Impact of Lameness on Reproductive Performance of Crossbred Cows in Small Holder Dairy Farms in and Around Jimma Town, Oromia Region, Ethiopia

[1]Nuraddis Ibrahim, [2]Fekadu Regassa, [2]Tefera Yilma and [1]Tadele Tolosa

[1]Jimma University, School of Veterinary Medicine, Ethiopia
[2]Addis Abeba University College of Veterinary Medicine and Agriculture, Ethiopia

Abstract: A longitudinal observation study was conducted from January 2020 to July 2021 with the objective to compare calving to first service interval (CFSI) and number of services per conception (NSPC) between cows classified as nonlame, moderately lame, or lame during the first 2 months after calving. During this period cows were examined for lameness every week using a 5-point locomotion scoring system. Cows clinically lame (CL) had a longer calving to first service interval (CFSI) when compared with cows which were never lame or those mild lame. The difference was significant (P<0.05). Similarly, the mean number of services per conception (NSPC) was longer ($P<0.05$) in lame cows than in normal ones. Only 13 out of 37 of the good body conditioned cows, 35.1% showed lameness. From the poor body condition, 37 out of 54 (68.5%) showed lameness ($P = 0.002$). From 37 examined primiparous cows, 15 (40.5%) were lame and among 54 examined multiparous cows, 35(64.8) of them were lame ($P = 0.022$). The majority of lameness cases occurred in adult cows having ≤4 years old (60.7%) than younger ones having =4 years old (45.7%), however there was no statistically significant difference ($P=0.162$) was observed in the age groups with respect to occurrence of lameness. The lesions that were found causing lameness were excessive hoof growth with vertical and horizontal fissure, sole ulceration and foot rot. Conclusion: Significant associations were found in this study between different degrees of lameness and fertility. Reducing lameness should be part of the management plan used to improve fertility of dairy cows.

Key words: Calving to first service interval · Clinically lame · Locomotion score · Nonlame · Number of services per conception

INTRODUCTION

Lameness is defined as any abnormality that causes the animal to change its gait or posture [1]. The association of stress and pain with lameness has an adverse effect on fertility in dairy cows [2, 3]. Lameness in cows during the early postpartum period has been associated with a higher incidence of ovarian cysts and a lower ovarian activity and consequently a lower likelihood of pregnancy and lower fertility than in the case of non-lame cows [4, 5].

Economic loss due to lameness can be decreased reproductive performance, increased open days and increased risk of mastitis, increased culling rate [1]. Lame cows have a lower milk production, reproduction, reduced mobility and reduced estrous behavior.

Huxley [6] reported that lameness caused 7 days longer calving to the first service interval, 30 days increase in calving to conception interval, 20% lesser conception rate and 1.2 more services per conception. Lameness postpones by up to 18 days the beginning of ovarian cyclicity and by 24 days the onset to estrus when compared to non-lame cows [4].

In previous studies, hoof lesions in cows, such as sole ulcers or white line lesions, result in significant differences in calving to first service when compared with

Corresponding Author: Nuraddis Ibrahim, Jimma University, School of Veterinary Medicine,
P.O. Box: 307, Jimma, Ethiopia. Tel: +251-0471116778, Mob: +251917808966.

healthy cows [7]. Lameness is an important problem in dairy industry in Ethiopia [8]. However, there is no available literature in the country that describes the effects of lameness on reproduction. Therefore, the objectives of this study were to explore and quantify impact of lameness on reproductive performance of cross breed cows in Jimma town dairy farms, Ethiopia.

MATERIALS AND METHODS

Description of Study Area: The study was conducted from January 2020 to July 2021 in and around Jimma town which is the town is located in the south western part of the Ethiopia in Oromia regional state (Figure 1). Jimma town is found at distance of about 352 km from Addis Ababa, the capital city of Ethiopia. Geographically, it is located at 7°13' and 8°56'N latitude and 35°52' and 37°E longitude. The area has an altitude ranging between 880 and 3358 m above sea level. The annual rainfall is ranging between 1200 mm–2000 mm; and the annual temperature of the area ranges 7°C–30°C. Farmers in the area practices mixed crop-livestock agriculture. The zone is one of the major coffee growing areas in southwest part of Ethiopia. Furthermore, the zone is well known by livestock production which can be estimated at about 2, 212, 962 cattle, 866, 561 sheep, 457, 311 goats, 96, 782, horses, 17, 644 mules, 77, 767 donkeys, 1, 951, 129 poultry and 546, 722 beehives [9].

