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Association Between Reproduction and Postpartum Cow Health during Summer Months in Dairies Located in the Great Plains Region

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Summary

Postpartum cow health has an impact on fertility of dairy cows, and impaired fertility in dairy herds ultimately influences profitability of dairy farms. During summer months, postpartum cow health and reproductive performance are affected in dairies located in the Great Plains region. The goal for this study was to evaluate farm-level associations between reproductive efficiency and postpartum cow health in dairy herds located in the Great Plains region. Data from June to August of 2010 to 2016 from 18 herds located in Colorado, Kansas, Oklahoma, Nebraska, and Texas were extracted. Overall pregnancy per AI was used as the measure of reproductive efficiency, and percentage of stillbirth cases, mastitis within 21 d after calving, and cows sold and cows dead within 60 d after calving were used to evaluate postpartum cow health and performance. Using the intercept and slopes from a logistic regression model, a transition cow index was created. Poor herd fertility, pregnancy per AI < 30%, was associated with percentage of stillbirth events and postpartum mastitis cases. In 93% of the instances that herds had pregnancy per AI < 30%, transition cow index was less than 0. This study demonstrates that fertility is associated with transition cow performance at the herd level during summer months in dairies located in the Great Plains region.

Introduction

The Great Plains region of the United States encompasses the following states: Colorado, Kansas, Oklahoma, Montana, Nebraska, New Mexico, South Dakota, North Dakota, Texas, and Wyoming. According to the U.S. Department of Agriculture's Economic Research Service, the number of dairy cows in this region was 1,335 million in 2016, which corresponded to 14.3% of the U.S. dairy herd. The majority of dairy farms located in this region are in the southern portion of the Great Plains and in semi-arid climates, where elevated temperatures are observed during summer months. In addition to heat stress, presence of flies and rain events may be additional stressors for dairy cows because rainfall in this area is mostly concentrated during summer.

It is well documented that reproductive efficiency and postpartum performance of dairy cows are affected under conditions of heat stress. Nonetheless, reports evaluating the

association between reproductive performance and postpartum health at the farm level during summer are lacking. The objective of this study was to evaluate herd-level associations between reproduction and postpartum cow health during periods of exposure to environmental stress in dairies located in the Great Plains region.

Experimental Procedures

Records of reproductive efficiency and cow health from multiparous cows (lactation > 1) from 18 herds were used in this study. Most of the herds are enrolled in the Dairy Records Intelligence Network (DRINK) program. Data from 2010 to 2016 for the months of June, July, and August were extracted from the herds' on-farm management software. Herds were located in Colorado, Kansas, Oklahoma, Nebraska, and Texas.

Pregnancy per Artificial Insemination

Number of cows inseminated and pregnant for each herd were extracted from 2010 to 2016. For each year, herd pregnancy per AI (P/AI) was calculated by dividing the number of pregnant cows by the number of cows inseminated from June to August.

Transition Cow Health

Number of calvings, stillbirth events, first cases of mastitis within 21 d after calving, cows sold within 60 d after calving, and cows dead within 60 d after calving were extracted to calculate the percentage of stillbirth, postpartum mastitis, cows sold, and cows dead in early lactation for each herd each year. Percentages of stillbirth, mastitis, cows sold, and cows dead were calculated by dividing the number of cases by the number of cows that calved from June to August.

Model to Evaluate the Association Between Reproduction and Transition Cow Health

Data from 15 herds from 2010 to 2015 (70% of the dataset) were used to create a model to evaluate the association between P/AI and transition cow health. Pregnancy per AI $\geq$ 30% was used as a proxy for reproductive efficiency. Pregnancy per AI ($\geq$ 30% vs. < 30%) for each herd each year was analyzed by logistic regression using the GLIMMIX procedure of SAS (version 9.4, SAS Inst., Cary, NC). The model included the following variables: percentage of stillbirth, mastitis, cows sold, and cows dead. Year was included as a random variable in the model. The intercept and slopes obtained from the logistic regression model were used to create a transition cow index. Using the entire dataset (18 herds from 2010 to 2016), transition cow indexes were calculated for each year to plot P/AI and indexes across herds and years.

Results and Discussion

Average P/AI of multiparous cows during summer months from herds located in the Great Plains region was 25% (Figure 1). Herd 1 had the greatest average P/AI (35%) from 2010 to 2016, and herd 18 had the least average P/AI (18%). For some herds, P/AI was consistent across years. For example, from 2010 to 2016, herd codes 8 to 18 did not achieve P/AI $\geq$ 30% in any of the summers.

