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Estimation of prevalence and incidence of subclinical mastitis in a large population of Brazilian dairy herds

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ABSTRACT

The objectives of this study were to estimate the prevalence and incidence of subclinical mastitis (SM) in a large population of Brazilian dairy herds and to describe how these indices changed over time. A data set comprising individual cow somatic cell counts (SCC) from 18,316 test days (TD) of 1,809 herds that participated in a Dairy Herd Improvement Association (DHIA) program between January 2011 and May 2015 was available for analysis. Only tests that had ≥10 lactating cows and that were performed at 30 ± 10-d intervals were used for analysis. The final data set included 8,285 TD from 517 herds located in 5 regions of the country. Prevalence (%) of SM was defined as the number of cows with SCC ≥200,000 cells/mL divided by the total number of tested cows on a given TD. The incidence of SM was defined as the number of cows whose SCC increased from <200,000 to ≥200,000 cells/mL over 2 consecutive TD divided by the sum of each cow's days at risk during this interval, expressed as new cases per cow month at risk. Prevalence and incidence of SM were compared among years, regions, herd size categories, and frequency of DHIA testing during the study period. The overall mean prevalence and incidence of SM including all tests performed during the study period was 46.4% and 0.17 new cases per cow month at risk, respectively. The prevalence of SM varied little from 2011 to 2015, and an increasing trend was observed over the years. Prevalence was lower in herds that performed ≥60 DHIA tests during the study period than in those that performed fewer tests and was not different among regions or herd size categories. Incidence of SM varied little over the years and was not different among the regions studied. Prevalence and incidence of SM in the 517 herds studied were high and did not improve over the years. These trends were observed across all herd size categories and regions studied. Producers who had more DHIA tests performed per herd during the study period had lower prevalence of SM. Results of this study highlight the need to establish large-scale milk quality programs in Brazil.
Key words: udder health, milk quality, bovine mastitis, epidemiology

INTRODUCTION

Subclinical mastitis (**SM**) is the most prevalent disease of dairy cows. Although SM is characterized by the absence of clinical signs and milk can still be marketed, it results in several detrimental effects on dairy production, such as reduction in production and quality of milk and dairy products (Barbano et al., 2006). Estimation of epidemiologic indices is critical in mastitis control programs to study the dynamics of SM within the herd. Prevalence estimates the proportion of infected cows at a fixed point in time, and incidence estimates the rate of new IMI over time. Both indices are essential for determining the scope of mastitis problems in dairy herds and assessing the efficiency of control measures (Ruegg, 2003). Prevalence and incidence of SM have been estimated worldwide from monthly individual cow somatic cell counts (**SCC**) performed by DHIA laboratories. Composite milk SCC is an inexpensive test with enough accuracy to allow diagnosis and management of SM at the herd level; its sensitivity and specificity at a threshold of 200,000 cells/mL have been reported as between 73 and 89% and between 75 and 86%, respectively (McDermott et al., 1982; Dohoo and Leslie, 1991).

Results of regional studies performed in Brazil indicate a wide variation in the cow-level prevalence of SM: Pará, 15.6% (n = 9 herds; Oliveira et al., 2011); Bahia, 38.5% (n = 10 herds; Oliveira et al., 2010); Minas Gerais and São Paulo, 46.1% (n = 34 herds; Costa et al., 1999); Rio Grande do Sul, 53% (n = 16 herds; Ziech et al., 2013); Minas Gerais, 55.4% (n = 44

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herds; Cunha et al., 2015); and São Paulo, 63.6% (n = 5 herds; Bueno et al., 2002). Other researchers studied SM at the quarter level and reported prevalences ranging from 15.4% (Paraná, n = 17 herds; Saab et al., 2014) to 34.3% (São Paulo, n = 5 herds; Bueno et al., 2002). Few studies have reported the incidence of SM in Brazilian dairy herds. Oliveira et al. (2013) reported that the incidence of SM in Minas Gerais (n = 5 herds) was 33%.

