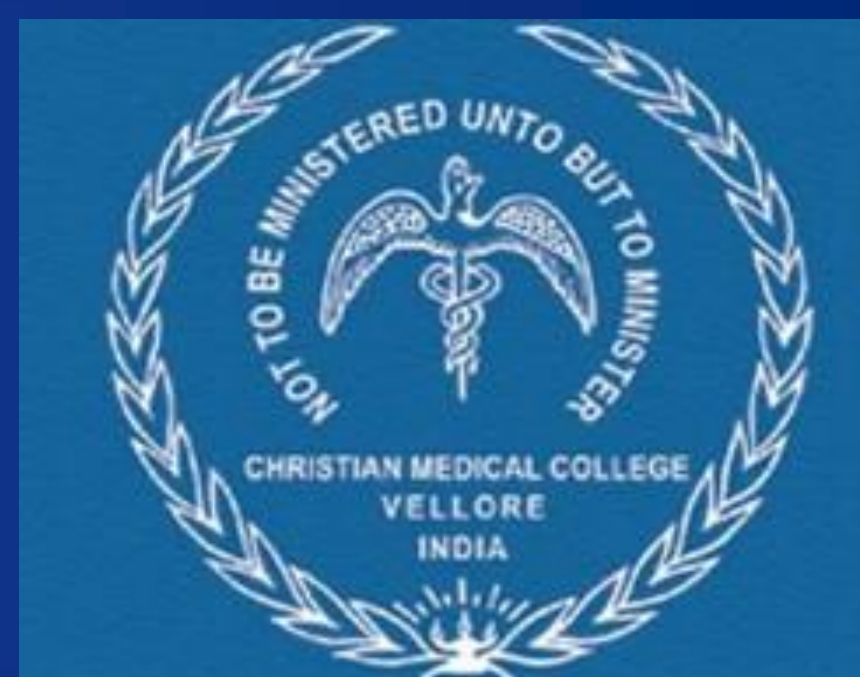


Prevalence and Risk Factors for Scrub Typhus in South India

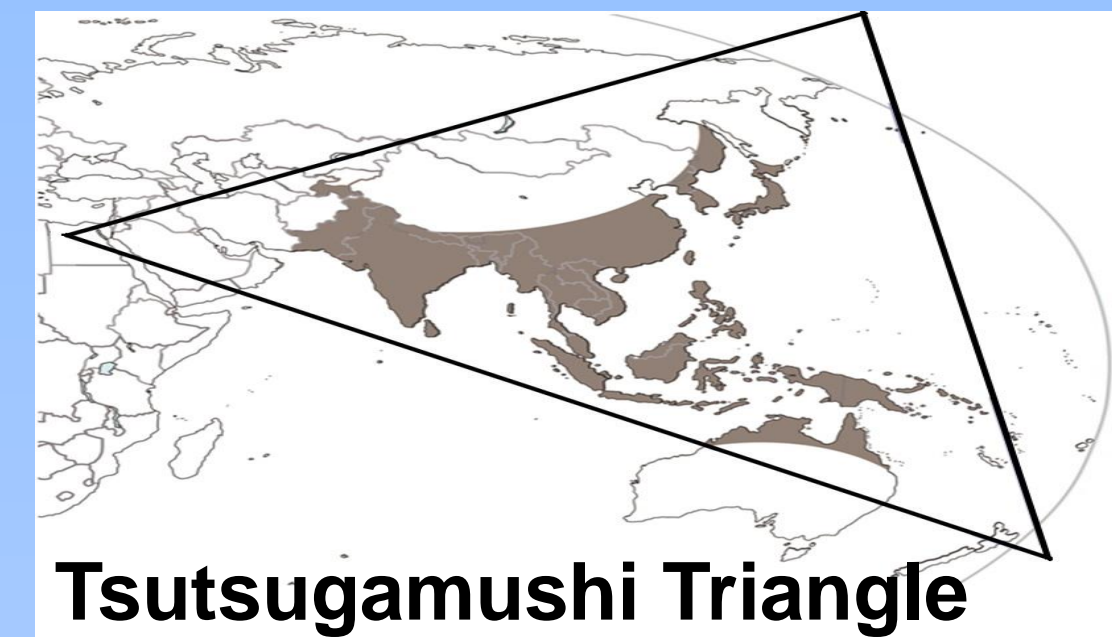
Authors: Paul Trowbridge¹, Divya P², Prasanna S. Premkumar², George M. Varghese²

¹Spectrum Health Center for Integrative Medicine, Grand Rapids, MI, USA; ² Christian Medical College, Vellore, Tamil Nadu, India



Background

- Scrub typhus is a mite-borne acute febrile illness endemic to South and East Asia and the Eastern Pacific Rim, which can have high mortality and be difficult to diagnose.



