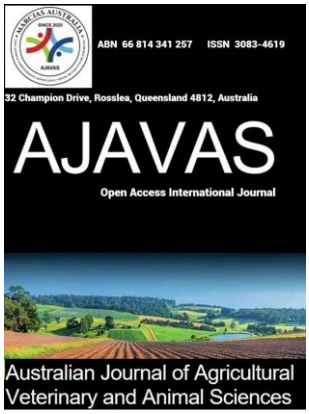

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Epidemiological characteristics of chigger mite infestation in free-range chickens in Cao Bang province, Vietnam

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ABSTRACT: *Chigger mites (Trombiculidae) are important ectoparasites of poultry, particularly under free-range production systems, where environmental exposure increases the risk of infestation. This study aimed to identify chigger mite species and investigate the epidemiological characteristics of infestation in free-range chickens raised by household farmers in Cao Bang Province, northern Vietnam. A cross-sectional survey was conducted on 856 chickens of different ages and sexes across four communes/wards in the province. Chigger specimens were collected, morphologically identified, and analysed for prevalence in relation to age, sex, and season. Two chigger mite species, Eutrombicula whichmanni and Neoschoengastia gallinarum, were identified. Both species mainly parasitized the flank and inner thigh skin and were detected in all surveyed locations with a frequency of 100%. The overall prevalence of infestation was 40.65% and increased significantly with chicken age ($P < 0.05$). Seasonal variation was evident, with the highest prevalence recorded in summer (51.94%), followed by spring (45.71%), autumn (33.94%), and winter (31.96%). Although infestation was more common in hens than in roosters, the difference was not statistically significant. These findings highlight the widespread occurrence of chigger mites in free-range chickens in Cao Bang Province and emphasize the need for targeted surveillance and seasonally adapted control strategies to support sustainable poultry production.*

Keywords: *Eutrombicula whichmanni, Neoschoengastia gallinarum, free-range chickens, prevalence*

Highlights

- Two chigger mite species (*Eutrombicula whichmanni and Neoschoengastia gallinarum*) were identified in free-range chickens in Cao Bang Province.
- Chigger mite prevalence was 40.65% and increased significantly with chicken age, with the highest levels observed during summer.
- Chigger mite infestation was widespread in free-range chickens, underscoring the need for improved. monitoring and seasonally targeted control strategies.

1.0 Introduction

Chigger mites, also known as harvest mites or red bugs, are members of the family Trombiculidae (Inumaru et al., 2025). Within this family, genera such as *Trombicula*, *Neoschoengastia*, and *Toritrombicula* are recognized as significant avian ectoparasites. Their life cycle includes seven stages, but only the larval stage is parasitic, while other stages are free-living soil dwellers. The pathological impact of chigger mites is largely defined by their unique feeding process. Unlike many other mites, chigger larvae burrow deeply into the skin, targeting all layers including the stratum corneum, stratum granulosum, and stratum germinativum. They typically attach in dense clusters sometimes numbering in the thousands at sites with thin skin, such as the breast, thigh, fluffs, and under the wings (Zhou et al., 2020; Nusrat et al., 2025).

Vietnam habours a rich diversity of chigger mites, with more than 100 species recorded, predominantly belonging to the family Trombiculidae (Nguyen, 1997). Previous studies have documented the presence of *Eutrombicula whichmanni* and *Neoschoengastia gallinarum* in poultry in several regions of northern Vietnam (Nguyen, 2015). However, most existing studies have primarily focused on species identification and distribution, with limited information on epidemiological patterns, particularly under smallholder free-range production systems. Free-range chicken production has expanded rapidly in northern Vietnam, including Cao Bang Province, driven by increasing consumer demand for high-quality poultry products. Despite its economic importance, this production system is often characterized by limited biosecurity, suboptimal hygiene, and increased exposure to environmental parasites. Consequently, chickens raised under free-range conditions may experience a higher likelihood of ectoparasitic infestation, including chigger mites (Mul and Koenraadt, 2009; Sparagano et al., 2014).

Understanding the epidemiology of chigger mite infestation, including its distribution and associated factors, is essential for designing effective surveillance and control strategies in poultry production systems. However, to date, there is a lack of epidemiological data on chigger mite infestation in free-range chickens in Cao Bang Province. In particular, information on prevalence, age-related patterns, and seasonal variation remains scarce. Therefore, the objectives of this study were to identify chigger mite species parasites infesting free-range chickens in Cao Bang Province and investigate the epidemiological characteristics of infestation in relation to age, sex, and season under smallholder production conditions.

