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Prevalence of Claw Lesions and Their Association with the Locomotion Scores in Smallholder Zero-Grazed Dairy Cows in Kikuyu District, Kenya

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Abstract: A cross-sectional study was carried out between June and August, 2013, in smallholder dairy farms in Kikuyu District, Kiambu County, Kenya to determine the prevalence of claw lesions and their association with the prevailing locomotion scores. The 161 dairy cows were evaluated in 100 zero-grazing dairy units. The occurrence of claw lesions in the hind limbs and respective locomotion scores in the selected cows was determined. Various claw lesions were identified which include: claw overgrowth (66.5%), underrun sole (45.3%), whiteline separation (37.3%), horizontal grooves (31.1%), horizontal cracks (15.5%), vertical cracks (1.9%), corkscrew (11.2%), sole erosion (18.0%), heel erosion (41.6%), splayed claw (16.8%), sole ulcer (3.1%), chronic laminitis (6.2%), foot rot (5.0%), traumatic pododermatitis (2.5%) and scissors-shaped claw (1.2%). Presence of various claw lesions was significantly associated ($p<0.05$) with locomotion scores of the cows examined in this study. Some of the claw lesions had strong association with locomotion scores. These included: corkscrew claws ($\chi^2 = 35.43$, $p<0.0001$), underrun (double), soles ($\chi^2 = 33.66$, $p<0.0001$), white line separation ($\chi^2 = 24.23$, $p<0.0001$), prominent deep horizontal grooves on the dorsal wall ($\chi^2 = 16.18$, $p = 0.0003$), overgrown claws ($\chi^2 = 10.90$, $p = 0.0043$), traumatic pododermitis ($\chi^2 = 9.38$, $p = 0.0092$) and horizontal hoof wall cracks ($\chi^2 = 9.29$, $p = 0.0009$). Other claw lesions were weakly associated with locomotion scores. They included: heel erosion ($\chi^2 = 8.01$, $p = 0.0183$) and sole ulcers ($\chi^2 = 5.99$, $p = 0.0490$). It is concluded that various claw lesions had a strong association with locomotion scores and therefore influencing the gait of the cows.

Key words: Dairy units, lameness, peri-urban, prevalence, cows

INTRODUCTION

Smallholder dairy units contribute over 70% of the total milk production in Kenya and provide subsistence for >600,000 low-income households. These smallholder zero-grazing dairy units vary in their designs and management practices, both between and within the farms. These variations predispose dairy cows to likelihood of occurrence of lameness especially from claw lesions (Nguhiu-Mwangi *et al*., 2008a).

Lameness in dairy cows has continued to be a major cause of ecomonic losses in dairy production industry all over the world (Kossaibati and Esslemont, 1997; Hernandez *et al*., 2005). Various ways in which lameness causes economic losses include lowered milk yield (Hernandez *et al*., 2005), reduced reproductive performance (Sogstad *et al*., 2006), high culling rates, discarded milk due to withdrawal period for antibiotics used for lameness treatment and the additional management labor required to care for lame cows. Lameness also contributes to financial losses due to veterinary services and therapeutics and loss of body condition due to its negative impacts on nutrition and feeding behavior (Huxley, 2013). Apart from economic effects, lameness is a welfare problem as a result of ensuing discomfort and pain which make affected cattle unable to cope with their environment (Offer *et al*., 2000; Somers *et al*., 2003) and significantly change their social ranking, feed intake, sexual activity, productive traits and longevity.

Claw lesions and lesions cause about 60-90% of all lameness in cattle (Sogstad *et al*., 2006; Nguhiu-Mwangi *et al*., 2008a). Some claw lesions are clinical, thus, manifest through lameness while others are subclinical hence only recognized when exposed by hoof trimming. Cattle under zero-grazed units are more predisposed to claw conditions as a result of housing factors, nutritional, environmental and management stresses (Telezhenko and Bergsten, 2005; Nguhiu-Mwangi *et al*., 2008a; Christoph, 2009). Moreover, zero-grazed cattle spend most of their time standing in small confined spaces in which their claws are exposed to

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excessive moisture from accumulated slurry and if the floor is concrete, pressure stress under the weight of the animal exacerbates development of claw lesions (Telezhenko and Bergsten, 2005; Nguhiu-Mwangi *et al*., 2008a).

