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Review article

Mange mite infestation in small ruminants in Ethiopia: Systematic review and meta-analysis

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ABSTRACT

Mange mites are economically important ectoparasites of sheep and goats responsible for rejection or downgrading of skins in tanneries or leather industries in Ethiopia. The objective of this systematic review was to compute the pooled prevalence estimate and identify factors influencing mange mite prevalence in sheep and goats at national level based on the available research evidence. Articles on mange mite infestation of small ruminants in Ethiopia were searched in PubMed, Web of Science, Google scholar and African journals on-line. The review was based on 18 cross-sectional studies carried out between 2003 and 2015 in four administrative states of Ethiopia. Accordingly, the pooled prevalence estimate in a random effects meta-analysis was estimated to be 4.4% (95% CI 3.0, 6.3) although there were evidence of a substantial amount of between-study variance (I^2 = 98.4%). In subgroup and multivariable meta-regression analyses, animal species, agro-ecology and administrative state were found to have significant effect on the prevalence estimate ($P < 0.05$) and explained 32.87% of the explainable proportion of the heterogeneity noted between studies The prevalence was found to be higher in goats in lowland agro-ecology. Region wise the highest estimate was calculated for Amhara (6.4%) followed by Oromia (4.7%), Tigray (3.6%) and Southern Nations, Nationalities and People Region (SNNPR) (3.1%). Significant difference was noted between Amhara and SNNPR. The study further revealed that mites of the genus *Sarcoptes*, *Demodex* and *Psoroptes* are the most prevalent mites infesting small ruminants in Ethiopia. Valid studies were lacking from five regional states. As some of these regions are known for their large small ruminant population, further studies are warranted to produce better picture of the infestation at a national level. Meanwhile, the need for monitoring the ongoing control intervention is suggested.

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1. Introduction

Ethiopia has a large population of small ruminants which comprises 24.2 million sheep and 22.6 million goats (CSA, 2012). In addition to their substantial contribution to the income generation and food security of most smallholder farmers of Ethiopia, small ruminants enable the nation to earn a considerable amount of foreign currency through export of skins and other by-products. The export of processed and semi-processed skins constitutes Ethiopian's second largest commodity. However, over the last decades, there are indications that the quality of raw material has deteriorated with an increasing number of reject grades and the appearance of skin disease called "ekek" that is mainly due to lice, keds, and mange infestations (Kebede, 2013; Abdulhamid, 2001). Mange mites are common causes of clinical and subclinical skin diseases among small ruminants in many regional states and different agro-ecologies in Ethiopia (Yasine et al., 2015; Beyecha et al., 2012; Kassaye and Kebede, 2010; Kumsa et al., 2012; Tadesse et al., 2011; Yacob et al., 2008a,b). According to the available studies, mange mites infesting small ruminants belong to three important genera; namely, *Sarcoptes*, *Psoroptes* and *Demodex* (Tolossa, 2014). The highest prevalence reported was 31.8% in goats and 21.1% in sheep, in and around Kombolcha locality of Amhara region (Tadesse et al., 2011). Moreover, the review by Tolossa (2014) emphasized the infestation to be very common in Oromia and Amhara regional states as well.

Sarcoptic mange is caused by burrowing mites which causes intense pruritis and make animals scratch and rub the body against hard objects. The continuous itch and subsequent restlessness influence time spent on food intake and subsequently production and deterioration of skin quality. On the other hand, psoroptic mange is caused by non-burrowing mites that feed on lipid emulsion of skin cells and exudates superficially and induce hypersensitivity reaction to the presence of antigenic mite fecal material. This leads to severe pruritis, wool loss, restlessness, biting and scratching of infested areas, weight loss, and reduced weight gain and in some cases, death. Demodectic mites reside much deeper in the skin and lesions may be papular, nodular and, in some cases, pustular (Taylor et al., 2007).

Despite the existence of several studies on mange mites' infestations of small ruminants in the country, there are diverse results among the studies with regard to the most important risk factors for the infestations as the differences between age- and species-susceptibility to mite infestation as well as the existence of association between mite infestation and a specific agro-ecology. To authors knowledge, no attempts has been made so far to conduct a quantitative analysis and explore reasons for heterogeneity between studies in mange mite infestation in small ruminants in Ethiopia. Thus systematic review and meta-analysis has been recommended as a way of providing evidence across published literature (Borenstein et al., 2009; Ryś et al., 2009; Akobeng, 2005), subsequently produce more tangible evidence on to which policy makers and researchers could craft the future roadmap. Thus the specific objective of this review was to provide national level pooled estimate for mange mite infestation in small ruminants and identify factors influencing the prevalence based on the research evidence using meta-analysis.

2. Material and methods

2.1. Study protocol

A protocol that addressed the review questions was developed at the very outset and included identification of outcomes of interest and definition of the inclusion and exclusion criteria. Two different kinds of guidelines and data-extraction templates were developed. The first was guide line for preliminary screening that mainly focused on title and abstract content. The second template was a kind of benchmark comprising specific criteria that help identify the valid studies at closer inspection in line with objective of the review. The major components were study design, data analysis, result presentation and conclusion. The last template was a format for data extraction of outcome of interest from valid studies. All the guidelines and templates were commented on by co-authors before use. Attempts were made to follow the PRISMA guide line in the course of the review process (Moher et al., 2009).

2.2. Literature search strategy

The literature search strategy included electronic and manual searches. Electronic search was done by using PubMed, Web of Science, Google scholar and African journals on line. The key electronic search words were: small ruminants, sheep, goats, external parasites, mange mite, *Psoroptes*, *Sarcoptes*, *Demodex*, and Ethiopia. Manual searches for unpublished manuscripts were done at five senior veterinary faculties namely, Addis Ababa University, Haromaya University, Jimma University, Gondar University and Hawassa University. Moreover the repositories of International Livestock Research Institute (ILRI), Addis Ababa and the Office of Ethiopian Veterinary Association were covered. The last search was done on June 25th of 2015.

2.3. Inclusion and exclusion criteria

The retrieved grey or published manuscripts which were written in English or Amharic language after 1990 were assessed at different level. The preliminary screening was done based on title and abstract level to see the compliance level with review objectives. Those reports that met the preliminary requirement were subjected to next level where reports were fully scanned at a closer range. The specific components were study design and sampling method for internal validity, laboratory procedure for appropriateness, data analysis and result presentations were central for a manuscript to be considered. Other aspects like discussions and conclusions were also seen but only used in rating once the manuscript qualified for review. The specific inclusion criteria were year of publication after 1990, study design (cross-sectional, ret-