2.0 Materials and methods

2.1. Study area and study design

A cross-sectional study was conducted on free-range chickens raised by household farmers in Vinh Quang, Hung Dao, Chu Trinh communes and De Tham ward, Cao Bang province, northern Vietnam. The study focused on smallholder production systems, where chickens are typically reared under free-range conditions with close contact with the environment.

2.2. Study animals and sampling strategy

Chickens of different ages and both sexes were included in the study. The sample size was calculated using OpenEpi software with a 95% confidence level and an expected prevalence of 36%, based on previous studies conducted in northern Vietnam (Nguyen, 2015). A total of 856 chickens was examined across four communes/wards, including Vinh Quang (n = 223), Hung Dao (n = 208), Chu Trinh (n = 236), and De Tham (n = 189). Chickens were selected using a household-based sampling approach. Households were recruited based on accessibility and willingness to participate, representing a form of convenience sampling commonly applied in field-based studies under smallholder conditions.

Within each selected household, chickens were sampled proportionally to flock size where possible. Chickens were selected through direct handling at the time of visit, with efforts made to include individuals of different age groups and both sexes to improve representativeness. Chickens were categorized into three age groups: <3 months, 3–6 months, and >6 months of age.

2.3. Examination, collection, and definition of infestation

Each chicken was physically examined by trained personnel for the presence of chigger mites. The examination focused on body regions commonly affected by infestation, including the flank, inner thigh, breast, and areas under the wings. Each examination lasted approximately 3–5 minutes per chicken. Chickens presenting at least one visible chigger cluster were classified as infected. When chigger clusters were detected, samples were carefully collected using a sterile scalpel to obtain the entire lesion while minimizing tissue damage and avoiding bleeding. All procedures were conducted by trained personnel to minimize stress to the animals. The number of chiggers per cluster was counted using a stereomicroscope. Samples from each chicken were preserved separately in 70% ethanol in sealed vials for subsequent processing and identification.

2.4. Preparation of specimens and species identification

Chigger specimens were processed following the method described by Nguyen (1994). Temporary mounts were prepared using acetic acid, lactic acid, or phenol alcohol, while permanent mounts were prepared using Arabic gum mounting medium. Specimens were examined under a light microscope at magnifications ranging from 300× to 1500×. Species identification was conducted using standard morphological taxonomic keys (Soulsby, 1982; Nguyen, 1994).

2.5. Assessment of factors associated with infestation

Infestation prevalence was analysed according to age group (<3 months, 3-6 months, and >6 months), sex (hens and roosters), and season. Seasons were defined as spring (February-April), summer (May-July), autumn (August-October), and winter (November-January).

2.6. Statistical analysis

All statistical analyses were performed using statistical software (Minitab version 16, Minitab Inc., State College, PA, USA). Infestation prevalence was calculated as the proportion of infected chickens among those examined.

Associations between infestation and categorical variables (age group, sex, and season) were assessed using the chi-square test. Differences were considered statistically significant at $P < 0.05$. Given the descriptive nature of the study, multivariable analysis was not performed and is discussed as a limitation.

2.7. Ethical considerations

All procedures were performed by trained personnel and conducted in accordance with national regulations on animal welfare (Law 32/2018/QH14 and TCVN 12448:2018). Sampling was carried out with care to minimize stress and avoid harm to the animals.

3.0 Results

3.1. Species identification of chigger mites infesting free-range chickens in Cao Bang Province

Various species of chigger mites were collected and identified in free-range chickens raised at household farms in four communes and wards in Cao Bang Province. The results are presented in Table 1.

Table 1. Species composition of chigger mites infesting free-range chickens in surveyed communes/wards

No.	Chigger mite species	Parasitic sites	Communes/wards				Frequency of occurrence (%)
			Vinh Quang	Hung Dao	Chu Trinh	De Tham	
1	*Eutrombicula whichmanni*	Flank skin Thigh skin	X	x	x	x	100
2	*Neoschoengastia gallinarum*	Flank skin Thigh skin	X	x	x	x	100
Total	2	Flank skin Thigh skin	X	x	x	x	100

The results in Table 1 indicate that two species of chigger mites, namely *Eutrombicula whichmanni* and *Neoschoengastia gallinarum* were detected in free-range chickens in all surveyed households across the four communes/wards of Cao Bang Province. These species were found mainly infesting the flank skin and the inner surface of the thigh skin. Both species were present in all four communes/wards, with a detection frequency of 100%.

