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Exploring the value of routinely collected herd data for estimating dairy cattle welfare

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ABSTRACT

Routine on-farm assessment of dairy cattle welfare is time consuming and, therefore, expensive. A promising strategy to assess dairy cattle welfare more efficiently is to estimate the level of animal welfare based on herd data available in national databases. Our aim was to explore the value of routine herd data (RHD) for estimating dairy cattle welfare at the herd level. From November 2009 through March 2010, 7 trained observers collected data for 41 welfare indicators in a selected sample of 183 loose-housed and 13 tethered Dutch dairy herds (herd size: 10 to 211 cows) using the Welfare Quality protocol for cattle. For the same herds, RHD relating to identification and registration, management, milk production and composition, and fertility were extracted from several national databases. The RHD were used as potential predictors for each welfare indicator in logistic regression at the herd level. Nineteen welfare indicators were excluded from the predictions, because they showed a prevalence below 5% (15 indicators), or were already listed as RHD (4 indicators). Predictions were less accurate for 7 welfare indicators, moderately accurate for 14 indicators, and highly accurate for 1 indicator. By forcing to detect almost all herds with a welfare problem (sensitivity of at least 97.5%), specificity ranged from 0 to 81%. By forcing almost no herds to be incorrectly classified as having a welfare problem (specificity of at least 97.5%), sensitivity ranged from 0 to 67%. Overall, the best-performing prediction models were those for the indicators access to at least 2 drinkers (resource based), percentage of very lean cows, cows lying outside the supposed lying area, and cows with vulvar discharge (animal based). The most frequently included predictors in final models were percentages of on-farm mortality in different lactation stages. It was concluded that, for most welfare indicators, RHD have value for estimating dairy cattle welfare. The RHD can serve as a prescreening tool for detecting herds with a welfare problem, but this should be followed by a verification of the level of welfare in an on-farm assessment to identify false-positive herds. Consequently, the number of farm visits needed for routine welfare assessments can be reduced. The RHD also hold value for continuous monitoring of dairy cattle welfare. Prediction models developed in this study, however, should first be validated in additional field studies.

Key words: animal welfare, herd data, monitoring, Welfare Quality

INTRODUCTION

Because farm animal welfare is high on political and societal agendas of many countries, pressure exists to establish welfare assurance programs in which farm animal welfare is routinely assessed. These programs require the use of on-farm animal welfare assessments, in which farms are visited and assessed against compliance with a set of animal welfare criteria. Routine on-farm assessment of dairy cattle welfare, however, is time consuming and, therefore, expensive (Knierim and Winckler, 2009; Blokhuis et al., 2010). This is especially true when on-farm assessments use mainly animal-based indicators, which are increasingly preferred over resource-based indicators because they are more closely linked to the welfare of animals (Webster et al., 2004). The Welfare Quality assessment protocol for dairy cattle, for example, in which the majority of indicators is animal based, takes about 4.4 to 7.7 h for herds of 25 to 200 cows (Welfare Quality, 2009). The time and consequent costs of on-farm assessment protocols may inhibit their use in welfare assurance programs.

A promising, more efficient strategy may be to estimate the level of animal welfare based on national herd databases, leading to a reduction in the number of on-farm assessments. Especially in developed countries, all kinds of data are routinely collected from dairy farms, relating, for example, to identification and registration, milk quality, productivity, and fertility. Various studies have shown univariable associations between these rou-

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tine herd data (**RHD**) and dairy cattle welfare indicators (**WI**; de Vries et al., 2011). Milk yield, for example, has been associated with body condition, water intake, lameness, integument alterations, social behaviors, and various indicators of disease (e.g., Steiger Burgos et al., 2001; Phillips and Rind, 2002; Bareille et al., 2003; Haskell et al., 2006; Bicalho et al., 2008; Roche et al., 2009). Therefore, RHD might provide a continuous, easy, and inexpensive opportunity to estimate the level of animal welfare on farms. Because WI are often associated with various RHD, it has been suggested that the potential of RHD for estimating dairy cattle welfare may increase when they are combined in multivariable analyses (de Vries et al., 2011). To determine its suitability for practical application, this potential should, therefore, be evaluated in an observational study at the herd level.

