Original Research Article

Risk factors related to Scrub Typhus: A case-control study

ABSTRACT

Aim: To study the occupational factors associated with the positivity of scrub typhus among the patients admitted in a secondary care hospital in a rural area in Chittoor, Andhra Pradesh.
Study design: A case-control study design
Place and Duration of Study: The study was conducted for the duration of six months among the patients admitted with fever and suspected for Scrub Typhus in a secondary care hospital in a rural area of Chittoor, Andhra Pradesh.
Methodology: The cases were defined as patients who were aged ≥18 years, admitted with fever and tested positive for Scrub Typhus by ELISA (IgM). The controls were defined as patients who were aged ≥18 years, admitted with fever and tested negative for Scrub Typhus by ELISA (IgM). After obtaining informed consent, a self-administered questionnaire was given to the study participants. A total of 98 participants (cases=47; control=51) were recruited using total enumeration sampling technique. For each case recruited, one control was selected after matching for age and gender. The cases and controls were compared for socio-demographic, clinical features, habitual and occupational factors.
Results: People with eschar was more likely to be scrub typhus positive with an odds ratio of 40.39 (95% CI: 5.14 – 317.27) (p value <0.001). Those who had the habit of not bathing daily were identified to be at risk of scrub typhus with an odds ratio 3.18 (1.11 – 9.15) (p value = 0.03). People who indulge in activities like cutting grass, field work and collecting wood were identified to be at risk of contracting the disease with odds ratio 10.51 (1.50 – 73.59) with p value = 0.02. The occupation was not found to be a significant risk factor in this study.
Conclusion: Poor hygienic practice like not bathing regularly and activities that involves field work, cutting grass and collecting wood poses high risk of contracting scrub typhus.

Keywords: Scrub typhus; Occupational factors, farming, cutting grass, collecting wood, Orientia tsutsugamushi, Eschar, rickettsial disease, tropical disease

1. INTRODUCTION

Scrub typhus is a rickettsial infection caused by *Orientia tsutsugamushi* (1). *Orientia tsutsugamushi* is an obligatory intracellular gram-negative bacteria (2). Human transmission of scrub typhus happens through the bite of infected chigger mites which is often found in the rodents and shrews (3). These infected chigger mites are commonly seen in the scrubs during the rainy season which is favorable for them to lay eggs (4). Scrub typhus is mostly seen in the month of July to November in Manipur (5), July to October in Sikkim (6), September to November in Darjeeling (7) and August to February in Vellore, India (8). Scrub typhus clinical manifestations can be similar to those of tropical febrile illnesses such as malaria, dengue

fever, typhoid fever, and leptospirosis (9). The clinical manifestation of Scrub typhus can vary from a simple fever with rash or eschar to severe multi-organ failure which can lead to death (10). An eschar may form at the site of the chigger bite, suggesting the diagnosis of scrub typhus (11). Eschar is a necrotic skin lesion caused by the bite of chigger mite (12). Females have the eschar mostly in the chest and abdomen, while males have it in the axilla, groin and genitalia. It is also observed in cheek, ear lobe, and dorsum of the feet rarely (13). There are about 1 million scrub typhus infections in a year in the Asia-Pacific region and the case fatality rate among the cases without appropriate treatment can go up to 30 to 70% (14). Scrub typhus infection, once thought to be limited to the Tsutsugamushi triangle is now found to be infecting people all over the world (15). The major risk factors for scrub typhus are agriculture (16–18), owning cow and poultry (19), living in rural areas, poor sanitation, mice around the house, sitting directly on the floor etc (20,21). Simple measures like Habitat modification, rodent control, wearing long sleeves clothes, bathing regularly, and proper sanitation can avoid the risk of getting infected (19,20). On the contrary, the awareness among the people about scrub typhus is very low and giving proper education to the general public may help in reducing the risk of getting infected with scrub typhus.

