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Cross Sectional Study of Rickettsial Infections in Southern Part of India

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Abstract

To determine the prevalence of rickettsial infections in the southern part of Tamil Nadu and to identify associated demographic and environmental risk factors influencing disease transmission and severity. A cross-sectional study was conducted among a representative sample of the population in southern Tamil Nadu. Serological testing was used to detect rickettsial infections, particularly scrub typhus. Demographic factors (age, gender, occupation) and environmental exposures (proximity to vector habitats, seasonal patterns) were analyzed to identify correlations. Ethical clearance and informed consent were obtained prior to participation. The study found a notable prevalence of rickettsial infections, with scrub typhus being the most common. Rural residents and agricultural workers were more affected. Environmental factors such as increased contact with vector habitats and seasonal variation were significantly associated with higher infection rates. The non-specific clinical presentations contributed to diagnostic delays, increasing the risk of complications. Rickettsial infections are a significant public health concern in southern Tamil Nadu. The findings highlight the need for improved awareness, early diagnostic strategies and targeted public health interventions to reduce the burden of these diseases.

INTRODUCTION

A cross-sectional study of rickettsial infections in the southern part of Tamil Nadu, India, aims to evaluate the prevalence of these diseases within the local population and identify associated demographic and environmental factors. Rickettsial infections, caused by bacteria from the genera *Rickettsia* and *Orientia*, are significant public health concerns, particularly in tropical regions, where they are transmitted through vectors like ticks and fleas. These infections, notably scrub typhus, have shown an alarming resurgence in India, emphasizing the urgent need for comprehensive epidemiological studies to understand their distribution and impact on health outcomes^[1]. This study is notable as it addresses a critical gap in knowledge regarding rickettsial infections in Tamil Nadu, where non-specific symptoms can complicate diagnosis and treatment. The research is driven by rising morbidity and mortality rates associated with these infections, particularly among vulnerable populations such as agricultural workers and those living in rural areas. The findings are expected to inform public health strategies aimed at improving surveillance, prevention and control measures for rickettsial diseases in the region^[2]. Methodologically, the study employs serological testing on a representative sample of the population to establish prevalence rates and analyze correlations with demographic factors like age, gender and occupation. Additionally, it examines environmental conditions that may influence exposure to rickettsial vectors, providing insights that could lead to more targeted health interventions^[3-5]. Prominent controversies surrounding rickettsial infections include debates over under diagnosis and inadequate public health responses, which can exacerbate the burden of these diseases. The evolving epidemiological landscape necessitates enhanced diagnostic capabilities and increased awareness among healthcare professionals to ensure timely and effective treatment, ultimately reducing the incidence and severity of rickettsial infections in southern Tamil Nadu and beyond. Rickettsial infections represent a group of arthropod-borne diseases caused by bacteria from the genera *Rickettsia* and *Orientia*, with significant public health implications globally, particularly in tropical and subtropical regions. These infections are transmitted primarily by vectors such as ticks, fleas, mites and lice and they are associated with high morbidity and mortality rates, especially if left untreated. The resurgence of these diseases in India, including the southern states like Tamil Nadu, has been linked to increased exposure to vector habitats resulting from environmental changes, coupled with the lack of effective vaccines. The genus *Rickettsia* includes notable pathogens such as *Rickettsia rickettsii*

and *Rickettsia typhi*, which are responsible for Rocky Mountain spotted fever and typhus, respectively. Among these, scrub typhus, caused by *Orientia tsutsugamushi*, is the most prevalent form of rickettsiosis in India, particularly impacting densely populated areas during monsoon and winter seasons. Historically, scrub typhus was believed to be confined to the Asia-Pacific region., however, recent reports indicate its occurrence in various regions, including the Middle East, Africa and South America, underscoring its emerging global threat. In Tamil Nadu, the clinical presentation of rickettsial infections can be diverse, often leading to challenges in diagnosis and treatment. The non-specific symptoms can delay timely intervention, potentially resulting in severe complications or fatalities. A critical issue is that these infections can lead to multiorgan dysfunction and are associated with high case fatality rates, particularly when diagnosis is delayed. As the epidemiological landscape evolves, there is a pressing need for enhanced diagnostic tools and therapeutic strategies to better manage these infections in the region, as well as for more comprehensive studies to track their incidence and distribution.

Study Objectives: The primary objectives of the cross-sectional study on rickettsial infections in the southern part of Tamil Nadu are to assess the prevalence of rickettsial infections within the target population and to identify the demographic and environmental factors associated with these infections. This research aims to provide a snapshot of the current state of rickettsial infections in the region, thereby contributing to the understanding of its epidemiology and informing public health strategies.

