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Effect of Musculoskeletal Disorders on the Reproductive Performance of Holstein Zebu Cross Dairy Cows

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Abstract
Two farms with a relatively better record keeping practice were selected to study the effect of musculoskeletal disorder (MSD) on reproductive and lactation performance. The dairy cows found in these farms were categorized into positive or negative to any form of MSD based on their health record and clinical findings. Reproductive performance was measured from CI, CFS, CCI, DALC, NSPC and NSALC. Further, lactation performance was also measured from average daily milk yield, total milk yield and lactation length. Out of the 92 cows, 23.9% were found to be positive for one form of MSD. The mean (±SEM) for CI, CFS, CCI, DALC NSPC and NSALC for the positive cows were 560.9±37.87, 186.2±12.81, 383.3±59.69, 313.6±35.69, 4.30±0.52, and 3.3±0.27, respectively. There was a significant difference ($p<0.05$) in CI, CFS, CCI NSPC and NSALC between MSD positive and MSD negative cows. The average daily milk yield, total milk yield and lactation length were in the order of 9.7±0.5 L, 3890.7±249.3 L and 413.1±17.54 days, respectively with a significant difference ($P<0.05$) in milk production between MSD positive MSD negative cows. Lactation length was unaffected by MSD. This study clearly showed MSD has a direct impact on the reproductive performance dairy cows and significantly influence milk production, which could be the reason for lack of improvement in the urban smallholder dairy industry in Ethiopia.
Keywords: MSD, Reproductive performance, Dairy cows

1. INTRODUCTION

The annual production of milk production in Ethiopia is approximately 645,000 tones which corresponds to a yearly production per cow of 215kg. The per capita milk consumption in Addis Ababa alone has dropped from 24 liters to less than 16 liters over the past two decades. In order to increase the milk supply to major urban centers, market oriented urban and peri-urban dairy production systems have recently emerged. The number of farms and the level of intensification is growing at a fast rate and these farms use improved genotypes, have large herd sizes, provide housing, use hired labor and artificial insemination and in some cases process milk (Lobago *et al* 2001; 2006). According to data obtained from the local Agricultural Office, there are few relatively large market-oriented dairy farms with milking herd size of >30 among the over 600 smallholder (average herd size of 3 cows) dairy farms in Debre Zeit town. A study on some of these farms showed that out of 57 diseases diagnosed, the proportional prevalence of musculoskeletal disorders (MSD) was about 16.3% (Lobago *et al* 2001). The major diseases of intensification include mastitis, MSD, infertility, and reproductive wastages.

MSD resulting from direct trauma or more often by a combination of predisposing factors are diseases that reduce overall profitability of the dairy operation (Greenough *et al* 1981; Guard, 1997). According to FAO sources, the total loss of production in the diary industry just due to lameness is assumed to be 15% in developed countries and 30-40% in developing countries. Economic losses, as a result of MSD, include reduced milk production, shortened duration of lactation, weight loss, death, culling, poor reproductive performance, and treatment costs (Weaver, 1984; Greenough *et al* 1981). Particularly, interval to first service after calving, calving to conception and overall conception rate are affected by MSD (Argaez-Rodriguez *et al* 1986; Collick *et al* 1989; Lee *et al* 1989; Luecy *et al* 1986). In Ethiopia, diseases of intensification and reproductive wastages are becoming important constraints, and affect the productivity of animals and profitability of the urban and peri-urban dairy production system (Lemma and Kebede, 2011). This study was carried out with the objectives of determining the status of musculoskeletal disorders and its effect on reproductive performance and milk production in smallholder dairy cows.

2. MATERIALS AND METHODS

This study was carried out on two selected relatively large urban dairy farms in Debre Zeit, a town located 45km southeast of Addis Ababa at 8.70N latitude and 390E longitude with an altitude of 1990 meters above sea level. It has an annual rainfall of 866mm of which 84% falls during the long rainy season extending from June to September. The mean annual maximum and minimum temperature ranges are 260c and 140c, respectively with a relative humidity of 61.3% (NMSA, 2003).