2. METHODOLOGY

A hospital-based case control study was done from December 2022 to May 2023 among the patients admitted in a secondary care hospital in Chittoor with Acute Undifferentiated Febrile Illness (AUFI) and suspected to have scrub typhus. The sample size was calculated for a sero-prevalence of 32% and an odds of 4.2 for farmers to be scrub typhus positive from an earlier study done in Vellore by George et al (22). With the 95% CI and 80% power, the sample size calculated for the study is 68 (34 cases and 34 controls). The in-patients with fever and are suspected to have scrub typhus were recruited based on the inclusion and exclusion criteria. After obtaining informed consent, a questionnaire was administered by the principal investigator to the patients who were admitted in the hospital with fever and suspected to have scrub typhus. The questionnaire contained demographic details, occupation, socio-economic status, habits related to personal hygiene etc., a total of 98 patients who were suspected to have scrub typhus were included in the study using total enumeration sampling technique. Patients who were aged ≥18 years, admitted with fever and tested positive for scrub typhus by ELISA (IgM) were recruited as cases and patients who were aged ≥18 years, admitted with fever and tested negative for scrub typhus by ELISA (IgM) were recruited as controls. For each case recruited, one control was selected after matching for age and gender. The data was entered using Epidata 3.1 version (Jens M. Lauritsen, Odense, Denmark) and analyzed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp, Armonk, NY, USA). The association of various occupational risks, socio-demographics, clinical features and hygienic practices were compared between cases and controls using statistical analysis. The continuous variables were reported as mean and standard deviation for normally distributed variables and median and inter-quartile range for skewed variables. The categorical data were reported as frequency and percentages. The association between two categorical variables were found by using chi-square test and odds ratio was reported with 95% confidence interval. Logistic regression was done to adjust for the confounders and adjusted odds ratio was reported with the 95% Confidence interval.

3. RESULTS AND DISCUSSION

The total number of participants recruited for the study were 98, out of which 47 were cases and 51 were controls. The proportion of females among the cases and controls were 68.1% and 54.9% and males were 31.9% and 45.1% respectively. People aged above 45 years were the majority of the study participants. At the baseline, there were no statistically significant difference between the cases and controls in terms of demographic characteristics.

Table 1: Distribution of cases and controls based on their socio-demographic variables (n = 98)

Socio-demographic factors		**Case (n=47)**	**Control (n=51)**	**Odds Ratio (OR) (95% CI)**	***P* value**	**Adjusted Odds Ratio (AOR) (95% CI)**	***P* value**
Gender	Female	32 (68.1%)	28 (54.9%)	1.75 (0.77 – 4.00)	0.18	2.80 (0.48 – 16.21)	0.25
	Male	15 (31.9%)	23 (45.1%)				
Age group in years	18 – 45	16 (34%)	20 (39.2%)	0.80 (0.35 – 1.83)	0.60	1.03 (0.19 – 5.47)	0.98
	>45	31 (66%)	31 (60.8%)				
Occupation	Farmers, daily wage & house wives	29 (64.4%)	28 (62.2%)	1.10 (0.47 – 2.60)	0.83	2.49 (0.47 – 13.22)	0.28
	Others	16 (35.6%)	17 (37.8%)				
Education	0 – 5 years	21 (46.7%)	15 (30.6%)	1.98 (0.85 – 4.61)	0.11	1.28 (0.15 – 10.93)	0.82
	>5 years	24 (53.3%)	34 (69.4%)				
Per capita income (Rs.)	0 – 3000	28 (68.3%)	22 (50%)	2.15 (0.89 – 5.22)	0.87	0.69 (0.11 – 4.39)	0.70

The mean duration of fever for the cases and the control group in this study was 5.83 (SD: 2.6) and 5.76 (SD: 3.8) days, respectively. Likewise, the average temperature of the cases

and the controls were 101.3°C (SD: 1.8) and 100.7°C (SD: 1.5) (Refer Fig. 1) which is almost similar.

