

Short Communication

The relationship between lameness and reproductive performance in dairy cows raised in small holder farms, Thailand

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Received: 4 November 2018; Revised: 13 February 2019; Accepted: 8 April 2019

Abstract

The aim of this study was to investigate the relationship between lameness and reproductive performance in dairy cows. A retrospective case-control study was conducted at 20 farms in 326 cows with high prevalence (>30%) and at 20 farms in 331 cows with low prevalence (<10%) of lameness. Cows having a locomotion score ≥ 3 were classified as lame. Reproductive data were collected and analyzed. Calving to calving interval, calving to first service interval, services per conception, and pregnancy rate in lame cows were poorer than non-lame cows ($P < 0.05$). The severity of reproductive consequences was greater in high prevalence farms than in low prevalence farms. Cows classified as lame were 3.5 times more likely to be non-pregnant compared with non-lame cows ($P = 0.0001$). Attributable proportion analysis indicated that non-pregnancy in lame cows could have been reduced by 70% if lameness had been prevented.

Keywords: lameness, reproductive performance, dairy cow, small holder farm

1. Introduction

Lameness is considered to be one of the most important disorders in dairy cattle. The problem has negative impacts on both animal welfare and farm economy (Whay, Main, Green, & Webster, 2003). Most economic consequences caused by lameness result from involuntary culling (Hernandez, Shearer, & Webb, 2001; Sprecher, Hosteller, & Kaneene, 1997), long-term milk yield reduction (Green, Hedges, Schukken, Blowey, & Packington, 2002), increased labor, discarded milk (Enting, Kooij, Dijkhuizen, Huirne, &

Noordhuizen-Stassen, 1997), impaired reproductive efficiency, and the need for hormonal treatment for breeding management (Sogstad, Østerås, & Fjeldaas, 2006). Prolonged calving to first service interval, calving to conception interval (Orgel, Ruddat, & Hoedemaker, 2016), calving to calving interval, and increased number of services per conception (Alawneh, Laven, & Stevenson, 2011; Sogstad *et al.*, 2006; Sprecher *et al.*, 1997) were reported to be the effects on reproductive performance as consequences of lameness in cattle. These consequences will disrupt dairy farming operation because generally milk cannot be produced without getting pregnant.

Approximately 80% of Thai dairy farms are small holder farms run by family members and the number of lactating cows is less than 30 heads per farm (Department of

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Livestock Development [DLD], 2018). The western part of Thailand is a large dairy industry area. Housing is one of the major underlying factors of lameness. The tie-stall system has been generally used in western Thailand for more than 60 years. In a tie-stall barn, the lying, standing, milking, and feeding areas are restricted to one place. Kara, Galic, and Koyuncu (2011) reported a higher mean locomotion score in cows raised in a tie-stall system compared to cows raised in a free-stall system. A study in Thai dairy farms also found that the tie-stall system was a risk factor for lameness. The mean prevalence of lameness in lactating cows found in that study was 22% and ranged from 0% to 70% (Wongsanit, Srisomrun, Kananub, Panneum, & Arunvipas, 2015). However, a study conducted in Malaysian dairy farms reported an average lameness prevalence of 19% that ranged between 10% and 33% in each farm (Sadiq, Ramanoon, Mansor, Syed-Hussian, & Mossadeq, 2017). Despite the knowledge that lameness has detrimental effects on reproductive performance, limited studies have examined the relationship between lameness and reproductive performance in small holder farms. Therefore, our study was performed to reveal the consequences of lameness on reproductive performance in small holder dairy farms.

2. Materials and Methods

2.1 Study design

A retrospective case-control study was conducted using the herd prevalence of lameness obtained from a previous study (Wongsanit *et al.*, 2015). Twenty farms with a high prevalence of lameness (>30%) were defined as cases and 20 farms with a lameness prevalence of <10% were defined as controls. A locomotion score was assigned to all lactating cows in these farms during a regular farm visit regardless of their days in milk. The 5-point scoring system developed by Sprecher *et al.* (1997) was used. Cows scoring ≥ 3 were classified as clinically lame. All claw lesions were recorded on the chart developed by Kasetsart University Veterinary Teaching Hospital to identify claw lesions during hoof trimming. Characteristics of the herds and cows were collected from dairy farmers during the visit.

All reproductive data were retrieved from the history recorded by the Farm Service Unit, Kasetsart Veterinary Teaching Hospital Nong Pho. Calving to calving interval, calving to first service interval, services per

conception, and pregnancy rate were calculated. Data from dairy cows with clinical reproductive problems, mastitis, and other illnesses were excluded from the analyses.

