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Assessment of farmer recognition and reporting of lameness in adults in 35 lowland sheep flocks in England

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Abstract

The aim of this study was to assess the accuracy of farmer recognition and reporting of lameness in their sheep flock when compared with the prevalence of lameness observed by a researcher. Thirty-five sheep farms were visited. Farmers were asked for estimates of the prevalence of lameness in 2008, in the flock and in one group of sheep that was inspected by the researcher the same day. These estimates were then compared with the researcher's estimate of lameness. All farmers were able to recognise lame sheep but they slightly under reported the prevalence of lameness in the group selected for examination when compared with the researcher's estimate. The proportion underestimated increased as the prevalence of lameness in the group increased. Farmer estimates on the day were consistently, closely and significantly correlated to that of the researcher's estimate of prevalence of lameness. We conclude that farmer estimates of prevalence of lameness in sheep are a sufficiently accurate and reliable tool for risk factor studies. The prevalence of lameness in sheep, nationally, is probably higher than the current estimate of 10% by 2–3%.

Keywords: *animal welfare, farmer reliability, lameness, recognition, reporting, sheep*

Introduction

Lameness is an important cause of poor welfare in sheep, with up to three million sheep lame in the UK each year. Farmers in the UK list lameness as their top health concern after sheep scab (Morgan-Davies *et al* 2006). Lameness results in reduced bodyweight (Marshall *et al* 1991), poor body condition, increased mortality in lambs and ewes, increased numbers of barren ewes, an increased time to finish lambs (Wassink *et al* 2010a) and reduced wool growth (Stewart *et al* 1984; Marshall *et al* 1991).

Estimates of the prevalence of lameness in sheep flocks in the UK come from studies that have relied on farmer estimates. The period prevalence of lameness from a stratified random postal survey was 8% in 1994 (Grogono-Thomas & Johnson 1997) and 10.4% in 2006 (Kaler & Green 2008a). Researchers have also used farmer estimates of the prevalence of lameness to identify risk factors for the prevalence of footrot (Wassink *et al* 2003) and interdigital dermatitis (Wassink *et al* 2004), to investigate farmer satisfaction with management of lameness (Wassink *et al* 2010b) and the proportion of sheep lame with specific foot lesions (Kaler & Green 2008a). All these studies assume that farmers can both recognise lame sheep and that they report the prevalence of lameness in their flock accurately.

Research has shown that farmers underestimate the prevalence of lameness in dairy cattle considerably when compared with an independent observer, with farmer estimates of 5.7% compared with 22.1% (Whay *et al* 2002) and 6.9% compared with 36% (Leach *et al* 2010). Whilst there was a degree of correlation between dairy farmer and researcher estimates of lameness, farmers underestimated the prevalence of lameness by two- to seven-fold, with no consistent pattern to explain the variation in estimation. Whatever the underlying reason behind the inaccuracy of estimates of prevalence of lameness given by dairy farmers, it is clearly a concern that sheep farmers might also underestimate the prevalence of lameness. Were they to do so to the same extent as dairy cattle farmers, then the true prevalence of lameness in UK sheep flocks would be as high as 31–52%.

In a recent study, sheep farmers correctly identified non-lame sheep and sheep lame with locomotion score 2 to 6 (Table 1), when studying video clips of sheep standing and walking (Kaler & Green 2008b). From this study, the authors concluded that sheep farmers recognise lame sheep in videos, even when their locomotion is only mildly abnormal (score 2) but that they made a separate decision on whether to treat lame sheep. However, the authors concluded that they did not know whether farmers identified lame sheep in their flocks as they did in video clips.

The aims of the current study were to investigate whether a farmer's estimate of prevalence was correlated to the true prevalence of lameness in their flock. In addition, we do not know whether the figure a farmer gives for the flock prevalence of lameness includes all severities of lameness or only

Table 1 Mean (± SEM) percentages of sheep by locomotion score and farmers that recognised, reported and caught each locomotion score.