3.2. Epidemiological characteristics of chigger mite infestation in free-range chickens

The results of the study on the epidemiological characteristics of chigger mite infestation are presented as follows:

3.2.1 Prevalence of chigger mite infestation by commune/ward

The results in Table 2 show that among the 856 chickens examined, 348 were infected with chigger mites, accounting for 40.65%.

Table 2. Prevalence of chigger mite infestation in free-range chickens by commune/ward*

Location (commune/ward)	Number of chickens examined (head)	Number of infected chickens (head)	Prevalence (%)
Vinh Quang	223	71	31.84^{c}
Hung Dao	208	91	43.75^{b}
Chu Trinh	236	122	51.69^{a}
De Tham	189	64	33.86^{c}
Overall	856	348	40.65

*Within the same column, prevalence values marked with different superscript letters are significantly different ($P < 0.05$).

Chu Trinh Commune exhibited the highest prevalence (51.69%), followed by Hung Dao Commune (43.75%). De Tham Ward (33.86%) had a higher prevalence than Vinh Quang Commune (31.84%). Differences in prevalence among communes/wards were statistically significant ($P < 0.05$), as indicated by differing superscript letters.

3.2.2 Prevalence of chigger mite infestation by age group

The prevalence and intensity of chigger mite infestation in free-range chickens according to age are presented in Table 3.

Table 3. Prevalence of chigger mite infestation in free-range chickens by age group*

Age group (months)	Number of chickens examined (head)	Number of infected chickens (head)	Prevalence (%)
< 3	285	92	32.28[c]
3–6	312	131	41.99[b]
> 6	259	125	48.26[a]
Overall	856	348	40.65

* Within the same column, prevalence values marked with different superscript letters are significantly different (P < 0.05).

The prevalence of chigger mite infestation increased with age (Table 3). Chickens aged over 6 months showed the highest prevalence (48.26%), followed by those aged 3–6 months (41.99%) and under 3 months (32.28%). The differences among age groups were statistically significant (P < 0.05).

3.2.3 Prevalence of chigger mite infestation by season

Chigger mite infestation was observed throughout all seasons. The results are presented in Table 4.

Table 4. Prevalence and intensity of chigger mite infestation in free-range chickens by season*

Season	Number of chickens examined (head)	Number of infected chickens (head)	Prevalence (%)
Spring	210	96	45.71[b]
Summer	206	107	51.94[a]
Autumn	221	75	33.94[c]
Winter	219	70	31.96[c]
Overall	856	348	40.65

* Within the same column, prevalence values with different superscript letters are significantly different (P < 0.05).

The results in Table 4 show that chigger mite infestation occurred in chickens throughout all four seasons. However, there was a statistically significant difference in infestation prevalence between spring and summer (P < 0.05), whereas no significant differences were observed between autumn and winter (P > 0.05). The highest prevalence was recorded in summer (51.94%), followed by spring (45.71%), autumn (33.94%), and winter (31.96%).

3.2.4 Prevalence of chigger mite infestation by sex

The prevalence of chigger mite infestation by sex is presented in Table 5.

Table 5. Prevalence of chigger mite infestation in free-range chickens by sex*

Sex	Number of chickens examined (head)	Number of infected chickens (head)	Prevalence (%)
Hens	435	180	41.38[a]
Roosters	421	168	39.90[a]
Overall	856	348	40.65

* Values within the same column sharing the same superscript letter are not significantly different (P > 0.05).

The difference between sexes in the prevalence of chigger mite infestation (41.38% in hens and 39.90% in roosters) was not statistically significant (P > 0.05) as portrayed in Table 5.

4.0 Discussion

This study provides baseline epidemiological data on chigger mite infestation in free-range chickens in Cao Bang Province, northern Vietnam. Two species, *Eutrombicula whichmanni* and *Neoschoengastia gallinarum*, were identified and found to be widely distributed across all surveyed locations. These findings are consistent with previous reports from other regions of Vietnam, where these species have been reported in poultry under free-range conditions (Nguyen, 1994; Nguyen, 2015).

The overall prevalence of infestation (40.65%) observed in this study indicates that chigger mites are widely present in smallholder chicken production systems. Although lower than some reports from Europe, where prevalence may exceed 80–90% in certain production settings (Mul and Koenraadt, 2009), the level observed here remains of concern, particularly given the potential impacts on animal health and productivity. Chigger mite infestation has been reported to cause skin irritation, inflammation, and lesions, which may reduce carcass quality and market value (Molín et al., 2020; Chaisiri et al., 2023). In severe cases, persistent infestation may also contribute to reduced growth performance and increased susceptibility to secondary infections (Chaisiri et al., 2023).