Nonetheless, the studies conducted thus far were limited due to the inclusion of small samples of cows and herds and the selection of herds from specific regions of the country. Such characteristics limit extrapolation of the results to larger populations of herds. Another limitation of most previous studies is that both prevalence and incidence of SM were estimated using the California Mastitis Test, which uses a threshold of traces (slight reaction) to define a case of SM. The test has subjective interpretation and provides a less accurate estimate of SCC than cell counting, resulting in a greater proportion of errors, such as false-negative results (Brito et al., 1997; Fosgate et al., 2013).

Thus, new studies that include larger samples of herds and that are based on DHIA SCC are needed to quantify the scope of the mastitis problem in Brazil. Estimating the prevalence and incidence of SM and describing longitudinal changes would be valuable to government agencies, dairy industries, and milk producers for developing large-scale milk quality programs. The objectives of this study were to estimate epidemiological indices of SM (prevalence and incidence) in a large population of Brazilian dairy herds and to describe how these indices changed over time.

MATERIALS AND METHODS

Study Design, Selection of Herds, and Preparation of the Data Set

The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Sargeant and O'Connor, 2014) was used as a guideline to report the results of this study. This research was designed as a longitudinal retrospective study. The original data set comprised individual cow SCC (composite milk samples) from 18,316 TD of all herds (n = 1,809) that participated in a DHIA program between January 2011 and May 2015. Herds were located in 3 Brazilian regions: South (Paraná), Southeast (São Paulo, Minas Gerais, Rio de Janeiro, and Espírito Santo), and other (Pará, Goiás, Ceará, and Bahia). Herds were excluded (n = 3,742 tests from 1,188 herds) from the data set if they had ≤10 DHIA tests performed during the study period. Only DHIA tests that included ≥10 lactating cows and that were performed at 30 ± 10-d intervals were used for analysis (5,499 tests from 48 herds were excluded for these reasons).

For a given TD, it was possible that farmers sent milk samples from a fraction of the lactating cows as opposed to testing the entire lactating herd. To minimize this problem, herds with a large variation in the number of lactating cows in consecutive DHIA TD were excluded from the study. To identify these herds, the coefficient of variation of the number of lactating cows tested on each TD during the study period was calculated for each herd. Herds with a coefficient of variation ≥25% were excluded from the analysis (n = 790 tests from 56 herds). This cut-off point was defined based on the 90th percentile of the coefficient of variation distribution of all herds and therefore excluded 10% of the herds with the largest variation in the number of cows tested. After all exclusions, the final data set used for analysis included 8,285 TD from 517 herds.

To categorize herds based on size, the average number of cows tested during the study period was calculated for each herd. The distribution of herd size was then analyzed, and the 33rd and 66th percentiles were used to categorize herds as small (≤55 lactating cows), medium (55–120 lactating cows), or large (≥120 lactating cows). Herds were further categorized based on the distribution (33rd and 66th percentiles) of the number of DHIA tests performed during the study period (≤35, 35–60, and ≥60).

Definition of Epidemiological Indices

A threshold of 200,000 cells/mL was used to define a case of SM (Dohoo and Leslie, 1991). The prevalence (%) of SM was defined as the number of cows with SCC ≥200,000 cells/mL divided by the total number of tested cows on a given TD. The incidence of SM was defined as the number of cows whose SCC increased from <200,000 to ≥200,000 cells/mL over 2 consecutive TD divided by the sum of each cow's days at risk during this interval. Each case was assumed to have occurred at the middle of the interval between 2 consecutive tests (Dufour and Dohoo, 2013). For example, a cow that experienced a case of SM between 2 TD spaced by 28 d contributed with 14 d at risk. Cows that did not experience a case between 2 consecutive tests contributed the total number of days included in the interval. Because the time interval between 2 tests varied between 20 and 40 d, the incidence rate (expressed as new cases per cow day at risk) was standardized to 30.5 d and expressed as new cases per cow month at risk (Dufour and Dohoo, 2013).