2.2 Statistical analyses

All reproductive parameters of interest were analyzed with descriptive statistics. The student *t*-test was used to compare the differences of the means of reproductive parameters. A conditional logistic regression model was used to estimate the effect of lameness on pregnancy. A *P*-value <0.05 was considered statistically significant. All analyses were conducted using the statistical software package STATA (version 13.0, Stata Corp., College Station, TX, USA).

3. Results

The mean number of lactating cows per farm was 16 ± 16 and all cows were crossbred Holstein-Friesian. A total of 765 dairy cows were screened for the study. Three hundred and sixty-two cows were in high prevalence farms and 403 cows were in low prevalence farms. Data from dairy cows with clinical reproductive problems ($n=98$), clinical mastitis ($n=2$), and other clinical illnesses ($n=8$) were excluded. The final dataset included 657 dairy cows: 326 cows in high prevalence farms and 331 cows in low prevalence farms. Based on calving to calving interval, calving to first service interval, services per conception, and pregnancy rate, lame cows in high prevalence farms had poorer reproductive performance compared to non-lame cows. In low prevalence farms, calving to calving intervals and calving to first service intervals were higher in lame than non-lame cows. The pregnancy rate of lame cows tended to be lower than non-lame cows, whereas services per conception were not statistically different in low prevalence farms. Overall, the severity of reproductive consequences was greater in high prevalence farms than in low prevalence farms (Table 1).

Claw lesions found in the study population were white line disease (WL) (61.2%), bruise sole (30.6%), sole ulcer (SU) (24.5%), double sole (16.0%) and white line separation (15.8%). Cows diagnosed with WL and SU had 67 and 63 days longer of calving to calving intervals, respectively. Calving to first service intervals of cows with WL and SU were longer than cows without the lesions by 58 and 31 days, respectively. The mean services per conception increased 1.0 time in cows with both lesions. Pregnancy rates

Table 1. Reproductive indices of lame and non-lame cows in high and low lameness prevalence herds.

Reproductive indices	High lameness prevalence herds		Low lameness prevalence herds	
	Lame cows	Non-lame cows	Lame cows	Non-lame cows
Calving to calving interval (days)	513 \pm 124 ^A	440 \pm 101 ^B	529 \pm 100 ^A	441 \pm 84 ^B
Services per conception(times)	2.98 \pm 2.4 ^A	2.06 \pm 1.5 ^B	2.0 \pm 1.4	1.65 \pm 1.2
Calving to first service interval (days)	152 \pm 122 ^A	97 \pm 78 ^B	137 \pm 71 ^a	102 \pm 54 ^b
Pregnancy rate (%)	21 ^A	40.5 ^B	44 ^c	60 ^d

^{A,B} Values with different superscripts within the same row differ significantly ($P < 0.001$)

^{a,b} Values with different superscripts within the same row differ significantly ($P < 0.05$)

^{c,d} Values with different superscripts within the same row differ significantly ($P < 0.10$)

of cows with WL and SU were 19.0% and 23.5%, while the rate of non-lame cows was 53.2%.

The proportion of pregnant cows was higher than non-pregnant cows in farms having low prevalence of lameness. On the contrary, the proportion of pregnant cows was lower than non-pregnant cows in high prevalence farms (Table 2). Cows in high prevalence farms were 3.2 times more likely to be non-pregnant compared with cows in low prevalence farms ($P=0.001$). When cows were categorized by lameness status, the proportion of pregnant cows was higher than non-pregnant cows in the non-lame group, while in the lame group most cows were non-pregnant (Table 3). Cows classified as lame were 3.5 times more likely to be non-pregnant compared with non-lame cows ($P=0.0001$). Attributable proportion analysis indicated that non-pregnancy in high lameness prevalence farms and in lame cows could be reduced by 43% and 70%, respectively, if lameness had been prevented.

Table 2. Numbers of pregnant and non-pregnant cows in high and low lameness prevalence herds.

Pregnant	Prevalence of lameness within herd		Total n (%)
	Low (0), n (%)	High (1), n (%)	
Non-pregnant (0)	135 (40.8)	224 (68.7)	359 (54.6)
Pregnant (1)	196 (59.2)	102 (31.3)	298 (45.4)
Total	331 (100)	326 (100)	657 (100)

Table 3. Numbers of pregnant and non-pregnant in lame and non-lame cows.

