swiss Tropical and Public Health Institute (Allschwil, Switzerland) for serological testing.

Study 1

- Participants: Wiwa people (n = 150), serum collected in 2014.
- Pathogen: *Coxiella burnetii*, tested by Q Fever IgG & IgM IFAs (Fuller Laboratories, Fullerton, CA, USA), positive cut-off titre ≥ 1:16.

Study 2

- Participants: Wiwa (n = 264) & Koguis (n = 275), serum collected between 2021 – 2022.
- Pathogens:
 - SFG & TG *Rickettsia* spp., tested by *Rickettsia* IgG IFA (Fuller Laboratories, Fullerton, CA, USA), positive cut-off titre ≥ 1:128.
 - Orientia tsutsugamushi*, tested by Scrub Typhus Detect™ IgG ELISA (Inbios International, Washington, USA) positive cut-off OD ≥ 0.4.
- Zoonotic disease risk factor data collected for the Wiwa participants (n = 147).



Figure 1. Map of the Sierra Nevada de Santa Marta, Colombia. Included Wiwa and Koguis villages are located within the area marked by the black oval. Insert shows a map of Colombia with the Sierra Nevada de Santa Marta highlighted in red.

Results

Table 1. Seroprevalence of *Coxiella burnetii* tested by IFA (positive titre ≥ 1:16)

	IgG Phase I	IgG Phase II	IgM Phase I	IgM Phase II	Overall*
Positive % (pos n / total n)	21 (31/150)	21 (31/150)	15 (22/150)	17 (25/150)	35 (52/150)
95% CI	15 – 28	15 – 28	10 – 21	11 – 24	27 – 43

Coxiella burnetii

- Odds of overall seropositivity increased with age (ref <12 years).
 - 12 to 44 years: OR = 4.00, 95% CI 1.77 – 8.87, p = 0.001
 - ≥ 45 years: OR = 4.67, 95% CI 1.42 – 15.41, p = 0.011
- Women had increased odds of IgM seropositivity.
 - IgM Phase I: OR = 2.76, 95% CI 1.01 – 7.53, p = 0.047
 - IgM Phase II: OR = 2.76, 95% CI 1.07 – 7.14, p = 0.036

Table 2. Seroprevalence of SFG & TG *Rickettsia* spp. tested by IFA (positive titre ≥ 1:128) and *O. tsutsugamushi* tested by ELSIA (positive OD ≥ 0.4)

	SFG <i>Rickettsia</i> spp.	TG <i>Rickettsia</i> spp.	<i>O. tsutsugamushi</i>
Wiwa, % (pos n / total n)	25.4 (67/264)	5.3 (14/264)	1.5 (4/264)
95% CI	20.2 – 31.1	2.9 – 8.7	0.4 – 3.8
Koguis, % (pos n / total n)	26.9 (74/275)	5.5 (15/275)	6.9 (19/275)
95% CI	21.8 – 32.6	3.1 – 8.8	4.2 – 10.6
Total, % (pos n / total n)	26.2 (141/539)	5.4 (29/539)	4.3 (23/539)
95% CI	22.5 – 30.1	3.6 – 7.6	2.7 – 6.3

SFG *Rickettsia* spp.

- Odds of seropositivity increased with age (ref. 12 – 44 years).
 - <12 years: OR = 0.22; 95% CI 0.11 – 0.43; p < 0.001
 - ≥ 45 years: OR = 2.76; 95% CI 1.70 – 4.48; p < 0.001

- Those that assisted with the birth of cattle had increased odds of seropositivity (Wiwa only).
 - OR = 8.23; 95% CI 1.25 – 53.96; p = 0.028

TG *Rickettsia* spp.

- Odds of seropositivity increased with age (ref. 12 – 44 years).
 - <12 years: OR = 0.20; 95% CI 0.05 – 0.87; p = 0.032

Orientia tsutsugamushi

- The Koguis people had increased odds of being seropositive compared to the Wiwa people.
 - OR = 4.8 95% CI 1.6 – 14.3, p < 0.001

Table 3. Exposure to potential risk factors for the transmission of zoonotic pathogens among the Wiwa people (n = 147).

Exposure	Positive, % (n)
Ticks found on body/ on the body of their child	77.6 (114)
Participate in animal slaughter:	
Chickens	73.5 (108)
Turkeys	3.4 (5)
Pigs	10.9 (16)
Cattle	4.8 (7)
Goats	49.0 (72)
Sheep	2.7 (4)
None	15.6 (23)
Assist in animal birth:	
Pigs	1.4 (2)
Cattle	3.4 (5)
Goats	5.4 (8)
Sheep	1.4 (2)
Other	3.4 (5)
None	76.2 (112)
Milking of animals:	
Cattle	8.2 (12)
Goats	5.4 (8)
Sheep	4.1 (6)
Other	2.0 (3)
None	81.6 (120)

References

- Dreyfus A, *et al.* Comparison of the Serion IgM ELISA and Microscopic Agglutination Test for diagnosis of *Leptospira* spp. infections in sera from different geographical origins and estimation of *Leptospira* seroprevalence in the Wiwa indigenous population from Colombia. *PLoS Negl Trop Dis* 16, e0009876, doi:10.1371/journal.pntd.0009876 (2022).
- Eldin C, *et al.* From Q Fever to *Coxiella burnetii* Infection: a Paradigm Change. *Clin Microbiol Rev* 30, 115-190, doi:10.1128/cmr.00045-16 (2017).
- Gunasekaran K, *et al.* Scrub Typhus and Other Rickettsial Infections. *Indian J Crit Care Med* 25(Suppl 2):s138-s143; doi: 10.5005/jp-journals-10071-23841 (2021)
- Bonell A, *et al.* Estimating the burden of scrub typhus: A systematic review. *PLOS Negl Trop Dis* 11(9): e0005838. doi.org/10.1371/journal.pntd.0005838 (2017)

Conclusions

This is the first study to identify exposure to *C. burnetii*, *Rickettsia* spp. and *O. tsutsugamushi* in the indigenous people residing in the Sierra Nevada de Santa Marta, Colombia.

The high seroprevalence of *C. burnetii* and SFG *Rickettsia* spp. seen in the Wiwa and Koguis people highlights the possible importance of ticks in transmitting diseases in these communities.

Further One Health studies that include humans, animals, and vectors are warranted to identify risk factors, clinical impact and potential medical, veterinary and environmental interventions.

Abbreviations

- | | |
|-------|-----------------------------------|
| SFG | Spotted fever group |
| TG | Typhus group |
| IFA | Immunofluorescence assay |
| ELISA | Enzyme linked immunosorbent assay |