Study Animals and Reproductive Management: The study was conducted on a total of 91 normally calved crossbred dairy cows (Holstein Friesian x Zebu crossbred). The data were collected between 2020 and 2021 which calved from January 2020 to July 2021. Based on a locomotion scoring system devised by Sprecher *et al*. [10], Cows were classified into five categories of lameness: 1 – non-lame (41), 2 – mild lame (8), 3 – moderate lame (27), 4 – lame (13) and 5- severe lame (2). Cows which scored ≥ 3 points were classified as clinically lame (CL).

The study animals were Holstein x Zebu crossbred cows selected from 11 intensively managed farms in the study area. The intensively managed cattle were kept indoors and received concentrate feeds in addition to hay and crop residues (such as corn stalks, wheat/barley straw and other leftovers from grain threshing). Animals on the farm were regularly vaccinated against common infectious diseases like Lumpy skin disease, Anthrax, Blackleg and Foot and mouth disease. Regular preventive treatments were administered against prevalent endo- and ecto-parasites.

All cows for observational study were kept under the same environment, feeding regime and husbandry system for the whole study period. In order to avoid confounding factors, the presence of reproductive health problems, some metabolic diseases and mastitis were recorded and excluded from the study, since these diseases can influence reproductive performance.

The first service in each herd did occur after the voluntary waiting period, which was 50 days after calving in all farms. Estrous signs were monitored by visual observation. Pregnancy was confirmed by rectal palpation 60–65 days after artificial insemination (AI).

Longitudinal Observation Study: This is longitudinal observational study where lame cows and non-lame cows compared for different outcome variables. This study included postpartum crossbred dairy cows (Zebu x Holstein Friesian) that were followed up for 330 days after calving to record their reproductive indices.

Screening of Lameness: Lameness was assessed based on a scale of 1 to 5 locomotion score, devised by Sprecher *et al.* [10] considering as lame dairy cattle those ones obtaining scores ≥ 3. For the locomotion assessment of the dairy cattle kept in tie stalls, these were loosened and were taken out of the barns. Similarly, in some of the farms where the dairy cattle were being let to exercise and/cleaning purpose were assessed after the morning milking.

Data Collection and Statistical Analysis: The age of this study animals was categorized into 2 categories either ≤4 or >4years and the data of age was recorded for every cow. Body condition score (5 scores: 1-5 scores) of all sampled cows was measured as described by Edmonson *et al*. [11] and categorized as poor (≤3) or good body condition score body condition score (BCS) (>3). Parity classified as primiparous and multiparous. All the dairy cattle in selected farms were repeatedly observed for the presence of abnormal gait. Data was collected using structured questionnaire format for questionnaire survey and using separate data recording sheets for locomotion scoring systems. All data were collected and recorded in a Microsoft ® Excel 2010 spreadsheet and statistical analysis was conducted using SPSS statistical software
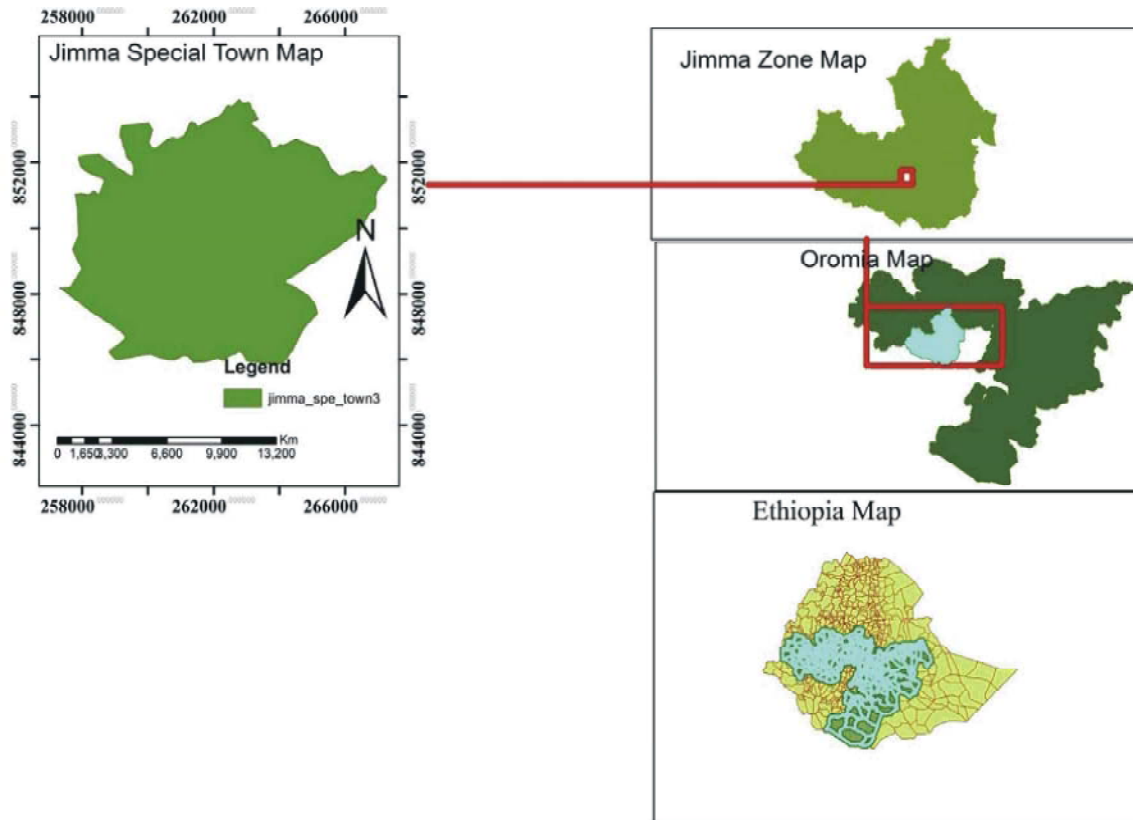
Fig 1: Map of the study area

