Original article

Prevalence and risk factors assessment of mange mites in livestock of Malakand Division, Pakistan

Asad Ali a, Khalid Hameed a, Mohsinullah Mohsin b, Wali Khan c, Naseem Rafiq d, Muhammad Anwar Iqbal e, Muhammad Kabir f, Habib Ul Hassan g, Tahir Usman h, Mustafa Kamal h

⇑Corresponding authors.
E-mail addresses: tahircau@gmail.com (T. Usman), mustafakamaluok@gmail.com (M. Kamal).

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Abstract

Mange mites represent a serious problem in livestock farming due to their worse effect on animals health, reducing milk and meat production. The status of mange mites prevalence was unknown from the livestock present in Malakand Division, Pakistan. Hence, the present study was conducted to determine the prevalence and risk factors assessment of mange mites in livestock of Malakand Division, Pakistan. Villages and livestock herds were visited for data collection and sampling for one year from September 2017 to August 2018. The diagnosis of mange infestation was carried out from skin scrapings collected from symptomatic animals. A total of 1437 animals were screened (240 sheep, 658 cows, 340 buffalos, 199 goats) from selected localities of the Malakand Division. The overall prevalence was 2.37%, with the highest prevalence in buffalos (5.0%) and lowest (0.42%) in sheep (p < 0.05). The locality also significantly affect the prevalence of mange mites in livestock, with a higher percentage (8.14%) in the Ouch area. The prevalence was higher in winter (3.78%) than in summer (1.07%). The prevalence was high (p < 0.05) in young animals (<1 year) (4.7%) as compared to adults (>1 year) (1.15%). Gender was also a significant risk factor for mange infestation. The infestation was higher in females (2.85%) as compared to males (0.64%) (p < 0.05). Herd size of less than ten animals had a significantly high prevalence rate (3.69%) compared to >10 animals (1.89%). Animals having an infection history >15 days infected more than animals having infection history ≤15 days. This study documented for the first-time epidemiology of mange mites in livestock of Malakand Division, Pakistan. Further studies involving molecular characterization of mange mites will increase our understanding on the spread of mange mites in Malakand Division livestock.

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1. Introduction

Mange refers to skin infestation in animals caused by parasitic mites characterized by pruritus, alopecia, crusted lesions and erythema (Pence and Ueckermann, 2002). The severe irritation causes the animal to scratch its body against walls of herd and tree trunks, leading to skin damage, which exposes animal skin to secondary viral and bacterial infections (Aatish et al., 2007; Asmare et al., 2016). The diagnosis of mange infestation is based on clinical signs; however, these can be mimic with other infestation like ringworm, ticks and flea allergy. Therefore, laboratory diagnosis through microscopic identification of eggs, nymph and adult from
skin scrapings is required for confirmation. The traditional microscopic identification of mites with debatable sensitivity is exclusively practised worldwide, as there is no commercially available serological and molecular diagnostic assay with high sensitivity (Lower et al., 2001).

Mange mites are small wingless arthropods with a size less than one millimetre and hardly visible with the naked eye, belonging to the class Arachnida and the subclass Acari (also known as Acarina). Mite body is divided into prosoma and opisthosoma with four pairs of legs. *Psoroptes, Sarcoptes, Chorioptes* and *Demodex* are the four genera of mites significant for livestock. *Sarcoptes scabiei* is a burrowing mite that favours the less hairy part of animal skin; however, it may spread to the entire body in the severe infection. As this mite penetrates deep into the subcutaneous layer of skin, the irritation caused by *Sarcoptes scabiei* is more severe than other mange mites (Asmare et al., 2016). The *Psoroptes ovis* is a non-burrowing mite with a size larger than other mange mites. This mite can lead to alopecia in all parts of the animal body with severe restlessness and pruritus (Taylor et al., 2007). This mite is most common in sheep and buffalos than other domestic animals. *Chorioptes* mites are non-burrowing and less pathogenic than *Psoroptes*, and *Sarcoptes* mites with a high density of mites are associated with crusted lesions, alopecia and irritation (Lusat et al., 2009; Kollbrunner et al., 2010). *Demodex* are follicular hair mites with an elongated body and short legs. They are found deep in hair follicles and skin glands (Taylor et al., 2007).

