Review Article

Mites and Mite-borne Disease in Sri Lanka: Are We Aware of the Disease Burden?

ABSTRACT

Aims: Mite infections of Sri Lanka are seldom reported or studied in animals and humans. The existing few studies are case studies reporting human infection of scabies and reporting dog and avian mites. The epidemiology of mite infestations and mite-borne diseases in Sri Lanka are not well established due to the limited knowledge of mite species present, types of disease transmitted, distribution and the prevalence. Hence, this systematic review intends to summarize the current knowledge, which will be helpful to the researchers in understanding the disease burden of mites in humans and animals in Sri Lanka and to identify the knowledge gaps in the specific subject.
Study design: Systematic Review
Methodology: The current systematic review on mite infestation and mite-borne diseases in Sri Lanka was written following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. A comprehensive literature search was carried out in the following databases: PubMed, SciVerse Scopus, and Google Scholar for studies published before the 31st of July 2024 using the keywords; “mites”, “diseases” and “Sri Lanka”.
Results: The literature search identified the following number of articles in the respective databases: PubMed (12), SciVerse Scopus (400), and Google Scholar (450). Only 15 articles were eligible for this review, and they were categorized based on articles that reported mite-borne diseases and mites reported in animals. Four cross-sectional studies have reported the prevalence of scrub typhus, while two cross-sectional studies have been conducted on scabies and asthma. Six studies reported the burden of mite infestation in wild animals, among them three surveys have been conducted in rodents, two on bats and one on bird nests.
Conclusion: A very few research on mites and mite-borne diseases in Sri Lanka focus on diseases such as scrub typhus and scabies, and only a handful noting mite infestations on wild animals. Therefore, it is critical to identify these mites and the epidemiological role they play in our environment to understand the health implications of mites.

Keywords: Ectoparasites, Infestation, Mites, Mite-borne diseases, Sri Lanka,

1. INTRODUCTION

Mites are small arachnids and are of ecological and public health importance. They play a vital role in soil formation and act as vectors of diseases. Mites are an ancient group that have evolved over 400 million years to adapt to a variety of environmental conditions (Poinar & Poinar, 1998). Over 48,000 distinct mite species have been identified worldwide, among them around 250 mite species are of significant public health importance (Schauff, 2000).

Some mites are ectoparasites of humans and animals. They cause direct and indirect health complications. Even though their implications are rarely fatal, some mite species cause diseases such as scrub typhus, scabies, dermatitis, demodicosis, purities and allergies that can cause several health consequences (Hoy, 2009). Scrub typhus is transmitted by the mite *Leptotrombidium delicense*, with rats serving as the primary reservoir hosts (Govindarajan et al., 2023). *Sarcoptes scabiei* causes scabies, which is a common skin ailment. Dermatitis, or trombiculosis, is another frequent mite-borne disease spread by Pyemotidae mites. D*emodex folliculorum* and *Demodex brevis* are two primary mite species causing "Demodicosis" in humans. Dermanyssosis is another mite-borne disease caused by poultry mite *Dermanyssus gallinae*. Dust mites are also a common cause of allergic responses, including asthma (Gøtzsche & Johansen, 2008). Mites-borne diseases, especially the mite allergens that induce allergic diseases result in significant morbidity and increased burden on health services (Sánchez-Borges et al., 2017).

Mite infestations in animals are a major veterinary concern, generating a variety of health problems in both domestic and wild species. Mites can parasitize mammal skin, respiratory systems, and gastrointestinal tracts of animals. *Sarcoptes scabiei* (scabies), *Psoroptes* (cattle scab), *Cheyletiella* (walking dandruff), and *Demodex* mites are all common types of mite infestations, and each cause unique clinical symptoms. These infestations can lead to symptoms such as itching, hair loss, dermatitis, and secondary infections. In addition, mite infestation in livestock causes a significant economic loss. It has been discovered that mite-borne diseases are expanding worldwide, and their distribution is shifting and expanding (Schauff, 2000). These environmental changes can impact the zoonotic potential of mite infestation in domestic and wild animals may have serious health consequences in humans (Kulatunga et al., 2023a). As a result, it is critical to determine the illness burden of mites in certain areas of the world.

