

# Investigation of Risk Factors for Specific Lameness Disorders in a Southeastern US Dairy by Survival Analysis

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## Introduction

Besides the direct costs of treatment and culling, lameness can negatively affect production, reproduction, and udder health, making it one of the greatest causes of economic loss in the dairy industry. Thin soles (TS) are associated with hoof wear and wet conditions, which are prevalent in the hot humid summers of the Southeast. This condition may predispose cows to potentially more serious conditions including sole ulcers (UL) and white line disease (WLD). This study was undertaken to quantify these hoof problems, and investigate risk factors and interrelationship of conditions

## Materials and Methods

Data were lactation and hoof records collected from May 2004 through October 2007 on a large southeastern US dairy. Cows identified as lame were presented for treatment to hoof trimmers certified through the Master HoofCare program (Univ. of Florida). Disorders recorded included, WLD (zones 1-2), UL (zones 4-6), TS, sole punctures (SP), laminitis and leg injuries (INJ). Annual and seasonal incidence risks (IR) were calculated for WLD, TS, UL, SP and INJ. Survival analysis with time-dependent covariates for parity, season, stage of lactation and previous hoof events (WLD, UL, or TS) was used to analyze risk factors for WLD, UL and TS. Survival data were limited to records including a first calving to avoid left censoring.

## Results

The IR dataset included records for 4,915 cows and 3,977 hoof records. The most common lesions were UL (1,009), WLD (803) and TS (697); 249 INJ and 180 SP were also recorded. Annual IRs were 12.1%, 9.5%, 9.3%, 3.3% and 2.3% for UL, WLD, TS, INJ, SP, respectively. Seasonal risk was highest in the summer (SUM, July–Sept) and lowest in the winter (WNT, Jan–Mar) in all cases, with the greatest seasonal differences seen for TS and UL. The survival dataset included records for 2,672 cows. The 1,447 hoof records included 358 WLD, 333 TS

and 308 UL. Parity (i.e. number of calving events during equivalent risk periods) did not affect risk for WLD, UL, or TS. Season was a significant risk factor. Hazard ratios (HR) for WLD were 10.6 (SUM) and 4.5 (autumn; AUT) relative to WNT. For UL, HR relative to WNT were 7.3 (SUM) and 3.1 (AUT), and for TS they were 18.2 (SUM) and 4.3 (AUT). Some significant ( $P < 0.05$ ) stage of lactation effects were seen. The HR were calculated relative to mid lactation (60-149 DIM) when risk was lowest. For TS, the late lactation (240-304 DIM) HR was 2.3. For WLD, the early lactation ( $< 60$  DIM) HR was 2.7, later mid-lactation (150-239 DIM) HR was 2.6, and late lactation HR was 3.7. The HR for  $> 305$  DIM was 2.6, but was only marginally significant ( $P = 0.08$ ). No stage of lactation effects were seen for UL. The effects of previous conditions were calculated depending on how closely one event followed another and relative to risk with no prior event. Having any WLD, UL, or TS made it more likely that another event would be recorded within 15 days, and even more likely that one would be recorded from 16 to 30 days later. For both UL and WLD, the greatest increase in risk from TS was for TS recorded 31-45 days earlier (HR 5.1 and 7.2, respectively). Having a TS event greater than 45 days in the past also increased risk of both UL and WLD (HR 2.2 and 3.0, respectively). The only other significant effect for events greater than 30 days past was an increased risk (HR=3.0) of WLD from UL recorded 31 to 45 days previously.

## Significance

In the southeast, hoof problems are more common during or directly following the hottest, most humid months. The increased risk of having any event, following closely after another event, in any order is likely due to the fact that some cows have a greater overall risk for hoof problems under adverse conditions. The longer association of TS with later WLD and UL indicates that this is the logical path of influence (i.e. TS predisposes for WLD and UL). This is further evidenced by the seasonal pattern of TS being very concentrated in the summer, while risk of WLD continues to be almost as high through the fall.