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Changes in prevalence of, and risk factors for, lameness in random samples of English sheep flocks: 2004–2013

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ABSTRACT

The aims of this study were to update the prevalence of lameness in sheep in England and identify novel risk factors. A total of 1260 sheep farmers responded to a postal survey. The survey captured detailed information on the period prevalence of lameness from May 2012–April 2013 and the prevalence and farmer naming of lesions attributable to interdigital dermatitis (ID), severe footrot (SFR), contagious ovine digital dermatitis (CODD) and shelly hoof (SH), management and treatment of lameness, and farm and flock details.

The global mean period prevalence of lameness fell between 2004 and 2013 from 10.6% to 4.9% and the geometric mean period prevalence of lameness fell from 5.4% (95% CL: 4.7%–6.0%) to 3.5% (95% CI: 3.3%–3.7%). In 2013, more farmers were using vaccination and antibiotic treatment for ID and SFR and fewer farmers were using foot trimming as a routine or therapeutic treatment than in 2004.

Two over-dispersed Poisson regression models were developed with the outcome the period prevalence of lameness, one investigated associations with farmer estimates of prevalence of the four foot lesions and one investigated associations with management practices to control and treat lameness and footrot. A prevalence of ID > 10%, SFR > 2.5% and CODD > 2.5% were associated with a higher prevalence of lameness compared with those lesions being absent, however, the prevalence of SH was not associated with a change in risk of lameness.

A key novel management risk associated with higher prevalence of lameness was the rate of feet bleeding/100 ewes trimmed/year. In addition, vaccination of ewes once per year and selecting breeding replacements from never-lame ewes were associated with a decreased risk of lameness. Other factors associated with a lower risk of lameness for the first time in a random sample of farmers and a full risk model were: recognising lameness in sheep at locomotion score 1 compared with higher scores, treatment of the first lame sheep in a group compared with waiting until >5 were lame, treatment of lame sheep within 3 days, ease of catching lame sheep and quarantine for > 21 days. A previously known factor associated with a lower risk of lameness was footbathing to prevent ID. We conclude that the prevalence of lameness in sheep in England has fallen and that this might be in part because of increased uptake of managements recently reported as beneficial to control lameness. Routine foot trimming should be avoided.

1. Introduction

Lameness costs the sheep industry in GB £24–£80 million per annum (Nieuwhof and Bishop, 2005; Wassink et al., 2010). Financial losses occur because of reduced rates of lambs born and reared, and slower growth rates of lame lambs (Wassink et al., 2010).

In 2004 a random sample of 3000 English sheep farmers were sent a one year retrospective questionnaire requesting information on types of foot lameness (Kaler and Green, 2008) and management of lameness in their flock (Kaler and Green, 2009). A total

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of 809 (27%) farmers replied after two reminders. The geometric mean prevalence of lameness was 5.4% (95% CI 4.7%–6.0%) and the global mean prevalence of all lameness was 10.6% with an estimated 6.9%, 3.7%, 2.4%, 1.9%, 0.9% and 0.8% of the sheep lame with at least one of interdigital dermatitis (ID), severe footrot (SFR), contagious ovine digital dermatitis (CODD), shelly hoof (SH), foot abscess and toe granuloma respectively. ID and SFR dominated the within- and between-flock prevalence of lameness with 90% lame sheep having these two lesions and 80% farmers reporting that it was the most common cause of lameness in their flock.

In the same study, factors associated with a higher annual period prevalence of all lameness (Kaler and Green, 2009) were routine foot trimming once or more per year compared with no routine foot trimming, routine footbathing and a stocking density of >8 ewes/ha. Separating lame sheep from sound at pasture was associated with a lower risk of lameness. In other observational studies with non-random samples of farmers, lower farmer reported prevalence of lameness was associated with quarantine of new and returning stock, isolation and treatment of all sheep lame with ID or SFR with parenteral and topical antibacterial treatments (Wassink et al., 2003), footbathing and turning a flock to clean pasture to treat ID (Wassink et al., 2004) and catching the first mildly lame sheep in a group for treatment within 3 days of first becoming lame (Kaler and Green, 2008). Factors associated with a higher prevalence of lameness were routine foot trimming (Grogono-Thomas and Johnston, 1997; Kaler and Green, 2009; Wassink et al., 2003, 2004, 2005), footbathing to treat footrot (Wassink et al., 2003, 2004) and a stocking density >8 ewes/ha (Wassink et al., 2003). Two clinical trials have demonstrated that recovery from footrot is most rapid when sheep are treated with parenteral and topical antibacterials with no paring of the diseased foot (Kaler et al., 2010, 2012).