2.1. Study animals

This study involved two commercial dairy farms (Tsedey and Genesis dairy farms) both holding Holstein*Zebu cross breeds (50-75% exotic blood) for milk production. Only cows with at least one parity and were milking at the time of data collection were selected. Based on the above mentioned criteria, 92 cows were included in the study. Both farms have well constructed barns suited for different animals (milking cows, pregnant cows, heifers, calves etc). The cows are provided with three types of feeds: Grass hay, concentrates and green feeds (Waste vegetables, Alfalfa and Napier grass). Artificial insemination is given by a skilled technician with occasional use of bulls and health care is also practiced by veterinarian in the farm. Both farms milk the cows manually two times per day. Milk records, breeding records and medical records are properly kept in both farms.

2.2. Study design

Clinical survey

Each of the animals were systematically clinically examined for presence of any form of MSD. An MSD was defined in this study as a disease that involves motion deficits, functional disorders, and lameness due to injury or infection of the soft-tissues structures, joints, and bones of the appendages. A thorough history, inspection, and physical examination were carried out to look for sources of inflammation, pain and lameness, and determine the nature, extent, and exact location of the injury. The gait and locomotion of each cow was evaluated. Presence of primary muscular diseases, neurologic deficits, metabolic disorders, infectious diseases, nutritional imbalances, congenital defects and deformities were also assessed. Results of the clinical examination were recorded on a predesigned format for later analysis. At the end cows were categorized as MSD positive or MSD negative based on the findings.

Record analysis and personal interview of dairy owners

A 12 months retrospective data of the study population was collected from the record regarding milk production, reproductive performance, and health status of the cows. Data on age, breed (blood level), parity, age at first calving (AFC), calving to first service (CFS), calving to conception interval (CCI), number of services per conception (NSPC), number of services after last calving (NSALC), days after last calving (DALC) for non pregnant cows, calving interval (CI), average daily milk yield (during most current lactation), milk yield per lactation (during the last completed lactation), and lactation length (last completed lactation) were collected either from the record when available or through personal interview of owners.

Data analysis

The data was stored and managed in Microsoft Excel and later analyzed using SPSS for Windows Version 15 (Chicago, USA). Data was described and expressed as mean (±SEM). The effect of MSD on reproductive and lactation performance was computed using one way ANOVA, Chi-square test and Odds ratio. Differences were considered significant when $P < 0.05$.

3. RESULTS

The prevalence of MSD 23.9% with no significant difference between the two farms. All (100%) of the MSD positive cows were lactating, aged between 36.3 and 89.2 months, with an average parity of 2.6 and 18.2% were pregnant. Few reproductive indices (AFC, CI, and DALC) and milk production (ADMY and TMY/L) were significantly different between the farms (Table 1).

Table 1. Descriptive statistics summarizing the reproductive and lactation performance of dairy cows

Parameters	N (Overall)	Mean (±SEM)	N (Tsedey/Genesis)	Tsedey	Genesis	*P* value
Age at first calving [months]	92	30.42±0.67	47/45	33.44±0.98	27.27±0.66	0.0000
Calving interval [months]	69	509.85±14.05	34/35	539.15±24.33	481.4±13.12	0.0390
Days after last calving [days]	75	270.57±17.2	40/35	308.43±25.3	227.31±20.92	0.0176
Calving to first service [days]	92	135.22±5.55	47/45	144.29±8.21	125.73±7.24	0.0945
Calving to conception interval [days]	30	249.9±22.33	17/13	262.53±31.92	233.38±31.05	0.5273
Number of service per conception	30	3.38±0.24	17/12	3.59±0.36	3.08±0.26	0.3089
Number of service after last calving	63	2.63±0.14	30/33	2.57±0.22	2.69±0.17	0.6415
Average daily milk yield [L]	92	11.24±0.29	47/45	9.63±0.31	12.92±0.37	0.0000
Total milk yield per lactation [L]	92	4358.12±149.23	47/45	3793.02±168.8	4948.33±218.06	0.0000
Lactation length [days]	92	396.69±10.62	47/45	400.54±14.87	392.67±15.33	0.7132

Except for DALC, all reproductive indices were significantly different (P<0.05) between MSD positive and MSD negative cows (Table 2). The differences in CFS and CCI were highly significant (P<0.001) between the positive and negative cows. Cows affected by MSD were also more likely to produce less milk than cows not affected (OR= 10.11, *P*=0.003). Over 95% of the positive cows received 3 or more inseminations before conception or 50% of them were at least 3 times inseminated after their last calving as compared to the 80% and