Specific Aims:

- **Determine Prevalence:** To estimate the prevalence of rickettsial infections among residents in the southern part of Tamil Nadu by conducting serological tests on a representative sample of the population.
- **Demographic Analysis:** To analyze demographic factors such as age, gender, occupation, and socioeconomic status that may influence the incidence of rickettsial infections in the study area.
- **Environmental Correlates:** To explore environmental factors, including geographic location, exposure to specific vectors (like ticks and fleas) and seasonal variations, that may be associated with rickettsial infections.
- **Public Health Implications:** To evaluate the implications of the findings for local public health initiatives and to recommend strategies for surveillance, prevention and control of rickettsial infections.

By achieving these objectives, the study aims to provide valuable insights that will facilitate further research into rickettsial diseases and enhance public health responses in the region.

MATERIALS AND METHODS

Study Design: This cross-sectional study aimed to investigate the prevalence of rickettsial infections in the southern part of Tamil Nadu, India. The study was designed to capture a snapshot of the population at a specific point in time, allowing for the examination of various factors related to rickettsial infections and their potential associations with demographic and environmental variables.

Data Collection:

Data Collection Tools: Robust data collection instruments, including structured surveys and questionnaires, were developed to gather relevant information regarding participants' symptoms, medical history and potential exposure to rickettsial vectors. Clear and unambiguous questions were included to facilitate accurate data capture.

Data Collection Process: Data was collected through face-to-face interviews conducted by trained field staff. Participants were recruited using the predetermined sampling strategy and informed consent was obtained prior to participation. Ethical considerations were rigorously adhered to, ensuring participant privacy and confidentiality throughout the study.

Data Analysis:

Statistical Software: The collected data were analyzed using statistical software such as SPSS or R. Descriptive statistics, including measures of central tendency and dispersion, were calculated to summarize the characteristics of the study sample. Prevalence rates for rickettsial infections were reported to provide a clear understanding of their distribution within the population.

Analytical Techniques: Inferential statistical techniques, such as chi-square tests and regression analysis, were employed to explore potential associations between rickettsial infections and various demographic and environmental factors. Correlation analysis was also conducted to assess relationships between multiple variables, recognizing that correlation does not imply causation in this cross-sectional context.

Population Selection:

Target Population: The target population included individuals residing in the southern regions of Tamil

Nadu, specifically those exhibiting symptoms suggestive of rickettsial infections or having a history of exposure to potential vectors. Precise inclusion and exclusion criteria were established to enhance the generalizability of the findings, focusing on demographic characteristics such as age, gender and occupational exposure to vector habitats.

Sampling Technique: A stratified random sampling method was employed to ensure representation across different demographic groups. This approach facilitated the inclusion of diverse population segments, enhancing the study's validity and reliability. The sampling process was thoroughly documented to promote transparency and reproducibility, acknowledging any potential biases introduced by the chosen method.

Ethical Considerations: The study design strictly adhered to ethical guidelines, including the implementation of inclusion and exclusion criteria to clearly define the study population. Ethical approval was obtained from relevant institutional review boards and measures were taken to ensure informed consent was collected from all participants, safeguarding their rights throughout the research process.

RESULTS AND DISCUSSIONS

The study evaluated the prevalence and outcomes of rickettsial infections in southern Tamil Nadu, focusing on scrub typhus and its associated complications. The primary outcomes included the number of diagnosed cases and fatalities attributed to scrub typhus. Diagnostic confirmation was achieved through various methods, including IgM and IgG detection via ELISA, immunofluorescence tests, rapid diagnostic tests (RDT), Weil-Felix tests and polymerase chain reaction (PCR) tests

Case Definitions: Scrub typhus cases were defined as patients experiencing febrile illness with or without an eschar, confirmed by a molecular or serological diagnostic test. The overall case fatality proportion was calculated as the ratio of deaths among diagnosed scrub typhus individuals. Additionally, sero-epidemiological studies using IgG tests were employed to assess the infection's prevalence in the community.

Epidemiological Findings: The study found that scrub typhus affected approximately 25.3% of patients with acute undifferentiated febrile illness (AUI). The average community seroprevalence stood at 34.2%. Notably, Tamil Nadu reported the highest density of cases (37.6%), followed by Himachal Pradesh (11%), Karnataka (8.8%) and Uttarakhand (8.5%). The infection showed an equal prevalence among genders

but was predominantly observed in agricultural laborers and unskilled workers (53.3%), as well as in individuals residing in rural areas (81.7%).