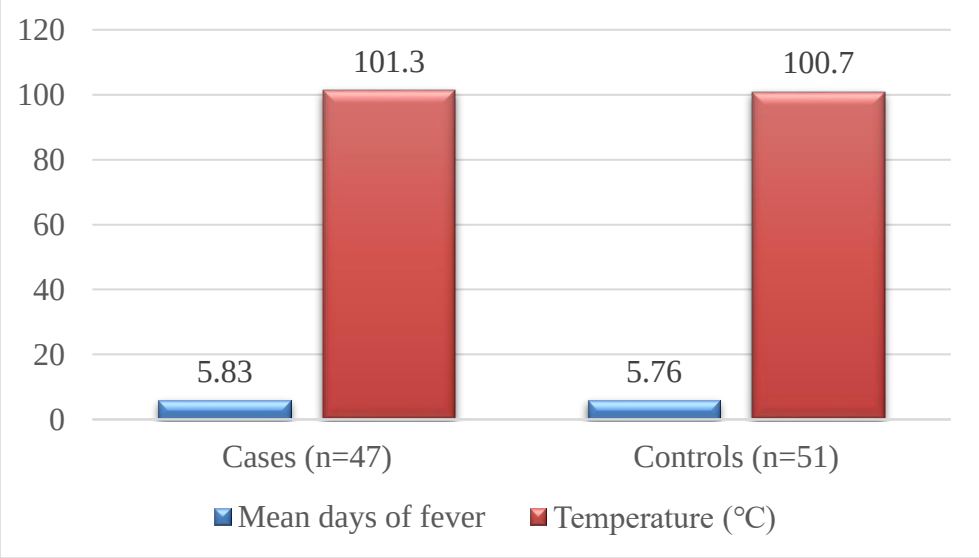

Figure 1: Mean duration of fever and temperature among cases and controls

When comparing the clinical characteristics of the cases and controls, it was found that the cases had a slightly greater percentage of myalgia, dyspnea, altered sensorium, head and body aches, and jaundice. Although the clinical signs and symptoms varied, the only symptom that was significantly higher ($p = 0.028$) in the cases (57.4%) when compared to the controls (35.3%) was dyspnea.

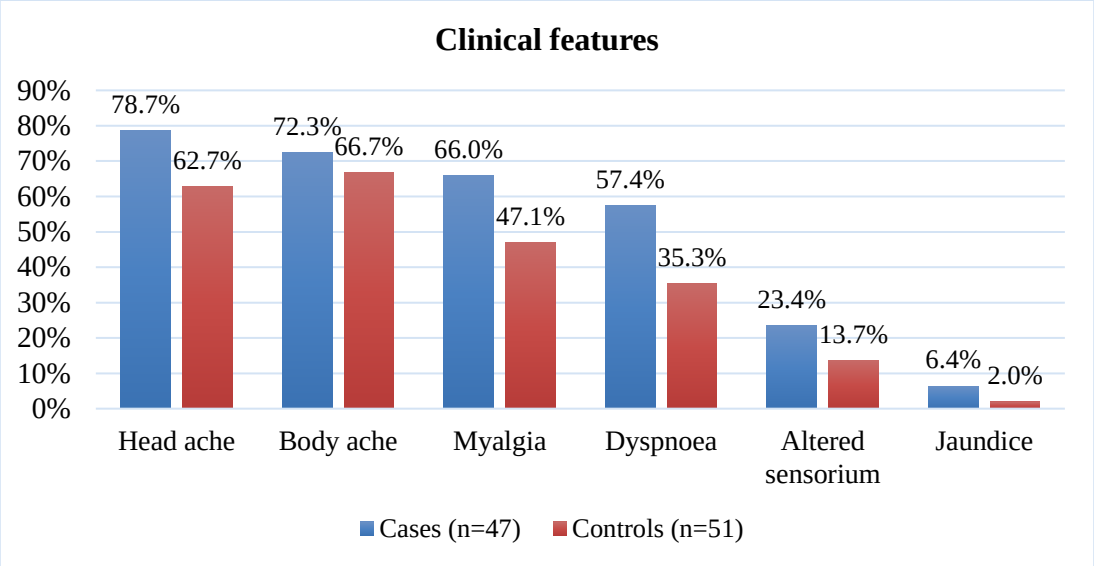

Figure 2: Distribution of cases and controls based on the clinical features (n = 98)

The proportion of eschar among the cases (44.7%) was significantly higher when compared to the controls (2%). Whereas, the proportion of people with rash was slightly higher among the controls (7.8%) when compared to the cases (6.4%).

