Associations between health status and the probability of approaching a novel object or stationary human in preweaned group-housed dairy calves

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ABSTRACT

Neonatal calf diarrhea (NCD) and bovine respiratory disease (BRD) are the 2 most prevalent diseases affecting the welfare and productivity of preweaned dairy calves in the United States. Early detection of these diseases improves both the probability of recovery and animal welfare. Group housing of preweaned calves is increasing in popularity and disease detection in a socially competitive environment can be challenging. One method of detecting disease is through the observation of key behaviors that occur during illness. Novel object and stationary human approach tests can be used to measure exploratory behavior, which is decreased during the expression of sickness behavior. The objectives of this study were (1) to determine associations between 4 categories of health status and the probability of calves approaching a novel object or stationary human, and (2) to determine the associations between rectal temperature and the probability of calves approaching. Holstein heifer calves (n = 75) in group housing were tested weekly for the first 6 wk of life for their willingness to approach a novel object (OBJ) or stationary human (SH). After the approach tests, calves were evaluated by research staff using a standardized health-scoring system. Treatment records were obtained from the farm to determine detection of BRD, NCD, and umbilical infections. Associations between probability of approach and BRD status were analyzed using a linear mixed model with a logit-transform (PROC GLIMMIX), controlling for calf as a random effect. All models controlled for week, pen, pen order, and test order. Calves with clinical signs of BRD on test day were 0.5 [95% confidence interval (CI) = 0.3–0.9] and 0.5 (95% CI = 0.3–0.9) times as likely to approach the OBJ and SH compared with healthy calves, respectively. Calves with a fever (rectal temperature ≥39.4°C) were 0.4 (95% CI = 0.2–0.8) and 0.4 (95% CI = 0.1–0.7) times as likely to approach the OBJ and SH compared with calves without fever, respectively. Calves that were recovering from NCD on test day, but were not showing clinical signs of NCD, were 0.4 (95% CI = 0.2–0.9) times as likely to approach SH, compared with healthy calves. These results suggest that approach tests may be useful for the identification of calves with clinical signs of BRD and calves with a fever in group housing.
Key words: calf, behavior, bovine respiratory disease, neonatal calf diarrhea, welfare

INTRODUCTION

Neonatal calf diarrhea (**NCD**) and bovine respiratory disease (**BRD**) are the 2 most prevalent diseases affecting preweaned dairy calves in the United States. According to producer-reported information, NCD and BRD affect 23.9 and 12.4% of preweaned calves in the United States, respectively (USDA, 2010). Producers cited NCD and BRD as the causes for 56.5 and 22.5% of preweaned heifer deaths, respectively (USDA, 2010).

Neonatal calf diarrhea has been associated with BRD (Hultgren et al., 2008), an increased age at first calving (Waltner-Toews et al., 1986), reduced ADG (Windeyer et al., 2014), and may be painful (Todd et al., 2010). Bovine respiratory disease negatively affects the economic viability of a dairy and is associated with reduced growth (Virtala et al., 1996a; Stanton et al., 2012), increased likelihood of mortality (Waltner-Toews et al., 1986; Stanton et al., 2012), increased age at first calving (Waltner-Toews et al., 1986; Stanton et al., 2012), decreased calving ease (Stanton et al., 2012), and an increased risk of not completing the first lactation (Bach, 2011). Bovine respiratory disease and NCD may be accompanied by feelings of malaise, which can reduce animal welfare (Millman, 2007).

To minimize these consequences, methods to accurately and efficiently identify ill calves are needed. Producers are relatively capable of correctly identifying NCD or BRD, but have been shown to have poor sensitivity when considering overall illness identification (Sivula et al., 1996). In a cross-sectional study, farm

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treatment records were compared with results from standardized health scores; the sensitivity of farm for identification of BRD was 24%, which was calculated as the proportion of calves identified by research staff with BRD that were treated by the farm in the previous 7 d (M. C. Cramer and A. L. Stanton, unpublished data). This presents a challenge, as late detection of illness can reduce treatment success and increase the rate of recurrence (McGuirk, 2008).