The observed increase in infestation prevalence with age is likely associated with prolonged environmental exposure. Older chickens, particularly laying hens, tend to spend more time in nesting and resting areas, where chigger larvae may accumulate in organic material such as litter and soil. This behavioural pattern may increase the likelihood of contact with infective stages, thereby contributing to higher infestation rates in older age groups. Similar age-related trends have been reported in previous studies on ectoparasites in poultry (Sparagano et al., 2014).

Seasonal variation in infestation was evident, with the highest prevalence recorded during summer, followed by spring, autumn, and winter. This pattern may be associated with climatic conditions that influence the survival and development of chigger mites. Warmer temperatures and higher humidity during spring and summer are likely to favour the development and reproduction of mites in the environment (Sparagano, 2020). However, environmental variables were not directly measured in this study, and these interpretations should be considered indicative rather than conclusive.

Although no statistically significant difference in infestation prevalence between hens and roosters was observed in the present study, previous studies have reported inconsistent findings. For example, higher prevalence in hens has been documented in Vietnam and has been attributed to longer production cycles and increased environmental exposure (Nguyen, 2015). In contrast, studies in scavenging chicken systems in other countries have reported higher infestation rates in roosters, possibly related to behavioural differences such as increased roaming activity (Nusrat et al., 2025). These discrepancies suggest that sex-related differences in infestation may depend on management practices and ecological conditions rather than sex alone.

From a practical perspective, the widespread occurrence of chigger mites in free-range chickens highlights the need for improved control strategies in smallholder production systems. These may include regular inspection of birds, improved sanitation of housing and nesting areas, and the use of appropriate acaricides where necessary (Do et al., 2022). Environmental management, such as reducing the accumulation of organic debris and maintaining dry conditions in resting areas, may also help to limit the development of mite populations.

Several limitations of this study should be acknowledged. First, species identification was based solely on morphological characteristics using established taxonomic keys. Although widely accepted, this approach may carry a risk of misidentification, particularly for closely related species, due to limited diagnostic characters and morphological similarity among taxa (Krantz and Walter, 2009). Future studies incorporating molecular techniques, such as DNA barcoding, would help to confirm species identity and resolve closely related taxa (Zhou et al., 2020). Second, the statistical analysis was limited to univariable comparisons, and potential confounding factors could not be controlled, which may affect the interpretation of associations (Fosgate, 2021). Third, environmental parameters were not measured, limiting the ability to fully explain seasonal patterns.

Despite these limitations, this study provides valuable baseline data on the epidemiology of chigger mite infestation in free-range chickens in Cao Bang Province. The findings contribute to a better understanding of infestation dynamics and may support the development of targeted surveillance and control strategies in smallholder poultry systems.

5.0 Conclusion

Eutrombicula whichmanni and *Neoschoengastia gallinarum* chigger mites were identified in free-range chickens in four communes/wards of Cao Bang Province, with an overall infestation prevalence of 40.65% that increased with age irrespective of the sex of chickens. The findings provide important baseline epidemiological data, highlight the widespread occurrence of chigger mites in smallholder poultry systems, underscore the need for improved monitoring and emphasise the need for targeted surveillance and seasonally adapted control strategies to reduce infestation and mitigate potential impacts on poultry health and productivity and support sustainable poultry production.

Author Contributions: Conceptualisation: Pham Dieu Thuy; Methodology: Pham Dieu Thuy, Nguyen Thi Kim Lan and Tran Nhat Thang; Formal Analysis: Duong Thi Hong Duyen, Chu Thi Trang and Nguyen Thi Ngan; Investigation: Pham Dieu Thuy, Nguyen Thi Kim Lan and Nguyen Thi Ngan; Resources: Tran Nhat Thang; Data Curation: Chu Thi Trang and Tran Nhat Thang; Writing—Original Draft Preparation: Pham Dieu Thuy; Writing—Review and Editing: Tran Nhat Thang. All authors have read and agreed to the published version of the manuscript.

Ethics Approval Statement: Ethical approval was not required as the study involved non-invasive field examination and sampling procedures conducted under routine veterinary practices . All research procedures were conducted in compliance with Article 72 of the Law on Livestock Production (Law 32/2018/QH14) regarding humane treatment and animal welfare and followed the National Regulation (TCVN 12448:2018) on animal welfare management.

Data Availability Statement: All the relevant data that support the findings of this study are available from the corresponding author upon reasonable request.

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