Mite infections in Sri Lanka are rarely recorded or investigated in animals and humans. Environmental factors, such as warm, humid climates and the close proximity of animals to humans, may facilitate the spread of mites. These infestations not only compromise animal welfare but also have economic consequences, especially in the agricultural sector, where productivity may be reduced due to animal discomfort and disease spread. The existing literature on mite infestations in Sri Lanka are mostly confined to case reports in selected diseases. There are a few studies that report human scabies infection and very few articles reporting the mites on dogs, birds and bees. The epidemiology of mite infestation and mite-borne diseases in Sri Lanka are poorly understood due to a lack of information on the mite species present, the types of diseases transmitted, and their incidence. The purpose of this systematic review is to update the existing knowledge, which will assist researchers understand the illness burden of mites in humans and animals in Sri Lanka and to identify the knowledge gaps in the specific field. Further, this work will encourage researchers in Sri Lanka to conduct more studies in this field to establish the epidemiological profiles on mite infestations and borne diseases in Sri Lanka.

2. METHODOLOGY

2.1 Search strategy

The current systematic review on Mite-borne diseases in Sri Lanka was written following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al, 2021). A comprehensive literature search was carried out in the following databases: PubMed (US National Library of Medicine, USA), SciVerse Scopus (Elsevier

Properties SA, USA), and Google Scholar for studies published before the 31st of July 2024. The following keywords; “Mites”, “diseases” and “Sri Lanka” were included in the search. Original research articles obtained from the comprehensive search of the databases with the above keywords were pooled together and duplicates were removed. The remaining articles were screened sequentially by reading the titles, abstracts, and full articles. Articles that did not satisfy the inclusion criteria were excluded at these stages. Additional articles were obtained manually using the reference lists of included articles.

2.2 Inclusion/Exclusion Criteria

The following inclusion criteria were used: (a) Identification of mite species from Sri Lanka, (b) Different types of mite-borne disease in Sri Lanka, (c) Mite infestation in humans (d) Mite infestation in animals, (e) Prevalence and incidences of mite borne diseases, (f) Original articles, (g) articles published before 31st of July 2024.

Studies were excluded based on the following exclusion criteria: (a) Mite-borne diseases in other countries, (b) Mite infestation to plants (c) reviews written on mites in Sri Lanka and other countries, (d) conference proceedings, (e) articles written in other languages.

3. RESULTS AND DISCUSSION

The literature search identified the following number of articles in the respective databases: PubMed (12) and SciVerse Scopus (400), and Google Scholar (450). Figure 1 presents the search strategy used in selecting the articles. This systematic review pools the available scientific evidence related to mites based on disease types, study types and host types.