- Disappeared for several decades in many endemic areas, re-emergence has been documented in multiple areas, including in South India in the early 2000's.

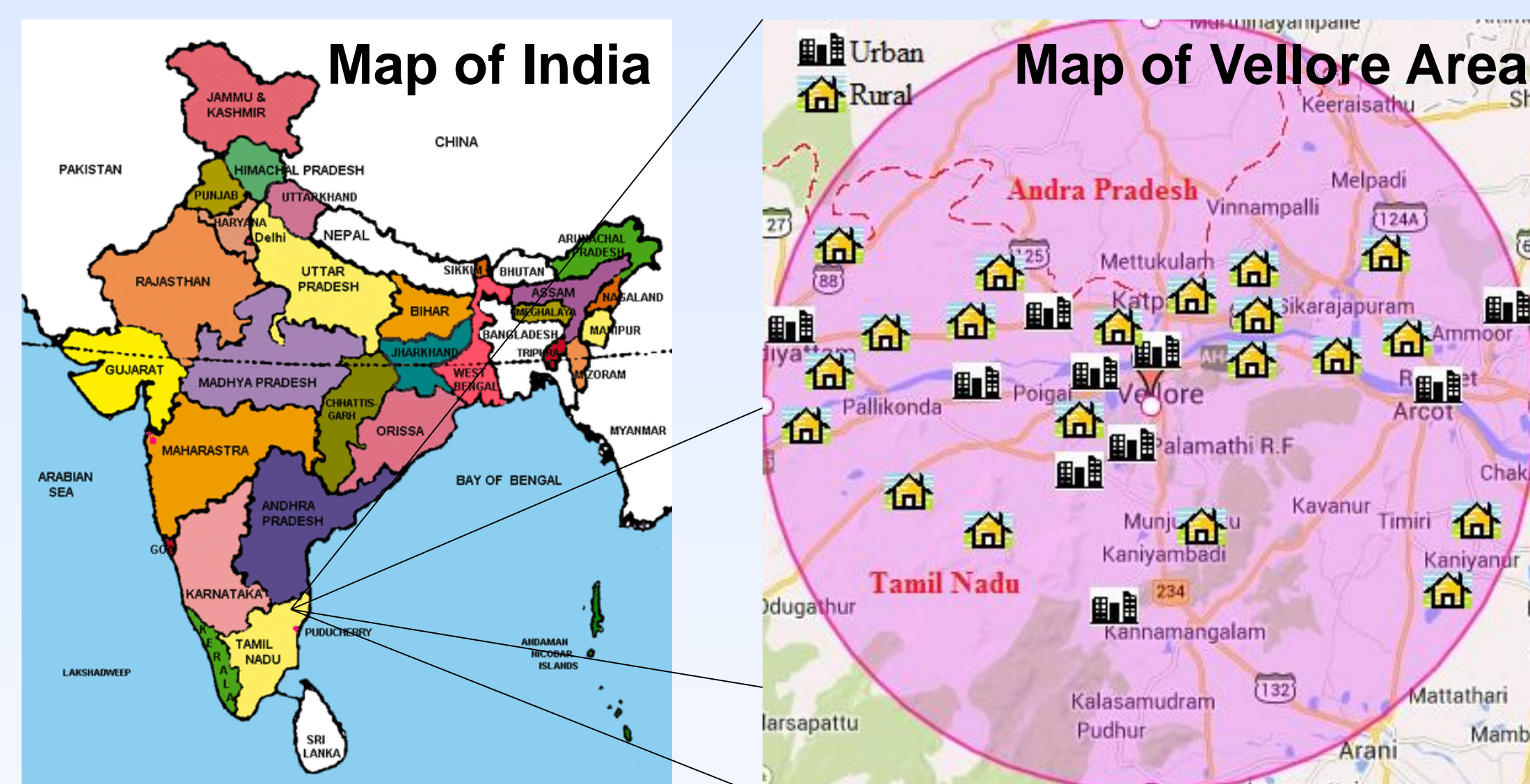
- At that time there was a 5% overall prevalence around Vellore, South India, but a high incidence among hospitalized patients¹.