In 2011 the Farm Animal Welfare Council proposed that the prevalence of lameness in 2004 of 10% should fall to 5% by 2016 and 2% by 2021 (FAWC, 2011) with farmer uptake of existing knowledge. Since 2006 there have been a series of campaigns in England run by AHDB Beef & Lamb (the levy body for beef and sheep farmers) comprising paper and electronic literature and farmer meetings. The aims of the current study were, given the above technology transfer, to test the hypothesis that the prevalence of lameness in sheep had fallen since 2004 and farmers had changed managements of lameness, and to identify novel factors associated with low prevalence of lameness in 2013.

2. Materials and methods

2.1. Questionnaire design and administration

A postal questionnaire (available on request) was developed by a group of researchers at the Universities of Warwick and Nottingham. Part of the questionnaire captured detailed information on the period prevalence of lameness, recognition of four foot lesions, management and treatment of lameness, ID and SFR and details about farm and flock. It was based on previous questionnaires designed for research into sheep lameness, available literature and expertise from within the group. Questions were based on the period May 2012–April 2013. Most questions were closed or semi-closed with an 'other' option.

In June 2013, the questionnaire was sent to 4000 lowland sheep farmers in England with >199 ewes; lists were obtained from DEFRA and AHDB Beef & Lamb who selected flocks randomly stratified by county and size with duplicated farmers removed. Up to two reminder letters, the second with a second copy of the questionnaire, were sent to non-respondents; respondents were sent a thank you acknowledgement.

2.2. Data preparation and preliminary analysis

Double data entry was done by an outside agency (Wyman Dillon Ltd, Bristol) and data were stored in Microsoft Excel. Data cleaning was done using specifically written code in Python using Pandas, SciPy and NumPy toolkits (McKinney, 2010; Oliphant, 2007; Pérez and Granger, 2007). Data were stored in Microsoft Access.

For each question, frequency distributions and measures of central tendency and dispersion were calculated. Farms were excluded from analysis if data on either the flock size or the annual period prevalence of lameness were missing. The geometric mean and standard error were calculated for the annual period prevalence of lameness. The global arithmetic mean prevalence of lameness was calculated for the year from the total number of lame sheep divided by the total number of sheep in the study.

Characteristic images and descriptions of four foot lesions (ID, SFR, CODD and SH) were included in the questionnaire (e.g. Fig. 1) and farmers were asked what they named each lesion, whether they had seen the lesion in their flock in the period and, if so, what percentage of their ewes had the lesion. Using images of lesions meant that farmers did not need to be able to correctly name a lesion in order to provide an accurate estimate of its prevalence, as they were asked to describe the prevalence of a lesion based on its description and appearance rather than its name. The global arithmetic mean prevalence of each lesion and the prevalence of each lesion as a percentage of all lesions were calculated.

From the management questions on routine foot trimming a single variable the rate of feet bleeding/100 ewes trimmed/year was calculated from the frequency of routine trimming, the percentage of sheep trimmed at each trimming event and the percentage of sheep that bled during each routine trim.

2.3. Multivariable modelling of associations between prevalence of foot lesions and lameness and management practices and lameness

Two over-dispersed Poisson regression models (Dohoo et al., 2003) were used (MLwiN 2.30, (Rasbash et al., 2014)) to estimate univariable and multivariable associations. The outcome variable was the period prevalence of lameness between May 2012 and April 2013 and the first model investigated associations with the four foot lesions and the second with management strategies.

The outcome was the number of lame sheep in the flock offset by the natural logarithm of the expected number of lame sheep in the flock. The model had a log link function and took the form:

$$\text{Number of cases on farm}_j \sim \alpha + \text{offset} + \beta j X_j + e_j$$

where α is the intercept, $\sim$is a log link function, offset is the natural logarithm of the number of expected lame sheep on each farm, $_{\beta j}$ are the coefficients for a vector of X_j explanatory variables which vary by farm j, and e_j is the residual random error.

The prevalence of four foot lesions ID, SFR, CODD and SH were categorised and added into the model as explanatory variables to identify lesions associated with a change in the overall prevalence of lameness reported by farmers.

To investigate the management factors associated with the period prevalence of lameness, variables were grouped into 9 sub-categories and a model built for each sub-category. The sub-categories were recognising and catching lame sheep, treatment of sheep with footrot and interdigital dermatitis, routine flock trimming, flock footbathing, culling and replacement of ewes, vaccination, whole flock antibiotic treatment, biosecurity and characteristics of the farm and farmer.