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Risk factors associated with subclinical mastitis as detected by California Mastitis Test in smallholder dairy farms in Jimma, Ethiopia using multilevel modelling

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ABSTRACT

The prevalence of subclinical mastitis and associated risk factors at the herd, cow and quarter level were studied using multilevel modelling in smallholder dairy farms in Jimma, Ethiopia. Forty-two herds, out of the 55 dairy farms located in Jimma (76%), were visited, a questionnaire was performed, and 635 quarters belonging to 176 lactating cows were screened to detect the presence of subclinical mastitis using the California Mastitis Test (CMT). Sixty-two percent of the cows and 51% of the quarters were subclinically infected. Quarters from cows in later stage of lactation (>180 DIM) [opposed to early lactation (<90 DIM)] were more likely to be subclinically infected (OR = 2.40, 95% CI = 1.44–3.99). Overall, quarters from cows milked by squeezing (as opposed to stripping) were less likely to be subclinically infected (OR = 0.45, 95% CI = 0.29–0.71), although quarters from cows with tick-infested udders were more likely to be subclinically infected when milked by squeezing (as opposed to stripping). The milking technique did not influence the likelihood of infection in cows without ticks on the udder. This study stresses the high prevalence of subclinical mastitis in smallholder dairy farms in Jimma and a lack of awareness of the existence of the disease among dairy farmers. Implementation of a mastitis prevention program adapted to the local needs, including a focus on milking technique, application of appropriate tick control measurements as well as fertility management, allowing cows to be dried-off at a more appropriate moment, are needed. To conclude, milking by squeezing instead of stripping, but not of cows with tick-infested udders, as well as fertility management could reduce the subclinical mastitis prevalence (and incidence) on the short term.

1. Introduction

Ethiopia maintains the largest cattle population in Africa, recently estimated by the Central Statistical Agency of Ethiopia (CSA, 2012) at 52.1 million animals of which 7.2 million are primary held for milk production. Despite these large numbers, milk production lags behind the demand. On average, yearly consumption of milk in Ethiopia is as low as 17 kg *per capita* whereas the average figure for Africa was 26 kg *per capita* in 1998 (Gebrewold et al., 1998). In response to the increasing demand for milk, smallholder dairy farms emerged in urban and peri-urban areas (Mekonnen et al., 2006) such as Addis Ababa and other cities including Jimma, located in South-West Ethiopia.

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Mastitis is highly prevalent in different dairy production systems in Ethiopia and largely impairs production (Almaw et al., 2008; Getahun et al., 2008; Lakew et al., 2009; Tolosa et al., 2009; Tesfaye et al., 2010). With the increasing level of the more susceptible Holstein blood in crossbreeds, the disease seems to be becoming more important (Almaw et al., 2008). Subclinical mastitis is, from an economical point of view, considered as the most important type of mastitis because of the higher prevalence and devastating long term effects of chronic infections compared to clinical mastitis. Production losses in Ethiopian crossbreeds due to subclinical mastitis have been estimated at 38 USD per lactation per cow (Mungube et al., 2005). However, because of lack of clinical symptoms and a quality control system, few farmers in Jimma and other parts of the country are aware of the subclinical form of mastitis and its consequences.

Knowing the prevalence of and identifying risk factors associated with subclinical mastitis is essential in designing prevention and control measures against the disease. However, availability of this information is limited in Jimma and other parts of Ethiopia, mainly because of lack of laboratory capacity. Therefore, the objectives of this study were to estimate the prevalence of subclinical mastitis at herd, cow and quarter level in smallholder dairy farms in Jimma town using the California Mastitis Test, and to identify associated risk factors as a first step toward increasing knowledge of the disease occurrence and potential control mechanisms.

2. Materials and methods

2.1. Description of the study area

Jimma is a medium-sized Ethiopian town with approximately 140,000 inhabitants located in Oromiya Regional State, Jimma Zone, 352 km South-West of the capital, Addis Ababa. The town's geographical coordinates are approximately 7°40′N latitude and 36°50′E longitude. Jimma has an altitude of about 1780 m above sea level and an annual rainfall ranging from 1400 to 1900 mm. Temperature varies between 6 °C and 31 °C (Alemu et al., 2011). The area is mainly known for its coffee production but crop and livestock production are important agricultural activities as well. Milk is produced in small dairy farms established in the city and sold to milk retailers and/or to consumers, most often in producer-owned milk shops.

2.2. Study herds and animals

Forty-two dairy herds of Jimma town dairy cooperative, out of the 55 active dairy herds in Jimma, were visited between July 2010 and June 2011 by a member of a team consisting of two veterinarians and two technicians. Herds were conveniently selected based upon motivation of the farmers. On average, four cows were milked per herd, ranging between one and ten (Table 1). Cows were tethered and hand-milked using the whole hand (five finger squeezing) or only thumb, index and middle finger (stripping) by employees or owners. Lack of space enforces most farms to strictly practice zero-grazing. Neither blanket dry cow therapy nor teat spraying or dipping after milking is performed. Calves are either bucket-fed or suckle the cows.

Table 1
Hierarchy of the dataset and descriptive statistics of number of herds, cows, and quarters included in the study.

Level	Total number	Average number at next higher level	Range at next higher level
Herd	42	–	–
Cow	176	4.2	1–10[a]
Quarter	635	3.6	1–4

[a] Referring to the number of lactating cows.

2.3. Data collection

During the farm visit, potential risk factors for subclinical mastitis at the herd, cow and quarter level were recorded through interviewing of the owner and by observation. Milk samples of all lactating cows ($N = 176$) were collected (Table 1):

Herd level information – Information on herd size (two categories: ≤10 versus >10, including lactating cows, heifers, bulls and calves), calf feeding (bucket-fed versus suckling), and number of milking personnel (employees, family members; three categories: ≤3, 4–6, >6 milkers) was recorded. Milking technique and hygiene was studied in more detail; questions on hand washing before milking (yes versus no), washing of the udder before milking (no, only the teats, the whole udder), teat drying before milking (no drying; yes by using 1 towel for multiple cows; yes by using 1 towel per cow), milking technique (squeezing versus stripping) and milking cows with clinical mastitis last (yes versus no) were asked. Data on housing were noted as well including subjects as grazing (zero-grazing versus limited access to pasture), floor type (solid concrete versus wood/soil) and straw/sawdust bedding (yes versus no) (Table 2a).

Cow level information – Age (2 categories: ≤4 y versus >4 y), parity (primiparous versus multiparous) and lactation stage [3 categories: <90 days in milk (DIM), 90–180 DIM, >180 DIM] was recorded for every cow. Body condition score (BCS; 5 categories: 1–5) of all enrolled cows was measured as described by Edmonson et al. (1989). Udder and leg hygiene was scored using a four point scoring system (4 categories: 1–4) as described by Schreiner and Ruegg (2002). Flank hygiene was scored using the same definitions. Cows were clinically examined for presence of tick infestation on the udder (yes versus no).

Quarter level information – For each quarter, position (4 categories: left front, left hind, right hind, right front) and presence of teat lesions (2 categories: yes versus no) were recorded.

2.4. Subclinical mastitis

Subclinical mastitis was diagnosed by performing the California Mastitis Test (CMT) on all lactating, clinically healthy quarters. Procedures and interpretations described by the National Mastitis Council (1999) were followed. The first stream of milk was discarded and then a few streams of milk were collected in the corresponding paddle wells. The paddle was tilted to remove excess of milk and an equal amount of a commercial reagent (DeLaval mastitis