The non-infective claw conditions especially those associated with laminitis are insidious, subtle and difficult to recognize early enough. These conditions manifest clinically at the phase when irreversible damage in the claw may already have been initiated (Nocek, 1997; Belge and Bakir, 2005). It is therefore, necessary to make early diagnosis for prompt remedial treatment and management measures to be undertaken before extreme damage sets in.

Locomotion scoring is a means not only of making early detection of lameness but can also be used to track down the effects of management, environmental and nutritional changes on incidence and severity of lameness. Locomotion scores and its association with the claw lesion have not been evaluated in smallholder zero-grazed dairy cattle in any part of the world. Therefore, this study evaluated claw lesions and their associated with locomotion scores of dairy cows in the smallholder zero-grazing dairy units in Kikuyu District, Kiambu County, Kenya.

MATERIALS AND METHODS

Study area: The study was carried out in Kikuyu District, Kiambu County of Kenya, between June and August, 2013. Kikuyu District is a peri-urban area of Nairobi, the capital city of Kenya. The district occupies an area of 236 km^2 with an approximate population of 265,829 and 77,045 households. It has a high number of smallholder dairy production units owing to high population in the urban and peri-urban areas, hence enhancing availability of a ready market for milk. The study area was divided into 4 zones which were designated as North, South, West and East from which smallholder zero-grazing dairy units would be selected and data collected.

Study design and farm selection: This was a cross-sectional study in which each selected smallholder zero-grazing dairy unit was visited once and each selected cow within the smallholder zero-grazing unit was examined only once during the period of data collection. A total of 100 smallholder dairy units were included in the study. For purposes of this study, a smallholder zero-grazing dairy unit was defined as one with a minimum of 2 and a maximum of 10 adult dairy cows that have calved at least once. In each zone, 25 zero-grazing units were purposively selected through the help of local veterinarians and animal health assistants who frequently attended to the problems of animals in the area. The purposive selection was done due to logistical reasons which included willingness of the farmers to allow their dairy units to be used in the study and also the difficulties of getting units that met the study criteria as per the definition of the smallholder zero-grazing unit.

Animal selection: The animals that qualified to be recruited for the study were adult dairy cows that had calved at least once, whether they were currently lactating or dry. In the smallholder zero-grazing dairy units that had three or less cows that met the criteria for recruitment into the study population, all the cows were examined. In smallholder zero-grazing dairy units that had more than three cows which met the criteria for the study, three cows were selected by Simple Random Method for examination.

Examination of the cows: The gait of each selected cow was assessed by observation as she stood and as she walked on the walk-alley of the zero-grazing unit. The gait was evaluated using the conventional locomotion scoring system adapted by Sprecher *et al*. (1997). Each cow was restrained in a standing posture in a crush. The claws were washed thoroughly with brush, soap and water. The limbs were then lifted one at a time by tying and fastening with rope to an overhead pole. The horn and weight-bearing surface of the claw were examined for any gross lesions which were then recorded in data collection sheets. The hind limbs were preferred for logistic reasons which included difficulties of accessing the forelimbs when a cow is restrained in the available restraint structures of the zero-grazing units.

Data management and analysis: The data was entered and stored in Microsoft Office Excel 2007. Data was verified and validated as per the data entries in the record sheets. It was then imported into SAS (Statistical Analytical System)© 2002-2003 (SAS Institute Inc., Cary, NC, USA). Descriptive statistics were generated and tests of simple associations were done using Chi-square (χ^2) statistics at $p<0.05$ significance level.

RESULTS

General description: In this study, 100 zero-grazing dairy units were visited for examination of the claws and locomotion scores in the dairy cows within these units. Of these zero-grazing units, 52.8 % (85) had 6-10 cows, 44.1% (71) had 1-5 cows and the remaining 3.1% (5) had over 10 cows. The average number and the median number of cows in the 100 zero-grazing units were 6 and 7, respectively. A total of 161 dairy cows in the 100 zero-grazing dairy units were examined for locomotion scores and claw lesions. The breeds of the cows were Friesian 53.4% (86), Ayrshire 26.7% (43), Guernsey

6.2% (10) and the crosses of these dairy breeds were 13.7% (22). Heart girth measurements also varied in which 23.60% (38) of the animals had heart girth size below 170 cm, 57.76% (93) had heart girth size between 170 and 180 cm while 18.63% (30) had heart girth of over 180 cm. The mean locomotion score was 1.3.