Parasitic mites have incomplete metamorphosis with eggs, nymph, and adult are the three stages in the lifecycle. Mange mites are obligatory parasites spending entire life in their host (Fentanew et al., 2015). Mange mites are contagious with rapid transmission between herds due to their ability to survive outside the host for several days. The most effective transmission method is direct skin contact due to the crawling of mites from one to another. However, indirect transmission is possible: when an animal scratches its body against any solid surface in response to irritation, the mites on the skin dislodged and eventually transmitted to a new host (Taylor et al., 2007; Fentanew et al., 2015).

Mange mites are cosmopolitan in their distribution, with varying distribution depending on mite and host species (Bochkov et al., 2014; Fentanew et al., 2015). Environmental factors and herd management influence the mange infestation. There are disagreements in the literature regarding age, gender, and host species to mange infestations susceptibility (Asmare et al., 2016). Specific reports on the emergence and re-emergence of mange infestation in certain populations in the world-leading uncertainty about the mange infestation in livestock and other animals worldwide (Daszak et al., 2000; Littlewood, 2011; Chen et al., 2014; Fraser et al., 2016).

The population of Malakand Division, Khyber Pakhtunkhwa, Pakistan, is predominantly rural, and the majority of the population is associated with agriculture farming and livestock rearing. The status of mange infestation in livestock of Malakand Division was unknown to the scientific community. Therefore, the current study was carried out to determine the prevalence and risk factors assessment of mange infestation in the livestock of Malakand Division.

2. Materials and methods

2.1. Study area

The study was carried out in Malakand Division, Khyber Pakhtunkhwa, Pakistan, between September 2017 to August 2018. These areas are located 14763–19681 feet above sea level. It lies 34°22′ and 35°50′ North and 71°02′ and 72°30′ east. Boundaries are linked with the west Chitral District in the northwest, in the south with Malakand Division and the east with the District of Swat, while in the west, it joins Afghanistan.

2.2. Survey and sampling

Ten localities were visited for survey and data collection (Fig. 1). Data collection was carried out through a self-developed questionnaire. Animals were screened for any signs of mange infestation. Skin scrapings were taken from animals symptomatic for mange infestation. For each skin scraping of every animal the hairs were removed from the area of the lesions with the help of a shaving machine and then the infected lesion margin were cleaned with 10% KOH solution. The skin scrapings were carried out through surgical blades and stored in falcon tubes containing 70% ethanol. The animal skin was scrapped deep enough that a blood drop appears on the skin of an animal. Then the samples were brought to the laboratory of Zoology, Department of Zoology, Mirpur University of Science and Technology, Azad Kashmir, to study mange mites (ectoparasites) and other related parameters.

2.3. Diagnosis of mite infestation

The collected sample of skin scraping was divided into two parts in the laboratory and put into separate falcon tubes. One part of the falcon tubes were exposed to 10% KOH and placed in an incubator for 30 min. After 30 min, slides were made from these samples with the help of droppers. The slides were then observed under a microscope. Due to KOH, the sample was clear for observing mites. The presence of mites in skin scrapings under a microscope confirmed the diagnosis (Fig. 2). The identification of mange mite species was carried out through morphological criteria described in the laboratory manual of parasitology (Soulsby, 1982).

2.4. Data analysis

Microsoft excel 2007 was used to calculate prevalence and 95% confidence interval. The Chi-Square test was used for risk factor analysis (Epi Info 7.2 CDC).

3. Results

3.1. The prevalence of mange mites in livestock animals

A total of 1437 animals were screened during the entire study in the Malakand Division (240 sheep, 658 cows, 340 buffalos, 199 goats), among them, 34 were infected for mange mites infection, giving an overall prevalence of 2.37% (95% CI: 1.58–3.15%).

The highest occurrence rate was reported from buffalos (5.0%; 95% CI: 2.68–7.32%), followed by cows (1.98%; 95% CI: 0.91–3.04%), goats (1.51%; 95% CI: 0.19–3.20%) and least in sheep (0.42%; 95% CI: –0.40–1.23%) (Fig. 3). The prevalence in sheep (reference category) was insignificant as compared to goats ($\chi^2 = 1.43, p > 0.05$) and cows ($\chi^2 = 2.78, p < 0.05$), while the prevalence was significantly high in buffalos ($\chi^2 = 9.82, p < 0.05$) (Table 1). The infection in buffalos were 12.58 times higher (95% CI: 1.66–95.18) as compared to sheep (reference category).