67% for negative cows, respectively

Table 2. Test of difference in reproductive performance indices between MSD positive and negative cows

Parameters	N	MSD Negative	MSD Positive	P value
Age at first calving [months]	92	30.1±0.68	31.4±1.82	0.4263
Calving interval [months]	69	495.7±14.17	560.9±37.87	0.0547
Days after last calving [days]	75	257±19.46	313.6±35.69	0.1617
Calving to first service [days]	92	119.2±4.69	186.2±12.81	0.000
Calving to conception interval [days]	30	201.4±9.34	383.3±59.69	0.000
Number of service per conception	30	3.1±0.24	4.3±0.52	0.0304
Number of service after last calving	63	2.4±0.14	3.3±0.27	0.0038
Average daily milk yield [L]	92	11.7±0.33	9.7±0.5	0.0038

4. DISCUSSION

Many researchers have proved the effect of lameness on fertility and reproductive performance, without going into detail on each lameness diagnosis. Hernandez *et al* (2001) found that lame cows having claw lesions were 0.52 times as likely to conceive as healthy cows, which also agrees with the present finding in MSD positive animals. CI was on average 65 days longer in cows affected by MSD. Enting et al. (1997) reported a longer CI for cows with clinical digital diseases, whereas Collick *et al* (1989) found that lame cows experienced a longer CFS, a longer CCI, and needed more services per conception than non-lame cows. Studies on Holstein*Zebu crossbred dairy cows in the central highlands of Ethiopia (Tesfu *et al* 1993) and large urban and peri-urban dairy farms in Addis Ababa (Lemma and Kebede, 2011) indicated generally a much lower mean CFS and CCI in the order of 88-97.5 and 124-157.8 days, respectively. Comparatively, the current study shows a much higher value. Severe cases of lameness were known to be associated with delayed ovarian activity in Holstein cows (Garbarino *et al* 2005) that would lead to prolonged CFS and CCI. Closely conforming with this is the highly significant difference in CFS and CCI between MSD positive and negative cows in the present study. Unlike previous reports for cross-bred cows in Ethiopia that showed a mean NSPC range of 1.5 to 2.5 (Beyene, 1992), both positive and negative cows had a relatively higher NSPC. MSD seemed to aggravate an existing poor reproductive performance.

Research based studies regarding the effect of lameness on milk yield are sparse with most studies showing no effect (Martin *et al* 1982; Deluyker *et al* 1991). Some authors report a decreased milk yield after diagnosis (Whitaker *et al* 1983; Tranter and Morris, 1991; Warnick *et al* 2001), others a decrease in milk yield before a cow was treated as well as after (Lucey *et al* 1986). Greenhough *et al* (1981) reported losses from 1% to 20% of total lactation. Although computation of the effect of MSD on total milk yield per lactation and the lactation length was not possible, MSD positive cows were known to have a comparatively reduced daily production level by 2 L/day. An economic analysis of data from 21 Dutch dairy farms estimated that cows culled for lameness had 3.3 kg/day lower milk production than the non-lame cows (Enting *et al* 1997). Other studies estimated milk production losses of 1.5 to 2.8 kg/day (Rajala-Schultz *et al* 1999). Decreased feed intake associated with MSD has been described (Hassall *et al* 1993; Bareille *et al* (2000) which can potentially contribute to reduced milk production.

5. CONCLUSION

MSD is one of the major dairy health problem sometimes presenting itself as an invisible foe in the effort to improve dairy productivity. It does also render a farm, whether smallholder or large commercial, inefficient by affecting both production and reproduction. MSD is a multi-causal problem of musculoskeletal system in which genetic, biological and environmental factors act in concert. It is primarily associated with growing intensification. According to this study, MSD is associated with prolonged CFS, CCI, and CI with higher NSPC leading to a lower conception rate renderifn the farms less profitable. Further reduced milk production renders the urban dairying economically unattractive since most of the smallholder farmers rely for their livelihood. Further studies are required to confirm the present finding on large scale and to evaluate the relative contribution of the various forms of MSD to the reduction in performance of the dairy cows.

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