Locomotion score	0	1	2	3	4	5
Definition (Kaler *et al* 2008)	Sound	Uneven posture, shortened stride on one leg	Visible nodding of head in time with shortened stride	Not weight bearing on affected limb when standing	Not weight bearing on affected limb when standing or moving	Difficulty rising, reluctant to move, more than one limb affected
Mean (± SEM)% adjusted for farm	90.6 (± 0.8)	1.8 (± 0.3)	3.6 (± 0.4)	3.1 (± 0.4)	0.8 (± 0.2)	0.1 (± 0.1)
Mean (± SEM)% unadjusted for farm	91.5 (± 0.8)	1.6 (± 0.3)	3.3 (± 0.5)	2.5 (± 0.45)	1.0 (± 0.3)	0.1 (± 0.1)
N (%) recognised lame by farmer		9 (25.7)	35 (100)	35 (100)	35 (100)	35 (100)
N (%) reported lame by farmer		3 (8.6)	32 (91.4)	35 (100)	35 (100)	35 (100)
N (%) caught by farmer		2 (5.7)	16 (45.7)	33 (94.3)	35 (100)	35 (100)

Locomotion score 6, will not stand or move (no sheep were observed with this score).

those sheep sufficiently lame to require treatment. We also do not know whether farmers include lame sheep that have been treated. These were the focus of investigation.

Materials and methods

To estimate the number of farmers visited, it was assumed that 90% of farmers would recognise locomotion score of 2 (Kaler & Green 2008a) with a 95% confidence interval and 10% precision (Stata SE 10.0, StataCorp, USA). A sample size of 35 was estimated. Farmers were selected on the basis of agreement to participate and a convenient travelling distance. They comprised a range of flock sizes, commercial and pedigree operations, and male and female shepherds. The 35 sheep farms were visited once by one researcher (EMK) between December 2008 and May 2009. Farmers were selected from a database of compliant farmers who had expressed an interest in participating in research into lameness in sheep at the University of Warwick (n = 29), from the EBLEX (the organisation for the English beef and sheep industry) English Performance Recorded Flocks Directory 2008 (EBLEX 2008) with permission from EBLEX (n = 3), by networked introductions with farmers (Rubin & Rubin 1995) (n = 1) and through snowball sampling (Sarantakos 2005), ie suggested by other participants (n = 2).

Study design

Farmers were contacted by telephone and asked if they were interested in participating in a study involving a single farm visit to assess lameness. If the farmer expressed an interest, they were asked the approximate prevalence of lameness in their flock and the size of their flock. A participant information leaflet was then sent by post. A further telephone call was made approximately two weeks later to arrange a convenient date to visit the farmer. A letter confirming the date and time of the visit, the researcher's contact details and further details about the visit was then sent by post. A final telephone call was made one-to-two days prior to the visit. On all farms, the person who had everyday care of the sheep flock was the person interviewed by the researcher. On the day of the visit, the interviewee was asked to sign a consent form agreeing to take part in the study.

Assessment of lameness in the flock

Once on the farm, the researcher asked the farmer to give an estimate of the period prevalence of lameness for the whole flock in 2008 and for an estimate of the current prevalence of lameness in the flock. The farmer was then asked to estimate the current prevalence of lameness in the group of sheep with the highest prevalence. The researcher then inspected this group for up to 1 h without the presence of the farmer and estimated the prevalence of lameness using a validated locomotion scoring system (Kaler *et al* 2008) (Table 1). The farmer was blind to the researcher's estimate of prevalence of lameness until the end of the visit.

The farmer was then asked to return to the field and to walk with the researcher and identify all sheep that they saw lame in the group. For each sheep that was identified by the farmer, the researcher recorded the severity of lameness and asked the farmer whether the sheep was lame enough to be caught and whether or not the farmer would include this sheep in an estimate, when reporting lameness, eg in a postal survey. When it was unclear which sheep was being referred to, the researcher sought clarification. To further reduce the possibility that the researcher and farmer were observing different sheep, the farmer was asked to point to all lame sheep seen until a pattern could be established. This was repeated until the threshold locomotion score of sheep that the farmer considered lame was established. The farmer was then asked to re-estimate the prevalence of lameness in the group from his/her observations.