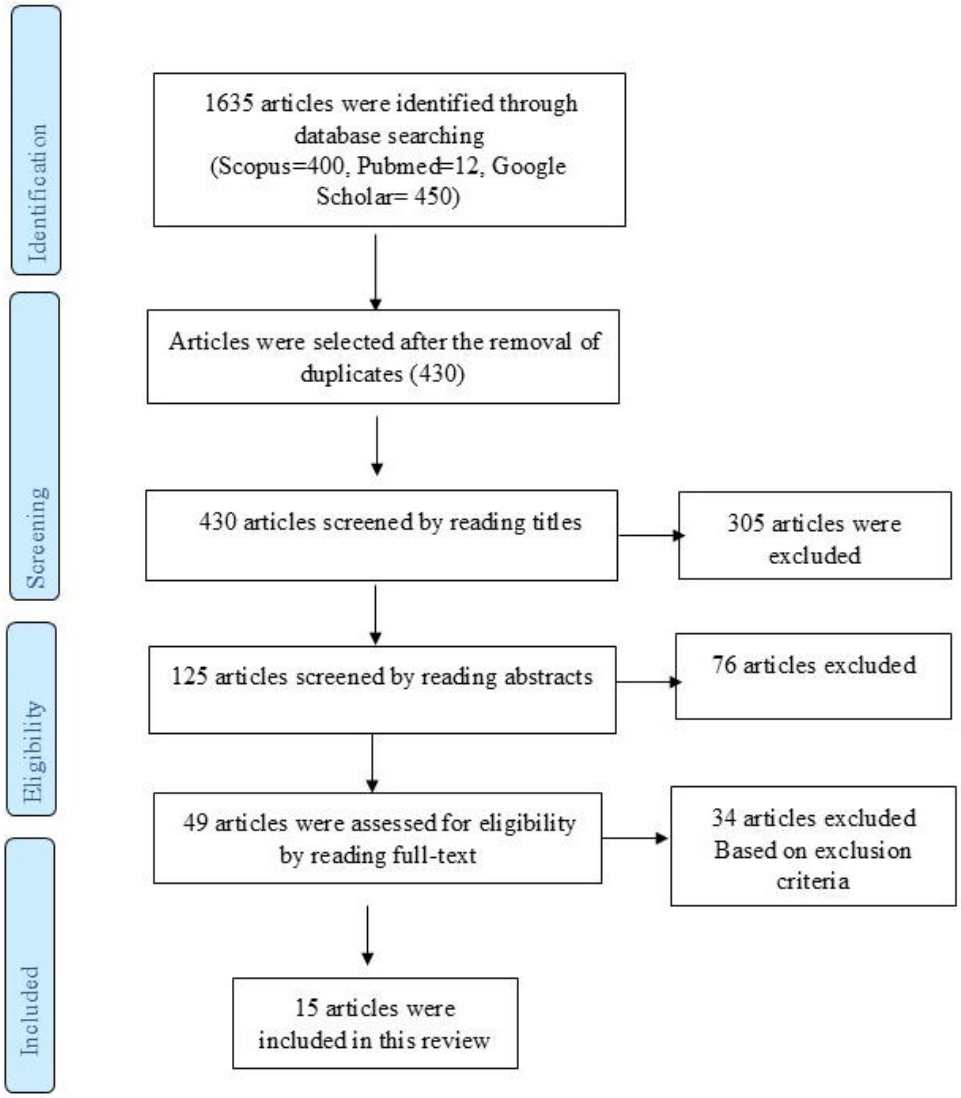

Figure 1: Search strategy followed to recruit the scientific evidence for the review based on PRISMA guidelines

Most of the studies included in this review are on scrub typhus. Four cross-sectional studies have reported the prevalence of scrub typhus in different populations of patients in different regions in Sri Lanka. Two cross-sectional studies have been conducted on scabies and asthma. Four studies reported the burden of mite infestation on wild animals. Table 1 summarizes the finding of the studies that have investigated the mite induced disease burden in humans in Sri Lanka.

3.1 Scrub typhus

Scrub typhus (tsutsugamushi disease) is a re-emerging and endemic disease in the Asia Pacific region (Rajapakse et al., 2012) mainly caused by the bacteria *Orientia tsutsugamushi* transmitted by the larval mite of *Leptotrombidium* sp. belonging to family Trombiculidae or commonly known as Chigger mites. These chigger mites can parasitize any terrestrial animal (Ashani et al., 2022). Scrub typhus is most common in the areas where rodents are numerous (Rajapakse et al., 2012). This disease can also be transmitted by those who are associated with forest environments, especially in areas surrounded by tall vegetation (Fernando, 2013).

According to a study conducted in Jaffna, Northern Province of Sri Lanka, 84.4% of patients admitted to hospitals with clinical signs of rickettsioses tested positive for scrub typhus (Pradeepan et al., 2014). Another study conducted in Dambadeniya found scrub typhus among pediatric patients. According to this study, De Silva et al. (2012), 20 of the 60 patients had definite scrub typhus and 24 had suspected scrub typhus based on serological evidence.