3.2. Prevalence in different localities surveyed

The occurrence rate of skin infestation were highest in Ouch herds (8.14%; 95% CI: 2.36–13.92%), followed by Kanju (4.76%; 95% CI: 0.21–9.32%), Timergara (3.0%; 95% CI: 0.64–5.36%), Chakdara (2.76%; 95% CI: 0.37–5.15%), Bara Bandai (2.3%; 95% CI: 0.07–4.58%), Kotlai (2.05% 95% CI: 0.06–4.94%), Mingora (1.50%;
95% CI: −0.56%-3.57%), Asband (1.12%; 95% CI: 0.56%-3.57%) and least in Matta (0.65%; 95% CI: 0.62%-1.91%) while there was no infestation reported in Batkhela city (Fig. 4).

There was no significant difference in the prevalence in Asbanr (references category), Mingora ($\chi^2 = 0.06$, p > 0.05), Matta ($\chi^2 = 0.16$, p > 0.05), Kotlai ($\chi^2 = 0.30$, p > 0.05), Bara Bandai ($\chi^2 = 0.45$, p > 0.05), Chakdara ($\chi^2 = 0.74$, p > 0.05), Timergara ($\chi^2 = 0.92$, p > 0.05), Barkhela ($\chi^2 = 1.60$, p > 0.05) and Kanju ($\chi^2 = 2.03$, p > 0.05), while significantly higher infection was reported from Ouch ($\chi^2 = 4.9$, p < 0.05) (Table 1).

3.3. Seasonal prevalence

The prevalence was higher in winter (3.78%; 95% CI: 2.35%-5.20%) as compared to summer (1.07%; 95% CI: 0.33%-1.80%) (Fig. 5). So, there was significant statistical association of season with the prevalence ($\chi^2 = 11.41$, p < 0.05) (Table 1).

3.4. Prevalence of mange mites in different sexes

The prevalence was higher in female animals (2.85%; 95% CI: 1.87–3.82%) than in male animals (0.64%; 95% CI: −0.24%-1.52%), there was significant statistical association of prevalence with the sex of animals ($\chi^2 = 5.17$, p < 0.05) (Fig. 6, Table 1).

3.5. Prevalence in different age groups

Regarding the age groups, the prevalence of mange mites was higher in young animals (≤1 year) (4.7%; 95% CI: 2.87%-6.67%) as compared to adults (>1 year) (1.15%; 95% CI: 0.48–1.83%) (Fig. 7). There was a significantly higher prevalence in young animals as compared to adults ($\chi^2 = 18.17$, p < 0.05) (Table 1).

3.6. Prevalence in different herd sizes

The prevalence was higher in small herds (<10 animals) (3.69%; 95% CI: 1.80%-5.59%) as compared to large herds (1.89%; 95% CI: 1.07%-2.71%) (Fig. 8). There was a significant difference in the prevalence in small and large herds ($\chi^2 = 3.93$, p < 0.05) (Table 1).
3.7. Infection history in livestock species

Those animals were infected more having infection history > 15 days (55.88%, 95% CI: 27.49%-60.88%) as compared to animals having infection history ≤ 15 days (44.12%, 95% CI: 18.86%-50.90%). The difference was not significant ($\chi^2 = 0.47$, $p > 0.05$) (Table 2).

3.8. Site of infestation in livestock species

The infection of mange mites according to site of infection was higher in the whole body (61.77%, 95% CI: 32.03%-65.64%), followed by neck region (17.65%; 95% CI: 2.31%-25.60%), legs (11.76%; 95% CI: -0.46%-19.07%) and least at the ear (8.82%; 95% CI: -1.59%-15.54%). There was a non-significant difference in the prevalence between ears (reference category), legs ($\chi^2 = 0.143$, $p > 0.05$) and neck region ($\chi^2 = 1.00$, $p > 0.05$), while significantly high infection was reported from the whole body ($\chi^2 = 13.5$, $p < 0.05$) (Table 2).

4. Discussion

The present study conducted for the prevalence of mange mites reported high prevalence in the livestock population. The reason may be due to herds poor hygienic conditions, and as skin diseases are not considered deadly diseases, so are considered by farmers as benign infestations expected to heal spontaneously and ultimately ignored by the farmers. This could be further added because most skin diseases are contagious, and they spread rapidly among ani-
mals in herds. The lack of early treatment and care of infested cases leads to disease spread in the entire herd. Similarly, the lack of awareness of farmers regarding the economic losses caused by skin disease is a critical factor for the high prevalence of skin diseases in the livestock of Malakand Division. The findings of the study are discussed as under.