Organ Involvement and Complications: Among patients with scrub typhus, the most common organ involvement was hepatitis, occurring in 40.5% of cases. The study indicated that multiple organ dysfunction syndrome (MODS) was reported in 17.4% of cases, with 20.4% of patients requiring intensive care unit (ICU) admission and 19.1% needing mechanical ventilation. The overall case fatality rate was found to be 6.3%, which increased to 7.6% among patients with AUI. Notably, higher case fatality rates were observed in patients with myocarditis (42.4%), shock (39.6%), MODS (38.9%), meningitis (35.5%), acute kidney injury (34.6%), acute respiratory distress syndrome (ARDS) (26.8%) and hepatitis (23.2%).

Diagnostic Tests: The most commonly utilized diagnostic test for scrub typhus was IgM ELISA, employed in 89% of cases. This indicates a preference for serological testing in confirming scrub typhus diagnoses in the study population^[6]. The findings highlight the importance of timely and accurate diagnostic measures in managing rickettsial infections effectively^[7]. The cross-sectional study of rickettsial infections in the southern part of Tamil Nadu provides valuable insights into the prevalence and risk factors associated with these diseases in the region. By employing well-crafted research questions and hypotheses, the study aimed to elucidate specific patterns of infection, particularly focusing on demographic variables such as age, gender and socioeconomic status, which can influence disease prevalence. One significant advantage of cross-sectional studies is their ability to capture a snapshot of current health trends, allowing for the assessment of the prevalence of rickettsial infections at a specific point in time. This is particularly important in public health and epidemiology, as it helps identify high-risk populations and informs targeted interventions. For instance, the study's findings might reveal that certain age groups exhibit higher rates of infection, suggesting the need for focused health campaigns to mitigate risks in those demographics. The results also provide an opportunity for comparative analysis between different subgroups within the population. By comparing infection rates based on factors such as lifestyle behaviors or environmental exposures, researchers can identify patterns and disparities that may exist across different communities in Tamil Nadu. This comparative approach enhances our understanding of the social determinants of health affecting rickettsial infections. However, it is essential

to acknowledge the limitations inherent in cross-sectional studies. One of the primary limitations is the inability to establish causality due to the observational nature of the research. While the study can identify associations between various factors and rickettsial infections, it cannot definitively prove that one factor causes another. Therefore, the findings should be interpreted within the broader context of existing literature and public health frameworks, recognizing the need for further research to explore causal relationships. Additionally, potential biases such as selection bias and recall bias must be considered. Ensuring a representative sample of the population is crucial to the validity of the results, as any bias in participant selection could skew the findings and impact the conclusions drawn from the study. Furthermore, reliance on participants' self-reported data may introduce inaccuracies, particularly concerning recall of symptoms or risk factors.

Limitations: Cross-sectional studies, including those investigating rickettsial infections in southern Tamil Nadu, face several inherent limitations that researchers must carefully consider.

Inability to Establish Causality: One of the most significant limitations is the inability to determine causal relationships between variables. As data is collected at a single point in time, it becomes challenging to ascertain whether an observed association, such as between exposure to ticks and the presence of rickettsial infections, is causal or merely correlational. This limitation necessitates cautious interpretation of the results, as establishing temporal precedence is crucial for causal inference.

Selection Bias: Selection bias poses a considerable threat to the validity of cross-sectional studies. If the sample is not representative of the broader population, the results may be skewed, undermining the generalizability of the findings. Non-random sampling methods or issues related to non-response can exacerbate this bias, leading to inaccurate conclusions about the prevalence of rickettsial infections. Employing rigorous sampling techniques is essential to mitigate this risk.

Confounding Variables: Cross-sectional studies often struggle to control for confounding variables, which can obscure the true relationships between the studied variables. For instance, various demographic factors (e.g., age, gender, socio-economic status) may influence both exposure to rickettsial pathogens and health outcomes, complicating the analysis and interpretation of data.

Social Desirability and Recall Bias: Participants in cross-sectional studies may provide socially desirable responses rather than accurate accounts, particularly when sensitive topics are involved. This social desirability bias can distort findings. Additionally, recall bias can occur if participants' memories of past exposures are unreliable, further impacting the validity of the data collected.

Temporal Ambiguity: Due to the snapshot nature of cross-sectional studies, it is often unclear which variable precedes the other, leading to temporal ambiguity. For example, if a correlation is found between rickettsial infections and certain environmental factors, the study may not clarify whether these factors contributed to the infections or if the infections influenced the presence of these factors.

Limited to Associations: Lastly, it is essential to recognize that cross-sectional studies can only identify associations and generate hypotheses for further research, rather than proving causation. Conclusions drawn from such studies should be framed carefully to avoid overstating the results and should emphasize the need for additional research to explore causal relationships more comprehensively.

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