Another parallel investigation aimed to identify patients with scrub typhus using immunological methods (ELISA or IFA). This study assessed 615 scrub typhus samples collected from 23 hospitals throughout eight provinces. Scrub typhus was found in patients treated at Base Hospitals Kuliyapitiya, Dambadeniya, General Hospitals Trincomalee, Matara, and Teaching Hospitals Kurunegala and Anuradhapura (Liyanapathirana & Thevanesam, 2011).

A study conducted in the Northern region of Sri Lanka revealed scrub typhus accounts for the acute febrile illness mostly among military personnel. According to this study, 79% of acute febrile conditions in soldiers has been related to scrub typhus (Premaratna et al., 2014). Premaratna et al. in 2017, genotyped 20 antigenically different *Orientia tsutsugamushi* strains in different localities in Sri Lanka (Ragama-Western Province, Balapitiya- Southern Province) revealing that, the most of these bacteria were belonging to Thai Karp-related clade. This study has also demonstrated a great antigenic diversity of *O. tsutsugamushi strains* in the studied areas of Sri Lanka (Premaratna et al., 2017).

A few case studies on scrub typhus have also been reported from Sri Lanka. A 65-year-old male with scrub typhus has been diagnosed with bilateral acute sensorineural hearing loss and cerebral salt-wasting (Goonetilleke, & Silva, 2023). A parallel study also reported 6 cases with scrub typhus presented with acute hearing loss (Premaratna et al., 2005).

3.2 Scabies

Human scabies is caused by the mite *Sarcoptes scabiei var. hominis,* commonly known as the itch mite (Karimkhani et al., 2017). Scabies is estimated to affect 200 to 300 million people worldwide each year, making it a common illness. Children, elderly, immuno-compromised individuals, and people who live in overcrowded settings are the groups most at risk for human scabies (Thompson et al., 2021).

A community-based cross-sectional study conducted on five randomly selected schools in Gampaha District Sri Lanka, revealed a 1.5% prevalence of scabies (Gunathilaka et al., 2019).

To avoid these consequences and lessen community transmission, it is essential to diagnose and treat scabies in children and close contacts as soon as possible. Monitoring, early detection, and timely treatment of secondary bacterial infections—which are frequently superficial but can be dangerous and invasive with related chronic morbidity and mortality—are all part of scabies (Thompson et al., 2021).

3.3 Asthma

Despite many medical advances, mortality and morbidity due to asthma are increasing globally. Asthma is prevalent among 13% -25% of schoolchildren in Sri Lanka (Hargreave & Nair, 2009). A cross-sectional study was conducted in the Gampaha District, Western Province, and it was found that house dust mites are one of the main triggering factors for asthma among the 12–14-year-old school children in this area (OR = 13.0) (Danansuriya et al., 2015).

Table 1. Mite-borne diseases reported in Sri Lanka

Disease	Study type	Locality in Sri Lanka	Outcomes	Reference
Scrub typhus	Cross-sectional study	Jaffna, Northern Province	84.4% of patients admitted to the hospitals with clinical features of rickettsioses (54 of the 64) were seropositive for scrub typhus	Pradeepan et al., 2014
	Cross-sectional study	Dambadeniya has reported scrub typhus among	Among the 60 patients, 20 patients confirmed scrub typhus and 24 had possible scrub typhus from serological analysis	De Silva et al., 2012
	Case study	Western Province	A 65-year-old male with scrub typhus has been diagnosed with bilateral acute sensorineural hearing loss and cerebral salt-wasting	Goonetilleke, & Silva, 2023
	Cross-sectional study	Kuliyapitiya, Dambadeniya, General Hospitals Trincomalee, Matara and Teaching Hospitals Kurunegala and Anuradhapura	Patients reported to Base Hospitals and general hospitals of some areas in Sri Lanka were positive for scrub typhus	Liyanapathirana & Thevanesam, 2011

	Cross-sectional study	Northern province	79% of acute febrile conditions in soldiers have been related to scrub typhus	Premaratna et al., 2014
	Case study	Western Province	6 cases with scrub typhus presented with acute hearing loss, a forgotten complication	Premaratna et al., 2005
Scabies	Cross-sectional study	Western province Gampaha	Prevalence of scabies among school children of randomly selected schools in Gampaha District	Gunathilaka et al.,2019
Asthma	Cross-sectional study	Western province Gampaha	One of the main triggering factors for asthma of 12–14-year school children	Danansuriya et al., 2015