In this study, a total of 1437 samples from 4 species were examined for mange mites prevalence. The infection rate was observed in terms of prevalence and risk factor assessment based on species, localities, seasons, age, sex, herd size, and infestation site. The highest prevalence was reported from buffalos (5.0%), followed by cows (1.98%) goats (1.51%) and the least in sheep (0.42%). This shows that there was no significant difference in the prevalence between cows and goats, while there was a significantly higher prevalence of mange mites in buffalos. The infection in buffalos was 12.58 times higher as compared to sheep (reference category).

In Pakistan, Aatish et al. (2007) studied the prevalence of mange infestation in sheep from district Dera Gazi Khan, Pakistan, and found higher prevalence (6%).

Regarding localities, the prevalence reported from different localities was 8.14%, 4.76%, 3.0%, 2.76%, 2.3%, 2.05%, 1.50%, 1.12% and 0.65% from Ouch, Kanju, Timergara, Chakdara, Bara Bandai, Kotlai, Mingora, Asband and Matta, respectively. There was no statistically significant difference in the prevalence recorded in Asbanr and Mingora. In contrast, there was a highly significant difference in the prevalence between Ouch and Matta. It may be due to the variation in rainfall, humidity and other ecological conditions of the studied areas (Ghosh et al., 2007).

The association of mange mites infection with the season may be because certain pathogens like ticks and dermatophytes favour the hot and humid environment. In contrast, mites and lice favour the winter. The prevalence was higher in winter (3.78%), as compared to summer (1.07%). There was a high statistical association of season with the prevalence ($\chi^2 = 11.41, p < 0.05$). The higher

![Fig. 4. Prevalence along with 95% confidence interval in different localities.](image)

![Fig. 5. Seasonal prevalence along with 95% confidence interval in livestock.](image)
Infestation in winter can be attributed to climatic conditions favouring the mite survival and transmission during the cold weather (Dinka et al. 2010). This could be further added by the fact that in winter, the animals feel cold. They use to come close to each other to survive in the harsh environment leading to quick transmission of mange infestation due to skin-to-skin contact.

The prevalence of mange mites was higher in female animals, 2.85% than in male animals, 0.64%, so there was a high statistical association of mange mite prevalence with the sex of animals ($\chi^2 = 5.17, p < 0.05$). The present results show the study in agreement with the conclusion of Tefera and Gebreah (2001), they concluded a highest disease prevalence rate in females gender. Furthermore, the behaviour of breeding in males could also be recognized to the transmission of disease to a number of females.

The prevalence of mange mites was higher in young animals as compared to adults. This would be due to the immature immunity
of young animals (Dinka et al., 2010). The present study results are in contrast with the result of Tefera and Gebreah (2001) and Dinka et al. (2010). They concluded that the prevalence was high in young livestock animal than older ones. However, Awol et al. (2014) did not report any role of age in the disease incidence. There was significantly high infection reported from the whole body ($\chi^2 = 13.5, p < 0.05$) in accordance with other parts of the body (neck, legs and ears), this is because the whole body is directly exposed to the mange mites attachment and those body areas having skin folds were highly infected.

5. Conclusion

In this study, a total of 1437 animals were screened (240 sheep, 658 cows, 340 buffalos, 199 goats) from selected localities of the Malakand Division. The overall prevalence was 2.37%, with the highest prevalence (5.0%) in buffalos and lowest (0.42%) in sheep ($p < 0.05$). The infection rate was observed in terms of prevalence and risk factor assessment based on species, localities, seasons, age, sex, herd size, and infestation site. The present study reported high prevalence in the livestock population. The reason may be due to herds poor hygienic conditions, and as skin diseases are not considered deadly diseases, so are considered by farmers as benign infestations expected to heal spontaneously and ultimately ignored by the farmers.

A future study involving the characterization of viruses, bacteria and dermatophytes will enhance our understanding of skin diseases in livestock of Malakand Division, leading to their possible control.

Table 2

| Disease Profile | Number of Animals | Chi-square for ratios | P-value |
|-----------------|-------------------|-----------------------|---------|
| Site of Infestation |                   |                      |         |
| Ear             | 3                 | Reference category   |         |
| Neck            | 6                 | 1                     | 0.31    |
| Legs            | 4                 | 0.143                 | 0.71    |
| Whole Body      | 21                | 13.5                  | 0.0002  |
| History of Infestation |                 |                       |         |
| <15 days        | 15                | 0.47                  | 0.49    |
| >15 days        | 19                |                       |         |

![Fig. 8. Prevalence along with 95% confidence interval in small and large herds.](image)

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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