- Known risk factors, including personal and environmental factors that bring humans into contact with mites and, perhaps, poverty, often vary significantly between locations and have not been explored in South India.

- Nutritional risk factors play a role in many infections but have not been explored in scrub typhus

Methods

- We performed a cross-sectional population study of adults (≥18 years of age) in the Vellore District of Tamil Nadu, South India within 30 kilometers of the city of Vellore.



- Within this area, 21 participants were recruited from each of 20 villages (rural) and 28 from each of 10 towns/cities (urban), which were randomly selected to represent the approximately 60% rural population of Tamil Nadu.

- Serum samples were drawn from each participant and Scrub Typhus Detect (InBios International, Inc, Seattle, WA, USA) Enzyme-Linked ImmunoSorbent Assays (ELISA) for IgG and IgM were run on each.

- A risk factor survey was administered to each participant, exploring personal habits, environmental exposures, and biometric data.

- Those found to be seropositive for scrub typhus by IgG, IgM, or both were used as cases in a case control study comparing risk factors.

Results

Table 1

Total Number of Participants	721
Mean Age	50.6 years
Sex	Female: 451 (62.6%) Male: 270 (37.4%)
Location	Rural: 437 (60.6%) Urban: 284 (39.4%)
Seropositivity	Positive: 229 (31.8%) - IgG: 214 (29.7%) - IgM: 30 (4.2%) - Both: 15 (2.1%) Negative: 492 (68.2%)

Table 2: Risk Factor Univariate Analysis

Determinant	Category	Seropositivity	Odds Ratio (95% CI)	Significance
Animals	Animal (n=211)	68 (32.2%)	1.06 (0.74-1.51)	0.75
	No Animals (n=467)	145 (31.0%)	R	
Occupation	Agriculture/Laborer (n=270)	93 (34.4%)	1.67 (0.74-3.77)	0.21
	Housewife (107)	22 (20.6%)	1.37 (0.49-3.84)	0.56
	Not Working (n=232)	85 (36.6%)	1.73 (0.71-4.21)	0.23
	Office/Shop/Other (n=102)	24 (23.5%)	R	
Agriculture	Rice/Vegetables (n=46)	14 (30.4%)	0.88 (0.39-1.97)	0.78
	Other (n=36)	6 (16.7%)	R	
House Type	Pucca/Tiled (n=690)	220 (31.9%)	1.55 (0.65-3.69)	0.32
	Kutcha (n=29)	9 (31.0%)	R	
Number of Rooms	(Per Room Increase)		0.84 (0.71-0.99)	0.05
Number of People	(Per Person Increase)		0.88 (0.79-0.98)	0.02
People/Room	(Per Person/Room Increase)		0.87 (0.69-1.08)	0.21
Bushes	Yes (n=366)	107 (29.2%)	0.83 (0.63-1.10)	0.19
	No (n=355)	122 (34.4%)	R	
Woodpile	Yes (n=398)	129 (32.4%)	0.99 (0.65-1.50)	0.96
	No (n=321)	98 (30.5%)	R	
Ditch	Yes (n=292)	96 (32.9%)	1.30 (0.78-2.17)	0.32
	No (n=427)	132 (30.9%)	R	
Water - Home	Yes (n=145)	48 (33.1%)	0.60 (0.01-28.52)	0.80
	No (n=528)	173 (32.8%)	R	
Water - Area	Yes (n=387)	132 (34.1%)	1.86 (0.39-8.93)	0.44
	No (n=334)	97 (29.0%)	R	
Home Cluster	Cluster (n=663)	218 (32.9%)	2.12 (1.05-4.27)	0.04
	Individual (n=53)	10 (18.9%)	R	
Work Top*	Shirt (n=199)	58 (29.1%)	1.25 (0.20-7.66)	0.81
	Banlian (n=16)	4 (25.0%)	R	
	None (n=1)	1 (100%)	Excluded	
Work Bottom*	Pants (n=55)	13 (23.6%)	0.69 (0.29-1.66)	0.40
	Lungy (n=155)	49 (31.6%)	R	
	Shorts (n=5)	0 (0.0%)	Excluded	
Home Top*	Shirt (n=199)	59 (29.7%)	2.89 (0.65-12.90)	0.16
	Banlian (n=13)	1 (7.7%)	R	
	None (n=2)	1 (50.0%)	Excluded	
Home Bottom*	Pants (n=47)	11 (23.4%)	0.51 (0.19-1.35)	0.18
	Lungy (n = 162)	50 (30.9%)	R	
	Shorts (n=5)	0 (0.0%)	Excluded	
Bathing	Whole Body (n=531)	169 (31.8%)	0.60 (0.12-2.94)	0.53
	Hands/Arms (n=145)	46 (31.7%)	0.90 (0.18-4.45)	0.90
	None (n=26)	11 (42.3%)	R	
Defecation	Field/Bushes (n=293)	94 (32.1%)	1.48 (1.01-2.18)	0.04
	Toilet (n=409)	131 (32.0%)	R	
Sex	Female (n=451)	147 (32.6%)	1.60 (1.05-2.45)	0.03
	Male (n=270)	82 (30.4%)	R	
Age	<20 (n=7)	0 (0.0%)	0 (0)	0
	30-40 (n=140)	33 (23.6%)	1.17 (0.46-2.98)	0.73
	40-50 (n=169)	47 (27.8%)	1.74 (0.72-4.27)	0.22
	50-60 (n=141)	49 (34.8%)	2.31 (0.82-6.51)	0.11
	>60 (n=197)	86 (43.7%)	3.06 (1.22-7.68)	0.02
	20-30 (n=67)	14 (20.9%)	R	
Height	(Per cm Increase)		0.96 (0.93-0.98)	0.001
Weight	(Per kg Increase)		0.97 (0.96-0.98)	<0.001
BMI	(Per kg/m ² Increase)		0.97 (0.94-0.99)	0.02
MUAC**	(Per cm Increase)		0.94 (0.90-0.98)	0.01