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3.4 Mite Species Recorded in Animals

Mites can easily infest animals like rodents, bats and birds. Generally, their infection level is usually quite low. Because they lie beneath the host's skin, however, most of the cases do not cause clinical symptoms. To diagnose if presented to the veterinary clinics, depending on the suspected mites, samples are typically collected using brushes, hair combs, or skin scrapes. Additionally, fecal sample analysis or skin biopsies may be used in diagnostics (Poinar & Poinar, 1998).

A few parasitological surveys especially on ectoparasites carried out in wild animals in Sri Lanka, have reported the mite infestations. Three parasitological surveys were conducted on rodents, 2 are on bats and one on birds revealing different mite species infesting these hosts. Interestingly mites were the most abundant parasites of these studies, indicating the importance of more surveys to analyze what species are infesting different hosts in different areas of the island.

A study has identified 15 species of chigger mites in 9 genera under three families: Trombiculidae, Leeuwenhoekiidae, and Walchiidae parasitizing rodents of the family Muridae in Sri Lanka. This study also provides a checklist for chigger mites in Sri Lanka (Ashani et al., 2022).

A field study conducted in the districts of Galle, and Hambantota of the Southern Province, and Gampaha of the Western Province, during the years 2019 -2020 reported 394 chigger mites from 58 small mammals (rodent species: *Rattus rattus* (Black rat), *Rattus norvegicus* (Brown rat), *Tatera indica* (Indian gerbil), *Gollunda ellioti* (Indian bush rat) and *Suncus murinus* (Asian house shrew)) were captured using baited traps. *Microtrombicula*, *Schoengastiella*, and *Leptotrombidium* mite species were among the three genera that were found. The most common species was *Leptotrombidium imphalum* (72.59%; n=286), which was followed by *Schoengastiella punctata* (8.12%; n=32). Some specimens, such as *Microtrombicul*a sp. (4.82%; n = 19) and *Leptotrombidium* sp. (3.55%; n = 14), could only be identified at the genus level. While 3.81%; n=15 was irreparably harmed, some (7.11%; n=28) were not trombiculid

mites. In the district of Galle, a new locale, *Leptotrombidium imphalum* was found parasitizing the murids, *Rattus novergicus* and *Tatera indica*, for the first time (Liyanage et al., 2024).

Ratnaweera et al., (2010) have reported on mite infestation in *Mus mayoriis pococki* an endemic rodent restricted to the southwestern rainforests of Sri Lanka. Screening of *M. mayoriis* in four rainforests that included two, man and biosphere reserves (Kanneliya and Sinharaja rain forests) and two forest reserves (Yagirala and Walankanda in the wet zone of Sri Lanka) of Sri Lanka from October 2006 to August 2007 revealed the presence mites of the genus *Echinolaelaps*. *Echinolaelaps* species, were the only ectoparasites found on *M. m. pococki* from Yagirala and Walankanda, while both mites and ticks were found on those from Sinharaja and other parasites were also present in Kanneliya (Ratnaweera et al., 2010).

Bats are another group of mammals that harbored many mite species. Five species of bats namely, *Rousettus leschenaultia*, *Rhinolophus rouxi*, *Hipposideros speoris*, *Hipposideros lankadiva* and *Miniopterus schreibersii* in caves located in Waulgalge, Waulpane, Naugala, Induruwa, Wijeriya, Ridiviharaya, Hatthikucchi, Kanneliya were screened for parasites in 2002. According to this study, mites were the most abundant group with 1,430 individuals collected from the five host species (Seneviratne et al., 2009). Another similar parasitological survey conducted in bats in 2020, occupied in Wavulgalgae cave has also revealed the highest prevalence for mites. Mites belong to families Spinturnicidae (N = 74) *Paraperighichum spp*. (N = 8) *Ancystropus* spp (N = 57), *Spinturuix* spp (N = 4) *Oncoscelus kanheri* (N = 5) have reported in all species of bats examined in this study (Kotagama et al., 2020).