Percentage of stillbirth and postpartum mastitis across herds were 4.4 and 7.0%, respectively. Percentage of cows sold and dead within 60 d after calving were 6.3 and 4.2%,

respectively. Postpartum mastitis and percentage of cows sold were not ($P \geq 0.12$) associated with P/AI $\geq$ 30%. Proportion of cows having a stillbirth event or dead within 60 d after calving ($P \leq 0.03$) were negatively associated with P/AI $\geq$ 30%. Transition cow index for each herd from 2010 to 2016 is displayed in Figure 2. Similar to P/AI, a pattern for transition cow index was observed for some herds. Herds with greater P/AI had greater transition cow indexes. This association between reproduction and transition cow health may be related to heat stress conditions that cows are exposed to, although other environmental stressors are likely involved with the poor performance observed for some herds. Investments in dry- and lactating-cow facilities may improve herd performance during the summer, and in turn, improving P/AI and transition cow health during the summer is expected to have significant impact in profitability of dairy farms.

The association between transition cow index and P/AI is demonstrated in Figure 3. For 85% of the instances that herds achieved P/AI $\geq$ 30%, transition cow index was $\geq$ 0 (Table 1). Furthermore, 93% of the instances that herds had a transition cow index below 0, P/AI was < 30%. It is important to mention that transition cow index < 0 was chosen as an arbitrary cut-off. Nonetheless, in occasions that transition cow performance was subpar, reproductive efficiency was likely to be suboptimal. Even though reproductive efficiency must not be only determined by P/AI, overall P/AI during the summer should be > 30% to achieve acceptable reproductive performance. Although this dataset does not evaluate the direct impact of postpartum cow health on reproductive performance, it demonstrates that transition cow performance and P/AI are associated at the herd level. Furthermore, data from primiparous cows were not used in this study. Effects of heat stress on fertility and postpartum cow health may be more severe for older than first-lactation cows (primiparous vs. multiparous). Therefore, in this study, we evaluated herd-level associations focusing on cows that are most susceptible to be affected by stress during summer months.

In conclusion, herds that do not achieve acceptable reproductive efficiency from June to August probably do not observe adequate transition cow performance in the same period. It is likely that the negative impact of environmental stressors during summer may be ubiquitous to several areas in the dairy farm (e.g., dry-cow facility and milking-cow facility).

Table 1. Frequency of distribution [% (n)] according to pregnancy per AI (P/AI) and transition cow index from June to August of 2010 to 2016 from dairy herds

Transition cow index	P/AI ≥ 30%	P/AI < 30%	Total
Greater than or equal to 0	20% (23)	32% (37)	52% (60)
Less than 0	3% (4)	45% (52)	48% (56)
Total	23% (27)	77% (89)	100% (116)

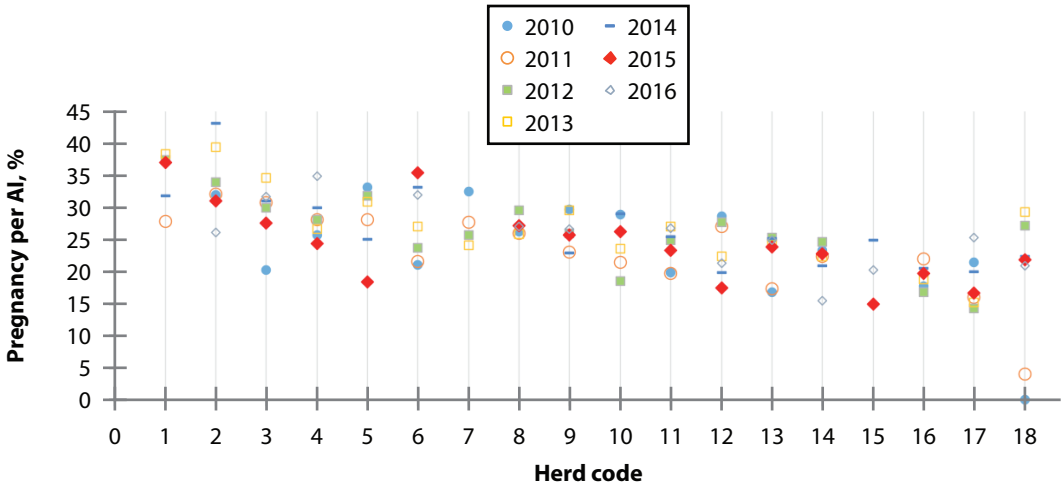

Figure 1. Pregnancy per AI of multiparous cows during summer months from herds located in the Great Plains region from 2010 to 2016. Herd code is ordered on the horizontal axis according to the average P/AI across the seven years.