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On two farms where there were very few lame sheep and it was therefore difficult to ascertain the farmer's definition of lameness, five randomly ordered video clips (Kaler & Green 2008a) of lame sheep with locomotion scores 1, 2, 3, 4 and 5 were shown to the farmer on a laptop computer. Farmers were not told the severity of the locomotion score of the sheep. They were asked whether the sheep was lame, was lame enough to be caught and whether or not the farmer would include this sheep when reporting the prevalence of lameness.

Data input, preparation and management

Data were recorded on standard forms. Each farm was given a numerical identity to ensure that the farm identities remained anonymous. Farmer names and addresses were not stored electronically. Data were entered into Microsoft Access® 2007 (Microsoft®, USA). Where possible, data were coded and drop-down lists were used in preference to text fields. Queries were used to check for errors and any anomalies were checked against the original paper record sheets. Data were extracted from the database and checked for errors before exporting to a spreadsheet (Excel® 2007, Microsoft®, USA) and then to a statistical analysis programme (Stata SE 10.0, StataCorp, USA).

Definitions of lameness

The period prevalence was the average prevalence of lameness for the whole flock between January and December 2008 estimated by the farmer on the day of the visit.

The point prevalence was the prevalence of lameness in the whole flock on the day of the visit, estimated by the farmer.

The farmer initial prevalence was the prevalence of lameness estimated by the farmer for the group of sheep inspected by the researcher.

The farmer re-estimate of prevalence was the prevalence of lameness re-estimated by the farmer for the group of sheep on the day of the visit, after observation with the researcher.

The researcher estimate of prevalence was the prevalence of lameness recorded by the researcher in the group of sheep on the day of the visit, where a lame sheep was defined as a sheep with a locomotion score ≥ 2.

Statistical analysis

Data from all 35 farms were included in the analysis. The median flock size and median number of sheep examined per farm were calculated. The five estimates of prevalence of lameness made by the farmer and researcher were compared with each other and with increasing thresholds of locomotion score and with the minimum locomotion score that the farmer recognised, reported and caught individual lame sheep for inspection, using Spearman's rank correlation tests (Petrie & Watson 1999). The farms were grouped into three categories ranked by the researcher's estimated prevalence of lameness of ≤ 5.0%, > 5.0 but ≤ 9.0%, and > 9.0%. The mean initial farmer estimate of lameness within each category was compared with the mean researcher estimate within each category using *t*-tests.

Results

Farms were located in Warwickshire (n = 8), Worcestershire (n = 8), Gloucestershire (n = 7), Oxfordshire (n = 7), Northamptonshire (n = 2), Herefordshire (n = 1), Cambridgeshire (n = 1) and the West Midlands (n = 1). Twenty-eight farms were commercial, six were pedigree and one had both pedigree and commercial flocks. Thirty-one shepherds were male and four were female. The median number of breeding ewes per flock was 330 (inter-quartile range [IQR]: 220–550).

Researcher estimates of locomotion score

The median number of sheep observed by the researcher per farm was 112 (IQR: 89–164): 5,198 sheep were examined in total. Four hundred and forty (8.5%) sheep had a locomotion score > 0 with 359 (6.9%) sheep with a locomotion score of ≥ 2. Eighty-one (1.6%) were locomotion score 1, 172 (3.3%) were locomotion score 2, 131 (2.5%) were locomotion score 3 and 50 (1.0%) sheep were locomotion score 4. The maximum locomotion score observed was locomotion score 5 (Table 1) in six sheep. The median abnormal locomotion score observed by the researcher across all farms was locomotion score 2 (IQR: 2–2.5). The mean prevalence of each locomotion score is presented in Table 1.