Prevalence of claw lesions and the prevailing locomotion scores: A summary of prevalence of claw lesions and the percentage of prevailing locomotion scores found among the 161 dairy cows examined are presented in Table 1. Claw overgrowth (66.5%) was the most prevalent claw lesion while scissors shaped claws (1.2%) was the least. Most of the zero-grazed dairy cows showed mild lameness (locomotion 2).

Association between claw lesions and locomotion scores: Levels of association between claw lesions and locomotion scores in all the dairy cows examined in this study are presented in Table 2. Presence of various claw lesions was significantly associated ($p<0.05$) with locomotion scores of the cows examined in this study. Some of the claw lesions had strong association with locomotion scores. These included: corkscrew claws ($\chi^2 = 35.43$, $p<0.0001$), underrun (double) soles ($\chi^2 = 33.66$, $p<0.0001$), white line separation ($\chi^2 = 24.23$, $p<0.0001$), prominent deep horizontal grooves on the dorsal wall ($\chi^2 = 16.18$, $p = 0.0003$), overgrown claws ($\chi^2 = 10.90$, $p = 0.0043$), traumatic pododermititis ($\chi^2 = 9.38$, $p = 0.0092$) and horizontal hoof wall cracks ($\chi^2 = 9.29$, $p = 0.0009$). Other claw lesions were weakly associated with locomotion scores. They included: heel erosion ($\chi^2 = 8.01$, $p = 0.0183$) and sole ulcers ($\chi^2 = 5.99$, $p = 0.0490$).

Table 1: Various claw lesions and the percentages of the prevailing locomotion score in the 161 dairy cows examined and evaluated for locomotion scores in the smallholder zero-grazing dairy units in Kikuyu District, Kenya between June 2013 and August 2013

			Locomotion score (%)		
Claw lesion type	No. of cows	Cows (%)	1	2	3
Claw overgrowth	107	66.5	59.8	38.3	1.9
Underrun/Double sole	73	45.3	45.2	53.4	1.4
White line separation	60	37.3	46.7	53.3	-
Horizontal grooves	50	31.1	48.0	48.0	4.0
Horizontal cracks	25	15.5	44.0	56.0	-
Vertical cracks	3	1.9	33.3	66.7	-
Corkscrew claw	18	11.2	16.7	72.2	11.2
Sole erosion	29	18.0	51.7	48.3	-
Heel erosion	67	41.6	58.2	41.8	-
Splayed claw	27	16.8	70.4	29.6	-
Sole ulcer	5	3.1	20.0	80.0	-
Chronic laminitis	10	6.2	10.0	80.0	10.0
Foot rot	8	5.0	50.0	50.0	-
Traumatic pododermatitis	4	2.5	-	100.0	-
Scissors shaped	2	1.2	-	100.0	-

Table 2: Associations between claw lesions and locomotion scores in 161 dairy cows examined in the smallholder zero-grazing dairy units in Kikuyu District, Kenya between June 2013 and August 2013

Claw lesions	χ^2-values	p-values
Claw overgrowth	10.90	0.0043*
Underrun (double) soles	33.66	<0.0001*
White line separation	24.23	<0.0001*
Horizontal hoof wall grooves	16.18	<0.0003*
Horizontal hoof wall cracks	9.29	0.0009*
Vertical hoof wall cracks	1.90	0.3859
Corkscrew claws	35.43	<0.0001*
Sole erosion	5.57	0.0619
Heel erosion	8.01	0.0183*
Splayed claws	0.43	0.8066
Sole ulcer	5.99	0.0490*
Flattened claw	20.50	<0.0001*
Interdigital necrobacillosis	1.58	0.4545
Traumatic pododermatitis	9.38	0.0092*
Scissor claws	0.94	0.6253

*Significant association at $p<0.05$

DISCUSSION

The results of this study generally show that there is association between locomotion scores of dairy cows in the smallholder zero-grazing units and claw lesions. The study showed that the average locomotion score in these zero-grazed dairy cows was 1.3 which indicates that a higher percentage of the cows in these zero-grazing units had between normal gait and mild lameness. It is important to also note that observationally some of the claw lesions were more severe though causing minimal change on the cows gait and therefore lower locomotion score.