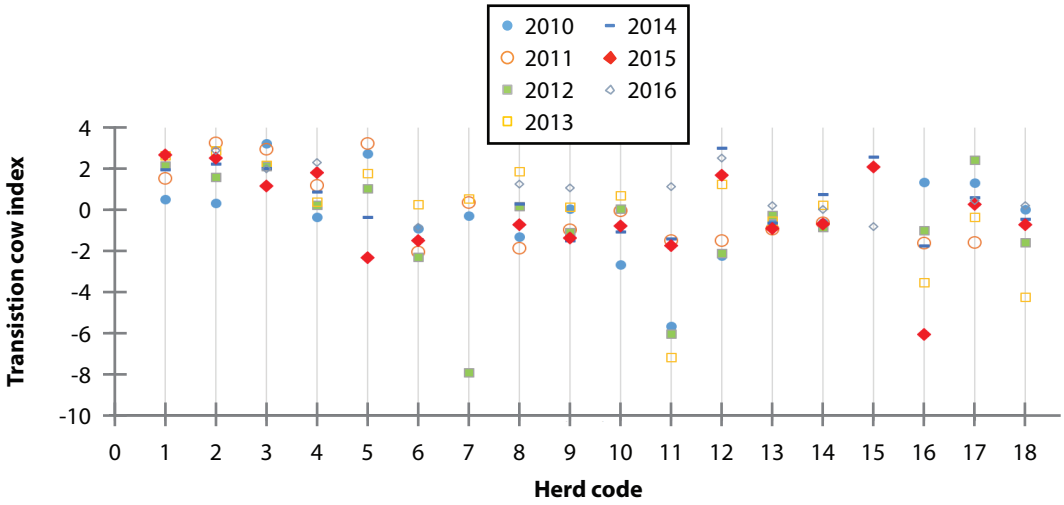

Figure 2. Transition cow index during summer months from herds located in the Great Plains region from 2010 to 2016. Intercept and slopes were obtained from the logistic regression model. Transition cow index = 5.7346 – 0.545 x percentage of stillbirth – 0.7437 x percentage of cows dead within 60 d after calving.

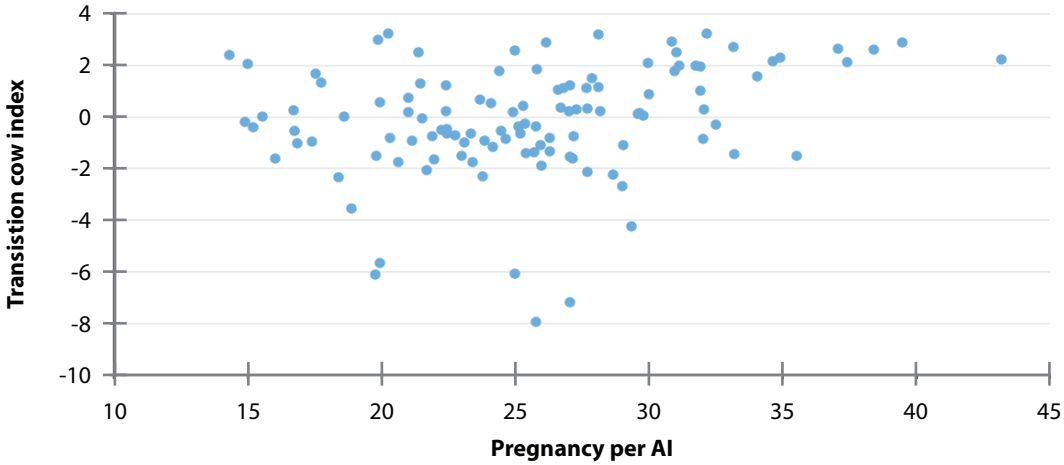

Figure 3. Transition cow index and pregnancy per AI during summer months from 18 herds from June to August of 2010 to 2016. Intercept and slopes were obtained from the logistic regression model.