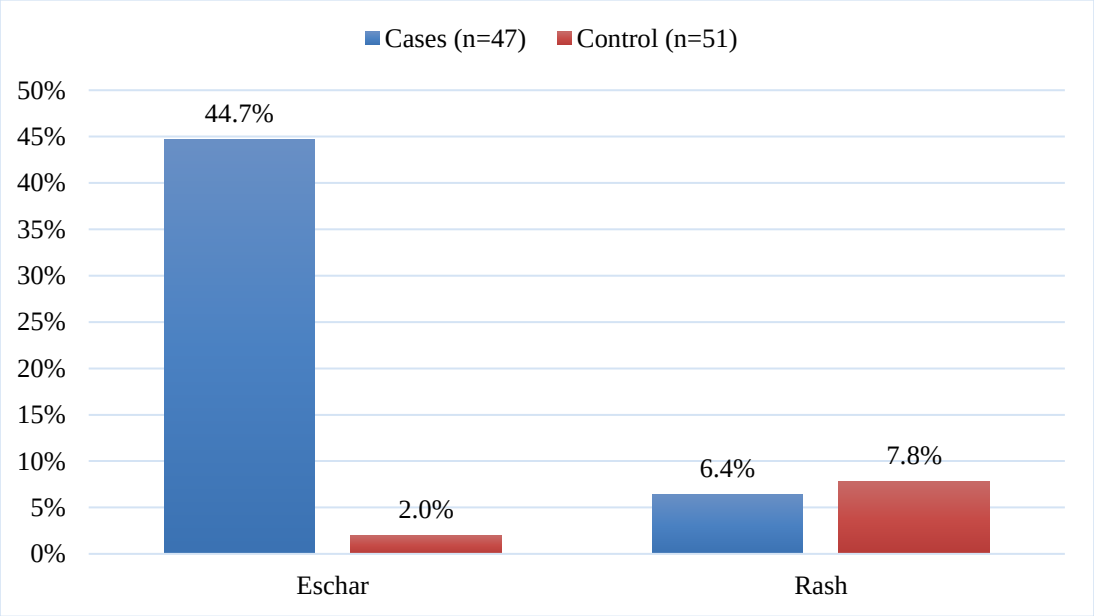

Figure 3: Distribution of eschar and rash among cases and controls

Table 2: Risk factor analysis

Risk factors		Case (n=47)	Control (n=51)	Odds Ratio (OR) (95% CI)	*P* value	Adjusted Odds Ratio (AOR) (95% CI)	*P* value
Gender	Female	32 (68.1%)	28 (54.9%)	1.75 (0.77 – 4.00)	0.18	2.80 (0.48 – 16.21)	0.25
	Male	15 (31.9%)	23 (45.1%)				
Age group in years	18 – 45	16 (34%)	20 (39.2%)	0.80 (0.35 – 1.83)	0.60	1.03 (0.19 – 5.47)	0.98
	>45	31 (66%)	31 (60.8%)				
Occupation	Farmers, daily wage & house wives	29 (64.4%)	28 (62.2%)	1.10 (0.47 – 2.60)	0.83	2.49 (0.47 – 13.22)	0.28
	Others	16 (35.6%)	17 (37.8%)				
Education	0 – 5 years	21 (46.7%)	15 (30.6%)	1.98 (0.85 – 4.61)	0.11	1.28 (0.15 – 10.93)	0.82
	>5 years	24 (53.3%)	34 (69.4%)				
Per capita income (Rs.)	0 – 3000	28 (68.3%)	22 (50%)	2.15 (0.89 – 5.22)	0.87	0.69 (0.11 – 4.39)	0.69
	>3000	13 (31.7%)	22 (50%)				
Eschar	Yes	21 (44.7%)	1 (2%)	**40.39 (5.14 – 317.27)**	**<0.001**	-	-
	No	26 (55.3%)	50 (98%)				
Bathe daily	No	14 (29.8%)	6 (11.8%)	**3.18 (1.11 – 9.15)**	**0.03**	1.66 (0.24 – 11.66)	0.61
	Yes	33 (70.2%)	45 (88.2%)				
Clothes Change after work	No	9 (19.1%)	3 (5.9%)	3.79 (0.96 – 14.98)	0.06	5.31 (0.26 – 109.20)	0.28
	Yes	38 (80.9%)	48 (94.1%)				
Cutting grass, field work & collecting wood	Yes	29 (61.7%)	22 (43.1%)	2.12 (0.95 – 4.77)	0.07	**10.51 (1.50 – 73.59)**	**0.02**
	No	18 (38.3%)	29 (56.9%)				
Pets	Yes	29 (61.7%)	22 (43.1%)	2.12 (0.95 – 4.77)	0.07	1.37 (0.32 – 5.96)	0.67
	No	18 (38.3%)	29 (56.9%)				
Sleeping on floor/outside	Yes	22 (46.8%)	22 (43.1%)	1.16 (0.52 – 2.57)	0.84	0.25 (0.04 – 1.40)	0.11
	No	25	29				