Pregnant	Lameness		Total n (%)
	Non-lame cows (0) n (%)	Lame cows (1) n (%)	
Non-pregnant (0)	223 (46.7)	136 (75.6)	359 (54.6)
Pregnant (1)	254 (53.3)	44 (24.4)	298 (45.4)
Total	477 (100)	180 (100)	657 (100)

4. Discussion

Poor reproductive performance in lame cows was found in small holder dairy farms regardless of the prevalence of lameness problem within the farm based on prolonged intervals from calving to calving and calving to first service, increased number of services per conception, and decreased pregnancy rate. All findings support the undesirable effects of lameness on reproduction reported by many researchers.

Sprecher *et al.* (1997) reported that cows considered lame before the end of a voluntary waiting period had impaired reproductive performance compared with non-lame cows. A study conducted in German dairy herds reported harmful effects of lameness on reproductive performance of cows, including calving to first service interval, calving to conception interval, and the ability to conceive within the first month of lactation (Orgel *et al.*, 2016). Whereas, Barkema, Westrik, van Keulen, Schukken, and Brand (1994) reported

longer calving to first service interval and first service to conception interval in cows having lameness than cows without lameness. In Thailand, a study conducted in small holder farms in the northeast part revealed that calving to conception interval in cows with subclinical laminitis was higher compared with cows without laminitis, which were 134.1 days and 119.8 days, respectively (Seesupa, Kanistanon, Pilachai, & Aiumlamai, 2016). Hernandez *et al.*, (2001) found that lame cows with claw lesions were 0.52 times less likely to conceive compared to cows without claw lesion, which is obviously higher than 0.29 times less likely to conceive in lame cows found in our study. Our study found that cows affected with lameness had 73–88 days longer of calving to calving interval compared to that of non-lame cows, which was higher than results reported by a Pennsylvania study (Lee, Ferguson, & Galligan, 1989). These differences are possibly due to dissimilarities of management practices and other factors influencing reproductive performance among the studies.

Several lesions of claws and limbs, such as heel-horn erosion, sole hemorrhage, and sole ulcer, were found to be associated with poor reproductive indices (Sogstad *et al.*, 2006). According to Charfeddine and Pérez-Cabal (2016), WL had a distinct detrimental impact on the reproductive performance of cows. Longer calving to calving intervals and calving to first service intervals, higher service per conception, and lower pregnancy rates in cows with WL than cows without WL were found in our study.

There have been many mechanisms to explain poor reproductive performance contributed by lameness. Garbarino, Hernandez, Shearer, Risco, and Thatcher (2004) found that lame cows were 3.5 times more likely to have delayed resumption of ovarian activity compared to non-lame cows during the early postpartum period. If lameness had not occurred, more than 70% of impaired ovarian activity would be prevented. Some studies found normal follicular growth in lame cows; however, ovulation was less likely to occur in these cows compared to non-lame cows (Morris *et al.*, 2009; Morris *et al.*, 2011; Sood, Nanda, & Singh, 2009). Less obvious estrus behavior in lame cows compared to non-lame cows was also reported (Morris *et al.*, 2011; Sood & Nanda, 2006), which might be due to a reduced response to estradiol as a result of decreased priming of progesterone (Fabre-Nys & Martin, 1991). In addition, lame cows normally spent longer lying time than non-lame cows (Nechanitzky *et al.*, 2016), thus estrus behavior may be difficult to detect in lame cows. Morris *et al.* (2011) reported that when estrus behavior was detected in lame cows, standing heat was found earlier in relation to ovulation time. Thus, insemination that was too early was possibly partially responsible for poor reproductive performance in lame cows as well.

Increased plasma cortisol resulting from pain and stress of claw lesions disrupts normal reproductive hormone releases (Dobson & Smith, 2000), which consequently affects the intensity of estrus behavior and oocyte production (von Borell, Dobson, & Prunier, 2007). A negative energy balance due to reduced feed intake in lame cows might be another explanation for undesirable reproductive efficacy (Garbarino *et al.*, 2004). In the case of nutritional-related lameness, endotoxins might partly be responsible for impaired reproductive performance (Seesupa *et al.*, 2016).

As described above, lameness is an important factor affecting reproductive performance by delaying ovarian activity as well as inhibiting estrous behavior from various processes. Results of the study reported here revealed that non-pregnancy in lame cows may be reduced by 70% if lameness can be prevented.

5. Conclusions

Our study showed that lameness had detrimental effects on reproductive performance in dairy cows raised in small holder farms. Therefore, optimizing claw health by appropriate preventive measures and early detection of claw and limb disorders are necessary to minimize reproductive consequences of lameness.

Acknowledgements

Financial assistance of this study was supported by Kasetsart University Development and Research Institute (KURDI) project 108-52. We thank all dairy farmers who participated in this study.

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