version 20.0. Descriptive statistics were used to compute percentages, proportions and frequency distributions of the data. Mean calving to first service interval (CFSI, days) and number of services per conception (NSPC) of the lame and healthy cows were compared by ANOVA. Tukey's test was used to express the difference among the groups. Statistical analysis was conducted using SPSS version 20.0. Statistical significance was set at $P < 0.05$ to determine whether there are significant differences between the parameters measured among the groups.

RESULTS

Impact of Lameness on Reproductive Performance: The mean interval from calving to first service interval (CFSI) in non-lame cows (n=41) was 85.15±23.6 days while in mildly lame-cows (n=8) was 89.63±9.13 (*P*=0.99). The mean interval from calving to first service interval in moderate-lame cows (n=41) was 118.2±29.8, in lame-cows (n=13) was 138.8±24.9 and in severe- lame cows (n=2) was 168±9.9 (*P*>0.05; Table 1).

The mean number of services per conception (NSPC) in non-lame cows (n=41) was 1.59±0.81. While, in mildly lame cows (n=8) NSPC was 1.75±0.9 (*P*=0.99). The mean interval from calving to first service interval in moderate-lame cows (n=41) was 2.85±1.54, in lame-cows (n=13) was 3.69±1.32 and in severe-lame cows (n=2) was 5.5±0.71 (*P*>0.05; Table 2).

Factors Associated: Of the good body conditioned cows, 13 out of 37 (35.1%) were lame and of the poor body condition cows, 37 of 54 (68.5%) were lame (*P*= 0.002). From 37 examined primiparous cows, 15 (40.5%) were lame and among 54 examined multiparous cows, 35 (64.8) of them were lame (*P*= 0.022; Table 3).

The higher percentage of lameness cases occurred in adult cows of >4 years old (60.7%) than younger ones of ≤4 years old (45.7%; *P*=0.162; Table 3).

The lesions that were found causing lameness were excessive hoof growth with vertical and horizontal fissure (76.32%), (Figure 2), sole ulceration (13.16%) and foot rot (10.52%; Table 4) (Figure 3).