*Measured in men only **Mid Upper Arm Circumference

Results

Table 3: Risk Factor Multivariate Analysis

Determinant	Category	Odds Ratios (95% CI)	Significance
Number of Rooms	(Per Room Increase)	0.95 (0.79-1.16)	0.66
Number of People	(Per Person Increase)	0.94 (0.84-1.05)	0.25
Home Cluster	Clustered	2.47 (1.20-5.12)	0.02
	Individual	R	
Defecation	Field/Bushes	1.23 (0.75-2.02)	0.42
	Toilet	R	
Sex	Female	1.80 (1.10-2.92)	0.02
	Male	R	
Age (years)	30-40	1.09 (0.38-3.18)	0.87
	40-50	2.08 (0.76-5.73)	0.16
	50-60	2.52 (0.85-7.44)	0.09
	>60	3.50 (1.32-9.29)	0.02
BMI	(Per kg/m ² Increase)	0.97 (0.94-1.00)	0.09

Table 4: Physical and Nutritional Risk Factors for Scrub Typhus

Determinant	Positive**	Negative**
Age (years)	55.0 (14.6)	48.6 (14.8)
Height (cm)	153.7 (8.9)	155.3 (9.0)
Weight (kg)	59.9 (12.8)	62.1 (13.9)
BMI (kg/m²)	25.4 (5.1)	25.8 (5.4)
MUAC (cm)*	26.2 (3.4)	26.5 (3.4)

* Mid Upper Arm Circumference; ** Mean (SD)

Discussion

- Prevalence:**
 - Increased in the last decade from 5% to >30%
- Risk Factors:**
 - Traditional risk factors not associated in South India, perhaps because the gestalt of the environment is so conducive to the spread this infection
 - Living in homes clustered near other homes was associated with seropositivity
 - Other markers of crowding were not
 - A confounder, such as poverty, may be present
 - Older age was associated with seropositivity for unclear reasons
 - Female sex was associated with seropositivity
 - Seen in prior literature⁵
 - May be associated with gender roles in South India
 - People who were seropositive were statistically significantly shorter, lighter weight, and smaller
 - The absolute differences were small
 - Suggests a role of chronic malnutrition or a confounder such as poverty

Conclusions

- Scrub typhus has become a common infection in South India.
- There is likely much asymptomatic or mild disease, though it remains unclear what factors contribute to this. Further research is warranted to elicit these factors.
- Efforts must be put forth to educate providers about this infection, as it has only recently re-emerged and many providers remain unaware of it.
- Further research is warranted to improve diagnostics
- Further research is warranted to explore the roles of poverty, age, and sex in this infection.
- Efforts to control the mite populations via landscape modification or use of pesticides may be warranted.
- Efforts at creating a vaccine must be supported

Limitations

- Cluster design for convenience, not a randomized sample.
- Sampling restricted to 30 km around Vellore, limiting generalizability.
- Difficulty recruiting young men, potentially skewing results.

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