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Associations between decreased fertility and management factors, claw health, and somatic cell count in Swedish dairy cows

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ABSTRACT

The aim of this retrospective single-cohort study was to investigate if a rapid change in feeding, management, or housing or an increasing incidence of claw diseases or udder health problems is associated with decreased reproductive performance. Data on individual cows and herds were retrieved from the Swedish official milk recording system and questionnaire data on feeding system was obtained from the regional dairy associations. In total, 63,561 cows in 759 herds were included in the study. The associations between the probability of pregnancy at first insemination and number of inseminations per animal submitted for artificial insemination and potential predictor variables were investigated using a logistic regression model and a Poisson regression model, respectively. The results indicated that cows with severe claw lesions or an increasing somatic cell count after calving had a lower probability of pregnancy at first insemination and had a higher number of inseminations per animal submitted for artificial insemination than healthy cows. Variables representing a change in housing, production system, or milking system within the period from 6 mo before calving until establishment of a new pregnancy were significantly associated with decreased reproductive performance. No differences in fertility were observed between cows milked in an automatic milking system compared with cows milked conventionally. The results indicate that a change of system, rather than the actual type of milking or housing system negatively affects reproductive performance. Special attention should therefore be paid to the fertility of cows when the herd management is changing. It is also important to prevent claw lesions and increasing cell counts after calving to avoid a decrease in reproductive performance.

Key words: total mixed ration, automatic milking system, loose-housing system, risk factor

INTRODUCTION

In recent decades, studies have shown an ongoing negative trend in dairy cow fertility worldwide (Lucy, 2001), including Europe and Sweden (Rodriguez-Martinez et al., 2008). In parallel, rapid technical progress and structural changes are occurring in the dairy industry. Between 2005 and 2011, the number of Swedish dairy herds was reduced by approximately 40% and the average size of the remaining 5,260 herds increased from 46 to 65 cows (Swedish Board of Agriculture, 2012). At the same time, cows are increasingly being kept in loose-house systems, being given TMR or partial mixed rations (**PMR**), and being milked in automatic milking systems (**AMS**). In 2004, 80% of the world's AMS were installed in northwest Europe (Koning and Rodenburg, 2004) and 755 AMS had been installed in Sweden by 2010 (Lakic, 2011).

Keeping larger herds of cows in loose-housing systems may increase the risk of several diseases, such as claw diseases or lameness (Bergsten and Herlin, 1996; Kujala et al., 2009) and the incidence of subclinical mastitis (Hovinen et al., 2009). In turn, both claw diseases and subclinical mastitis have been shown to be risk factors for decreased fertility (Hultgren et al., 2004; Lavon et al., 2011). The feeding of the cows and their energy balance may also influence their reproductive performance (e.g., see Friggens, 2003). Concerns have been raised that TMR feeding throughout the lactation may decrease fertility due to cows being overconditioned at calving (Spörndly, 2005). These concerns are partially supported by Danish findings that cows fed a high-energy-density TMR from 100 d before expected calving had a higher BCS after calving, and a more severe negative energy balance than cows fed a low-energy-density TMR (Nielsen et al., 2010). Finally, little is known about the effects of AMS on fertility (Jacobs

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and Siegford, 2012). The aim of this study was to investigate if the negative trend in reproductive performance of Swedish dairy cows can be linked to the new feeding, management, or housing systems, or to occurrence of claw diseases or udder health.

MATERIALS AND METHODS

Study Design

The study was designed as a retrospective single-cohort study and is here reported according to the strengthening the reporting of observational studies in epidemiology (STROBE) statement (von Elm et al., 2007). It used a data set retrieved from the Swedish official milk recording scheme (**SOMRS**; Olsson et al., 2001) that was merged with complementary data on feeding management collected from a questionnaire to feed advisors. We included herds with more than 60 calving cows per year and cows calving from March 1, 2010, to February 28, 2011. The cow was the unit of interest. Each cow was followed from 6 mo before her first calving, occurring within the defined time period until the next calving or until she left the herd non-pregnant. If none of these events had occurred earlier, the follow-up period ended at the day of data retrieval (May 1, 2012).

Data Collection

Data from SOMRS. We retrieved data from SOMRS on individual identity, breed, parity, and calving date for the cows calving within the period of interest. We also retrieved dates of inseminations, dates and results of gynecological examinations, records of claw health from claw-trimming events (Eriksson, 2006), and information on dates and reasons for a cow leaving the herd, as well as individual monthly test-day milk yield and SCC. Finally, herd-level data, including housing, type of milking, and production system [i.e., whether the herd was organic and certified according to KRAV (Uppsala, Sweden) standards; KRAV, 2013], as well as dates of potential changes in system, were retrieved.

The Questionnaire. A questionnaire was sent to the directors of the farm advisory services at the 7 regional dairy associations in Sweden who further distributed it to the local farm advisors of each region. The questionnaire collected data on type of feeding system and on type of feeding advice provided in the herds of interest. More specifically, the questionnaire investigated whether the cows were fed TMR (i.e., all roughages and concentrates mixed and fed ad libitum; individual concentrate doses <1 kg/d during milking not included), PMR (i.e., some of the roughages and concentrates mixed and fed ad libitum, but >1 kg of concentrates per day fed individually and separately from roughage), or individual feeding [separate (**SEP**) feeding; i.e., all roughages and concentrates fed separately and concentrates fed to cows individually]. A question on whether the herds received monthly feed advice based on milk yield and BCS in all cows was also included.

Data Management

The Outcome Variables. Two measures of reproductive performance were edited from the SOMRS data and further evaluated as outcomes; the dichotomous variable pregnant (or not pregnant) to first AI (**PAI**) and the count variable number of inseminations per animal that was submitted for AI (**NINS**). An AI event was considered to lead to establishment of pregnancy if it was followed by calving within 270 to 290 d. When information on a subsequent calving was missing, the AI was also considered successful if followed by a rectal palpation or ultrasound examination confirming the pregnancy. All cows, for which information on whether she was pregnant or not to first AI were available were included in the analyses of PAI (n = 58,975). All cows that had a minimum of 1 AI recorded within 30 to 365 DIM were included in the analyses of NINS (n = 63,561).

The Predictor Variables. Breed, calving season, claw status, the interval from calving to first AI (**CFI**), individual kilograms of ECM at the first test day after calving, 2 measures of SCC, and parity were evaluated as potential cow-level predictors of the outcomes, and were all retrieved from the SOMRS data. Breed was included using the 3 categories Swedish Red, Swedish Holsteins, or other breed. Calving season indicated whether a cow calved in winter (December–February), spring (March–May), summer (June–August), or autumn (September–November). The CFI interval was categorized as early (<60 DIM), medium (61–100 DIM), or late (>100 DIM) according to the 25th and 75th percentiles of the distribution in the study population. Claw status was categorized as no or mild lesion, severe lesion, or no trimming record available in SOMRS. The category no or mild lesion was used if the cow had been trimmed but recorded as "claw status ok," or if dermatitis (both digital dermatitis and the harmless interdigital dermatitis), heel horn erosion, or mild sole hemorrhages were recorded. Severe lesion represented severe sole hemorrhage, sole ulcer, double sole, claw abscess, or white line disease. The categories were chosen based upon the most common reasons for lameness in Swedish dairy cows (C. Bergsten, Swedish University of Agricultural Sciences, Alnarp, Sweden,