Table 1: Descriptive statistics (mean ± SD) of calving to first service interval (CFSI) in different degrees of lameness

Score	Description	No examined	Mean ± SD CFSI (days)
1	Normal (Not lame)	41	85.15±23.6
2	Mildly lame	8	89.63±9.13
3	Moderately lame	27	118.2±29.8
4	Lame	13	138.8±24.9
5	Severely lame	2	168±9.9

Table 2: Descriptive statistics (mean ± SD) of nnumber of services per conception (NSPC) in different degrees of lameness

Score	Description	No examined	Mean ± SD NSPC
1	Normal (Not lame)	41	1.59±0.81
2	Mildly lame	8	1.75±0.9
3	Moderately lame	27	2.85±1.54
4	Lame	13	3.69±1.32
5	Severely lame	2	5.5±0.71

Table 3: Factors associated with the occurrence of lameness

Factor	Group	No examined	Prevalence (%)	OR	95% CI	P-value
Body condition score	Good (>3)	37	13(35.1)			0.002
	Poor (≤3)	54	37(68.5)	0.25	0.103-0.6	
Parity	Primiparous	37	15(40.5)		0.022	
	Multiparous	54	35(64.8)	2.7	1.14-6.4	
Age	≤ 4	35	16 (45.7)			0.162
	> 4	56	34(60.7)	1.84	0.78-4.31	

CI=confidence intervalOR=Odds ratioP=Probability

Table 4: Proportions of foot and leg problems in animals with locomotion score ≥ 3

S. No	Type	Frequencies	Percentage	Quarters
1	Excessive hoof growth with vertical and horizontal fissure	29	76.32	Both feet
2	Foot rot	4	10.52	Rear feet
3	Sole ulceration	5	13.16	Rear feet
4	Total	38	100	

Fig. 2: Increased hoof growths of hind and front feet

Fig. 3: Foot rot (swelling of entire digit) and topical treatment practice

DISCUSSION

The present study strongly supports earlier findings that lameness is related to an impaired reproductive performance. In the current study, the mean days from calving to first service was longer in clinically lame cows compared with cows which were mild- and non-lame cows, the difference was significant($P<0.0.05$). In agreement to our study Orgel *et al*. [12] and Niorn *et al.* [13], lameness prolonged calving to first service interval.

In our study, we observed a higher number of services per conception in clinically lame cows when compared with cows which were mildly and never lame cows, the difference was significant ($P=0.000$). Similar to our finding, Niorn *et al.* [13] also recorded 2.98 ± 2.4 service in lame-cows. Compared to our finding, Olechnowicz and Jaskowski [1] reported lower percentage (2.14%) of lame cows. Huxley [6] recorded 1.2 more services per conception. This difference could be due to the management factors.

Lameness prevalence in this study was significantly associated with BCS and parity which agrees with findings from other authors [14, 15], however contradicts with Sadiq *et al.* [16] and Mulatu [8]. Differences might be due to system of sample size, breeds and corresponding milk yielding capacity.

In our study, lameness incidence increases with age and adult cows tend to have increased levels of hoof damage. This finding is in agreement with the finding of Raber *et al.* [17].

In 76.32% of the dairy cattle with locomotion score ≥ 3 foot and leg problems were due to excessive hoof growths associated with vertical and horizontal fissures that were in agreement with the reports of Sulayeman and Fromsa [18], Abunna *et al*. [19] and Mulatu [8]. Similarly, Sadiq *et al*. [16] reported that for cows with claw lesions, the prevalence of lameness was associated with overgrown claw in dairy farms in Selangor, Malaysia. According to the guideline made by Shearer [20], increased hoof growth (particularly of the outside claw of

rear feet) leads to overgrowth and eventually overloading of the affected claws. The end result is a greater likelihood of developing claw disease.

CONCLUSION

In this study, clinically lame (CL) cows had a longer calving to first service interval (CFSI) when compared with cows which were non-lame and with mild-lame cows. Similarly, the mean number of services per conception (NSPC) was longer in clinically lame cows than in non-lame cows. From this study, it can be concluded that parity and body condition can be considered as important factors which influence the occurrence of lameness in dairy cows. The lesions that were found causing lameness were excessive hoof growth with vertical and horizontal fissure, sole ulceration and foot rot. Significant associations were found in this study between different degrees of lameness and fertility. The results from this study indicate that reducing lameness should be part of the overall management plan used to improve fertility.