		(53.2%)	(56.9%)				
Toilet at home	No	14 (29.8%)	12 (23.5%)	1.38 (0.56 – 3.39)	0.50	1.57 (0.25 – 10.13)	0.63
	Yes	33 (70.2%)	39 (76.5%)				
Rodents at home	Yes	24 (51.1%)	19 (37.3%)	1.76 (0.79 – 3.93)	0.22	3.33 (0.71 – 15.77)	0.13
	No	23 (48.9%)	32 (62.7%)				
Bushes, grassland, garbage near home	Yes	37 (78.7%)	37 (72.5%)	1.40 (0.55 – 3.55)	0.49	0.71 (0.12 – 4.37)	0.71
	No	10 (21.3%)	14 (27.5%)				
Drying clothes on walls/ bushes	Yes	11 (23.4%)	14 (27.5%)	0.81 (0.32 – 2.01)	0.82	0.16 (0.02 – 1.24)	0.08
	No	36 (76.6%)	37 (72.5%)				

In the univariate analysis, the presence of eschar was found to be significantly suggestive of scrub typhus with an odds ratio of 40.39 (95% CI: 5.14 – 317.27) when compared to the controls. People who do not bathe daily has a higher odds ratio of 3.18 (95% CI: 1.11 – 9.15) to be scrub typhus positive when compared to the people who bathe daily. Demographic characteristics like age, gender, occupation, education, income and other habits were not found to be significantly associated with scrub typhus. When adjusted for the confounders, people who involve in activities like cutting grass, farming and collecting wood has shown an increased risk to be scrub typhus positive with an adjusted odds of 10.51 (95% CI: 1.50 – 73.59) when compared with the people do not involve in such activities.

This study aimed to find out the association between the occupation and scrub typhus positives in the secondary care hospital in Chittoor, South India. Due to the low sample size, the study failed to find out the association between the scrub typhus positivity and occupation if ever exist. However, this study found a positive association between scrub typhus and outdoor activities like cutting grass, field work and collecting wood. This is in concordance with the study done in Thailand in 2023 by Tasak et al (23), systematic review by Wang et al in 2024 (24), and study in Beijing, China by Lyu et al in 2013 (25). The eschar detection rate among the scrub typhus cases was 44.7% in our study which is slightly lower than the reported 58% by Yoo et al in 2022 (26) and higher than the pooled eschar positivity of 28.5% in India by Gupta et al in 2024 (27). The age and gender were not significant in our study which is in contrast with the study done in Vellore by D'Cruz et al (8) reporting that age and gender were significant risk factors for scrub typhus positivity. Similarly, occupation was not found to be a potential risk factor for scrub typhus which is contradicting to the study done by George et al in Vellore (22), in Bhutan by Gautam et al (28) and in Nepal by Thapa et al (29) stating that occupation like farming and agriculture is significantly associated with the scrub typhus positivity. Not bathing daily has found to be a significant risk factor in our study and this is in agreement with the systematic review done by Wang et al (24).

4. CONCLUSION

Poor hygienic practice like not bathing regularly and activities that involves field work like farming, cutting grass and collecting wood poses high risk of contracting scrub typhus. Scrub typhus infection, once thought to be limited to the Tsutsugamushi triangle is now found to be infecting people all over the world.

Consent

All authors declare that 'written informed consent was obtained from the patient before collecting data.

Ethical approval

The study proposal was approved and permitted by the Institutional Review Board (minute no: 40/11.11.2022)

Disclaimer (Artificial intelligence)

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Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Details of the AI usage are given below:

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