Kulathunga et al. in 2023, reported a novel finding of nest-dwelling mites in bird nests in Sri Lanka. This has examined bird nests in urban, suburban, and rural areas in the Western Province in Sri Lanka. A total of 1493 mites were collected from 180 nests. Out of all the mite orders gathered, the family Mesostigmata had the largest relative abundance (58.6%) and the prevalence (74.4%) followed by the Sarcoptiformes (41.1%, 72.8%) and Trombidiformes (0.3, 2.2%). *Pycnonotus cafer* (red vented bulbul) nests had the highest diversity of mites (Kulathunga et al., 2023).

Table 2. Comparative analysis

Mite species	**Host**	**Locality in Sri Lanka**	**Outcomes**	**Reference**
Chigger mites	Rodents of the family Muridae in Sri Lanka	Island wide	15 species of chigger mites in 9 genera under three families: Trombiculidae, Leeuwenhoekiidae, and Walchiidae	Ashani et al., 2022
Different species of mite	*Rattus rattus* (Black rat), *Rattus norvegicus* (Brown rat), *Tatera indica* (Indian gerbil), *Gollunda ellioti* (Indian bush rat) and *Suncus murinus* (Asian house shrew))	Districts of Galle, and Hambantota of the Southern Provinc	*Microtrombicula, Schoengastiella,* and *Leptotrombidium* mite species were identified from the rodents	Liyanage et al., 2024

		e, and Gampaha of the Western Province		
Different species of mites	*Mus mayoriis pococki*	Southwestern rainforests Kanneliya and Sinharaja; rain forests. Yagirala and Walankanda forest reserves	Mites were the only ectoparasites found on *M. m. pococki* from Yagirala and Walankanda, while both mites and ticks were found on those from Sinharaja and other parasites were also present in Kanneliya	Ratnaweera et al., 2010
Different species of	Five species of bats; *Rousettus leschenaultia*, *Rhinolophus rouxi*, *Hipposideros speoris*, *Hipposideros lankadiva* and *Miniopterus schreibersii*	Waulgalge, Waulpane, Naugala, Induruwa, Wijeriya, RidiviharayaHatthikucch, Kanneliya	Mites were the most abundant group with 1,430 individuals collected from the five host species	Senevirat ne et al., 2009).
Different species of mites	bats	Wavulgagae cave	Mites belong to the families Spinturnicidae (N = 74) Paraperighichum spp. (N = 8) Ancystropus spp (N = 57), Spinturuix spp (N = 4) Oncoscelus kanheri (N = 5) have been reported in all species of bats	Kotagama et al., 2020
Different species of mites	Bird nests	Western Province	A total of 1493 mites were collected from 180 nests. Out of all the mite orders gathered, family Mesostigmata had the largest relative	Kulathunga et al., 2023

	abundance (58.6%) and prevalence (74.4%). The Sarcoptiformes (41.1%, 72.8%) and Trombidiformes (0.3, 2.2%) were next in line. *Pycnonotus cafer* (red vented bulbul) nests had the highest diversity of mites

However, further studies are warranted to identify new mite species parasitized on wild and domesticated animals. These studies will establish a mite diversity, preferred hosts and their geographical distribution in Sri Lanka. There are limited number of morphological keys are available for identification of mite species, hence, molecular characterization could be recommend to accurate identification of mite species level.

4. CONCLUSION

A very few studies have been conducted on mites and mite borne diseases in Sri Lanka, most of which highlights diseases like scrub typhus, scabies and few recording the mite infestations on wild animals. No records are found on mite infestations on domestic animals like dogs, cats and cattle, which may contain unique mite infestations. It's of utmost importance to identify these mites and the epidemiological role that they play in our environment to understand the health implications of the mites in the human population as well as the domestic and wild animals.

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ABBREVIATIONS

ELISA: Enzyme Linked Immunosorbent Assay
IFA : Immuno fluorescence Assay