To our knowledge, only 2 studies have explored the value of RHD for estimating dairy cattle welfare in an observational study at the herd level, using multivariable analyses. Sandgren et al. (2009) used RHD to identify herds with poor welfare in 55 Swedish dairy herds. A herd was considered to have poor welfare if it was among the 10% worst-scoring herds for at least 2 of 9 animal-based indicators assessed. Based on the same data set, Nyman et al. (2011) aimed to identify herds with good welfare, which were herds that were not among the 10% worst-scoring herds for any of the 9 animal-based indicators assessed. In both studies, sensitivity (**Se**) and specificity (**Sp**) were optimized, and used to evaluate performance of final prediction models. Sensitivity is the probability of correctly identifying a herd with poor welfare, whereas Sp is the probability of correctly identifying a herd with no poor welfare.

In our study, we included a larger number of dairy herds and more WI to evaluate the value of RHD for estimating dairy cattle welfare than Sandgren et al. (2009) and Nyman et al. (2011). We focused on the fact that a high Se, a high Sp, or an optimum value for both Se and Sp may be demanded in different decision-making contexts (Greiner et al., 2000). A high Se, for example, may be required when overlooking herds with poor welfare is considered unacceptable, whereas a high Sp may be demanded when costs of on-farm welfare assessments are a serious impediment. Optimizing both Se and Sp may be required if the purpose is to estimate welfare levels in a population for which the prevalence is unknown, or to monitor welfare over time. In these 3 contexts, RHD could be used as a prescreening, instant-assessment, or monitoring tool, respectively. However, a trade-off exists between Se and Sp (Dohoo et al., 2009). The higher the proportion of herds that are correctly identified as having poor welfare (i.e., high Se), for example, the higher the proportion of herds that are incorrectly identified as having poor welfare (i.e., more false positives, thus low Sp). These trade-offs must be evaluated to judge the value of RHD for different applications. Our aim, therefore, was to explore the value of RHD for estimating dairy cattle welfare at the herd level, by using different levels of Se and Sp.

MATERIALS AND METHODS

Sources of RHD

Both for herd selection and evaluation of their potential for estimating dairy cattle welfare, we used data from several national databases containing RHD relating to identification and registration, management, milk production, milk composition, and reproduction (Table 1). Data stored in these databases are routinely collected from Dutch dairy farms by the Dutch identification and registration (I&R) system, the rendering plant, the milk quality assurance company (participation legally required), the animal health service, and the cattle improvement syndicate (voluntary participation). Sampling frequency at the farm varies from continuous (e.g., slaughter date) to approximately 4 wk (e.g., individual milk yield), and registration is at the animal or the herd level, depending on the variable. These databases cover all Dutch dairy herds for most data, except for test-day milk recordings of the cattle improvement syndicate, which covers about 80% of all Dutch dairy herds.

Herd Selection

To properly evaluate the value of RHD for estimating dairy cattle welfare, we aimed for data from herds that span a wide range of levels of animal welfare. This wide range could be obtained by either visiting a large number of herds or by increasing the variation in the levels of welfare among herds. Because the number of farms that could be visited was limited, herds were selected to increase variation in the level of animal welfare. Because most WI and RHD were animal based, it was hypothesized that relations between WI and RHD would not much depend on the type of housing system. Therefore, herd selection was not restricted to a single type of housing system.

For approximately 5,000 herds in the RHD database participating in a health program of a Dutch dairy cooperative, we calculated a composite health score (**CHS**) between 0 (worst) and 50 (best). A CHS, for which RHD was used from January 2008 through June 2009, consisted of 5 variables that were expected to be associated with animal welfare [based on de Vries et al. (2011)]: cow and young stock mortality, bulk tank