The mean locomotion score of 1.3 found in these smallholder zero-grazed dairy herds in the current study compares closely to locomotion score 1.26 reported by Olechnowicz and Jaskowski (2010). However, it is lower than locomotion score of 1.77 reported by Barker *et al.* (2007). This low mean locomotion score in the current study can probably be explained by the fact that a higher percentage of the claw lesions and lesions found in these cows, either caused no lameness at all (score 1) or caused mild lameness (score 2). Similar higher percentages of non-lame dairy cows were reported previously in the small scale-farming units in some peri-urban areas of Nairobi, Kenya (Gitau *et al*., 1996; Nguhiu-Mwangi *et al*., 2009). The types of floor and design of the smallholder zero-grazing dairy units in the study area may have lowered the sensitivity of locomotion scoring system particularly for cows with lesions that have higher pain threshold or with lesions that do not cause pain at all, hence judged as having low locomotion scores. The lesions may also not cause sufficient discomfort to change the gaits of the cows (Tadich *et al*., 2010). However, the use of locomotion scoring is pertinent for identifying and recording early cases of lameness in order to promptly carry out remedial treatment and control.

Although, many lesions found on the claws caused low locomotion scores, the high prevalence of claw

lesions in this study is consistent with the findings of previous researchers (Nguhiu-Mwangi *et al*., 2009). This is probably attributable to the fact that claw lesions are by far the most common cause of lameness in cattle (Clarkson *et al*., 1996). The high prevalence of claw lesions could further be attributed to interactive varied factors such as floor type, stocking rate, slurry, parity and lactation stage and long hours cows stand in confinement of the zero-grazing units without ever being released to open yards (Nguhiu-Mwangi *et al*., 2008a). This confinement provides suitable underfoot environment in which multiple interactive factors favor development of claw lesions (Clarkson *et al*., 1996; Cook *et al*., 2004). The high percentage of the cows that had claw lesions without showing lameness (locomotion score 1) was probably due to the lesions being in the subclinical phase. Similar findings have been reported in the study of laminitis in which cases of subclinical laminitis manifest an insidious course that eventually contributes to the development of more severe future lameness episodes as long as the predisposing factors persist (Nocek, 1997; Belge and Bakir, 2005).

In the current study, claw overgrowth and the underrun (double) soles were the most prevalent claw lesions. These claw lesions are associated to claw trimming, hence, lack of regular claw trimming predisposes their occurrence. Since, almost all the cows with claw lesions or lesions in this study were found to have locomotion scores 1 or 2, it could imply that either the claw conditions did not cause any pain/discomfort or caused mild pain/discomfort, hence locomotion scores 1 and 2, respectively. It may also mean that the evaluation of locomotion scores is not sensitive enough to distinguish between mild and moderate discomfort (score 2 and 3) but could easily distinguish the extreme cases of absence of limb discomfort (score<2) or presence of severe pain (score = 3). This agrees with the explanation given by Tadich that presence of hoof lesions may not necessarily mean association with increasing locomotion scores.

The strong association between locomotion scores and some of the claw conditions such as overgrown claws, corkscrew claws, double soles and horizontal grooves can probably be attributable to claw deformations that result from these conditions as well as their possible association with laminitis (Rebhun and Pearson, 1982; Greenough, 1987; Nocek, 1997; Nguhiu-Mwangi *et al*., 2008c). Other lesions such as white line separation, horizontal hoof wall cracks and traumatic pododermatitis may be strongly associated with locomotion scores due to possibility of pain caused when these lesions involve the deep parts of the claw such as the corium. This is closely consistent with previous findings (Dyer *et al*., 2007). All the claw conditions showing strong association with locomotion scores are likely to cause severe lameness in the affected cows.

Conversely, the claw lesions that were weakly associated with locomotion scores such as heel erosion, affect only the superficial parts of the horn and are unlikely to cause pain, hence may not influence the gait or locomotion scores. In contrast to previous findings of sole ulcers being strongly associated with higher locomotion scores (Nguhiu-Mwangi *et al*., 2008b; Tadich *et al*., 2010), sole ulcers in the current study were found to be weakly associated with locomotion scores. This may be attributable to the fact that the prevalence of sole ulcers in the current study was low. Moreover, the sole ulcer lesions in this study were below the surface of the horn of the sole in which case the sensitive tissue did not tread directly on the ground, hence less pain and low locomotion scores.

CONCLUSION

From this study, it is concluded that the lesions that were found to have a strong association with locomotion scores and therefore influence gait of the cows included: overgrown claws, corkscrew claws, double soles, prominent horizontal grooves on dorsal wall of the claw, hoof cracks and traumatic pododermatitis.

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