Currently, several methods of disease identification exist, including examination of clinical signs of individual animals (McGuirk, 2008), detecting changes in feeding behavior data from automated feeders (Svensson and Jensen, 2007; Borderas et al., 2009), radio frequency technology (Quimby et al., 2001), and noninvasive infrared thermography (Schaefer et al., 2012). Whereas these methods represent options for disease detection, daily individual health exams may be time-consuming and the automated monitoring technologies may not be financially feasible for all farms. Therefore, alternative methods of disease detection are needed.

The observation of calf behavior may facilitate detection of disease. Sickness behavior is a term that is used to describe characteristic changes in behavior that occur as a result of physiologic changes associated with illness. The behavioral changes may include lethargy, increased lying time, isolation from other animals, and decreased grooming, appetite, exploratory behavior, and interest in novelty (Hart, 1988; Haba et al., 2012). Observation of these behavioral changes represents an opportunity for a low-cost method of disease detection.

Object and human approach tests have been used in adult cattle to examine temperament and fear responses (e.g., Gibbons et al., 2009) and in heifer calves from 2 to 6 wk of age (Lauber et al., 2006). However, these were performed in an unfamiliar environment and the effect may be different when performed in a familiar environment because fear and exploratory behavior can be competing motivations (Murphy and Wood-Gush, 1978). Exploratory behavior toward a novel object is decreased when mice are injected with LPS, which induces sickness behavior (Haba et al., 2012). Therefore, a modified approach test may provide a potential method to measure changes in exploratory behavior in preweaned dairy calves that are due to illness. To our knowledge, the relationship between approach tests and illness has not been studied in cattle. Thus, the objectives of the current study were to (1) determine the associations between 4 categories of health status on the probability of approaching a novel object or stationary human and (2) to determine the associations between rectal temperature on the probability of approaching and a novel object or stationary human.

MATERIALS AND METHODS

Animals and Housing

The Animal Care and Use Committee at the University of Wisconsin-Madison approved all procedures in our study (protocol A01516–0-09–12). The study was conducted on a commercial dairy (consisting of 2 source farms) containing 3,700 lactating cows in Wisconsin. Holstein heifer calves (n = 79) were enrolled upon entry into 1 of 8 pens where they were housed in stable groups of 8 to 10 calves throughout the trial. No random assignment to pen was carried out because the farm filled each pen as calves were born. Calves were enrolled in 2 cohorts over a period of 2 wk. Calves entered the pens between one and 2 d of age and were monitored for 6 wk. Each pen measured 3.7×3.8 m and contained 1 water dish and 2 nipple feeders. The distance between the 2 nipples was 75 cm. Pen flooring consisted of slats covered with a rubberized material (Cozy Calf Cribs, Blue Diamond Industries LLC., Strawberry Point, IA). The back portion (3.7×2.6 m) of the pen had flooring with supplemental heat whereby hot water ran through steel pipes attached to the bottom of the flooring system. Calves were offered acidified waste milk ad libitum; milk was acidified to a pH of 4.0 to 4.5 using formic acid, reheated to 21 to 38°C, and pumped from the milk reservoir through plastic tubing to nipples in the pens, which contained one-way valves based on the method of Anderson (2013). Calves were weaned when calves in the pen averaged 6 wk of age. The farm weaned calves over a period of 5 d by decreasing the amount of time milk was available. No milk intake data were available for this system.

Data Collection

Weekly farm visits by research staff consisted of administering approach tests followed by a standardized health score, height (Calf height stick, Nasco, Fort Atkinson, WI), weight (Holstein dairy calf weigh tape, Nasco), and a blood sample via jugular venipuncture for a separate study. Enrollment of calves took place over 2 wk with 52 and 27 calves enrolled during the first and second farm visit, respectively. Research staff observed calves weekly for the first 6 wk of life. Test day refers to the day that research staff visited the farm for health assessments and approach tests.

Behavioral Assessments. All approach tests were performed before health examinations. Two approach tests were used: novel object (**OBJ**) and stationary human (**SH**). For each test, calves were given 60 s to approach. For OBJ, a single researcher entered each pen