ACKNOWLEDGMENTS

REFERENCES

1. Olechnowicz, J. and J.M. Jaskowski, 2011. Behaviour of lame cows: A review. Vet. Med., 56: 581-588. [Google Scholar].

2. Hultgren, J., T. Manske and C. Bergsten, 2004. Associations of sole ulcer at claw trimming with reproductive performance, udder health, milk yield and culling in Swedish dairy cattle. Prev. Vet. Med., 62: 233-251.

3. Melendez, P., J. Bartolome, L.F. Archbald and A. Donovan, 2003. The association between lameness, ovarian cysts and fertility in lactating dairy cows. Theriogenology, 59: 927-937.

4. Garbarino, E.J., J.A. Hernandez, J.K. Shearer, C.A. Risco and W.W. Thatcher, 2004. Effect of lameness on ovarian activity in postpartum Holstein cows. J. Dairy Sci., 87: 4123-4131.

5. Alawneh, J.I., R.A. Laven and M.A. Stevenson, 2011. The effect of lameness on the fertility of dairy cattle in a seasonally breeding pasture-based system. J. Dairy Sci., 94: 5487-5493.

6. Huxley, J.N., 2013. Impact of lameness and claw lesions in cows on health and production. Livest. Sci., 156: 64-70.

7. Lucey, S., G.J. Rowlands and A.M. Russell, 1986. The associations between lameness and fertility in dairy cows. Vet. Rec., 118: 628-631.

8. Mulatu Woldehana Bachore, 2018. Epidemiological investigation of lameness in selected dairy farms of Sululta town, central Ethiopia, MVSc thesis, College of Veterinary Medicine and Agriculture of Addis Ababa University.

9. CSA (Central Statistical Agency), 2017. Report on livestock and livestock characteristics. The Federal Democratic Republic of Ethiopia, Private peasant holdings, Statistical bulletin 570. Addis Ababa, Ethiopia.

10. Sprecher, D.J., D.E. Hostetler and J.B. Kaneene, 1997. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology, 47(6): 1179-1187.

11. Edmonson, A.J., I.J. Lean, L.D. Weaver, T. Farver and G. Webster, 1989. A body condition scoring chart for Holstein dairy cows. J. Dairy Sci., 72: 68-78.

12. Orgel, C., I. Ruddat and M. Hoedemaker, 2016. Prevalence and severity of lameness in early lactation in dairy cows and the effect on reproductive performance. Tierarzti Prax Ausg G Grosstiere Nutztiere, 17: 207-217.

13. Niorn Ratanapob, Wandee Thiangtum, Theera Rukkwamsuk, Smit Srisomrun, Supachart Panneum and Pipat Arunvipas, 2020. The relationship between lameness and reproductive performance in dairy cows raised in small holder farms, Thailand, Songklanakarin J. Sci. Technol., 42(4): 766-770, Jul.-Aug.

14. Green, L.E., V.J. Hedges, Y.H. Schukken, R.W. Blowey and A.J. Packington, 2002. The impact of clinical on the milk yield of dairy cows. J. Dairy Sci., 85: 2250-2256.

15. Solano, L., H.W. Barkema, E.A. Pajor, S. Mason, S.J. Le Blanc, J.Z. Heyerhoff, C.G.R. Nash, D.B. Haley, E. Vasseur and D. Pellerin, 2015. Prevalence of and associated risk factors in Canadian Holstein-Friesian cows housed in freestall barns. Journal of Dairy Science, 98: 6978-6991.

16. Sadiq, M.B., S.Z. Ramanoon, R. Mansor, S.S. Syed-Hussain and W.S. Mossadeq, 2017. Prevalence of, claw lesions and associated risk factors in dairy farms in Selangor, Malaysia. Tropical Animal Health and Production, 49: 1741-1748.

17. Raber, M., C.J. Lischer, H. Geyer and P. Ossent, 2004. The bovine digital cushion-A descriptive anatomical study. The Veterinary Journal, 167: 258-264.

18. Sulayeman, M. and A. Fromsa, 2012. Lameness in dairy cattle: Prevalence, risk factors and impact on milk production. Global Vet., 8: 1-7.

19. Abunna, F., I. Zeben, H. Waketole and G. Mamo, 2017. Epidemiology of lameness in extensive and intensive dairy farms in Bishoftu town, central Oromia, Ethiopia. Biomirror, 8: 9-17.

20. Shearer, J.K. and S.R. Van Amstel, 2011. Lameness in dairy cattle. Dairy Production Medicine, pp: 233-253.