Estimates of prevalence of lameness

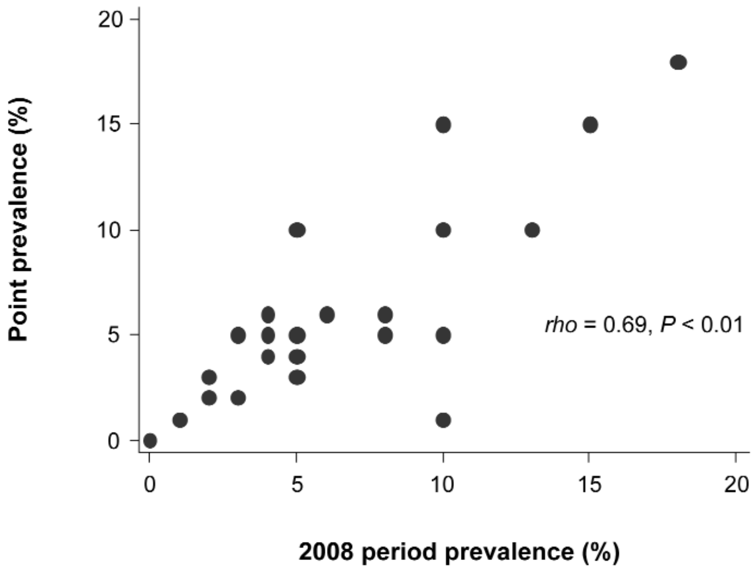
The median farmer estimated period prevalence of lameness for 2008 was 5% (IQR: 4–10%) and the median point prevalence for the flock on the day of the visit was 5% (IQR: 3–6%). These estimates were correlated (Spearman's *rho* = 0.69, $P < 0.01$) but not significantly different when compared using a paired *t*-test ($z = 1.35$, $P = 0.18$) (Figure 1, Table 2).

The median prevalence of lameness in the group with the highest prevalence initially estimated by the farmer was 5.4%, significantly lower than the researcher's estimate of 7.9% ($z = 2.15$, $P = 0.03$). Nine farmers gave initial estimates above the researcher's estimate, 19 below and seven were identical. The correlation coefficient was 0.73 ($P < 0.01$) (Figure 2, 3[a], Table 2). The farmer re-estimate was also significantly lower than the researcher's estimate (median 5.8, $z = 2.22$, $P = 0.03$). Six farmers gave estimates above the researcher's estimate, 16 below and 13 were identical (Figure 2), giving a higher correlation of 0.86 ($P < 0.01$) (Table 2, Figure 3[b]).

Correlations between estimates of lameness

The majority of estimates of lameness were correlated with each other (Table 2, Figure 3). The farmers' initial and re-estimate of prevalence of lameness were highly correlated with each other and both were correlated with the researcher's estimate of prevalence of lameness with locomotion score ≥ 2. The period prevalence of lameness was correlated with the point prevalence of lameness for the flock on the day of the visit but not to the researcher's estimate of lameness in the group. The point prevalence of lameness in the flock was correlated with the farmers' initial and re-estimate of prevalence of lameness in the group.

Figure 1



Scatter diagram of the point prevalence of lameness on the day of the visit against the period prevalence of lameness in 2008 both reported by farmers.

Table 2 Spearman correlation coefficients (*rho*) for observations on lameness.

		1	2	3	4	5	6	7	8	9
1	2008 period prevalence									
2	Flock point prevalence	0.69*								
3	Farmer initial group prevalence	0.31	0.56*							
4	Farmer re-estimate group prevalence	0.38*	0.62*	0.90*						
5	Group prevalence LS ≥ 2	0.37*	0.56*	0.73*	0.86*					
6	Group prevalence LS ≥ 1	0.40*	0.62*	0.69*	0.94*	0.83*				
7	Group prevalence LS ≥ 3	0.10	0.32	0.68*	0.85*	0.71*	0.78*			
8	Farmer consider sheep lame	–0.19	–0.03	–0.24	–0.06	–0.23	–0.11	–0.06		
9	Farmer report sheep lame	–0.08	–0.05	–0.07	0.17	–0.09	0.13	0.30	0.47*	
10	Farmer catch lame sheep	0.09	–0.01	–0.03	–0.12	–0.13	–0.21	–0.04	0.26	0.29

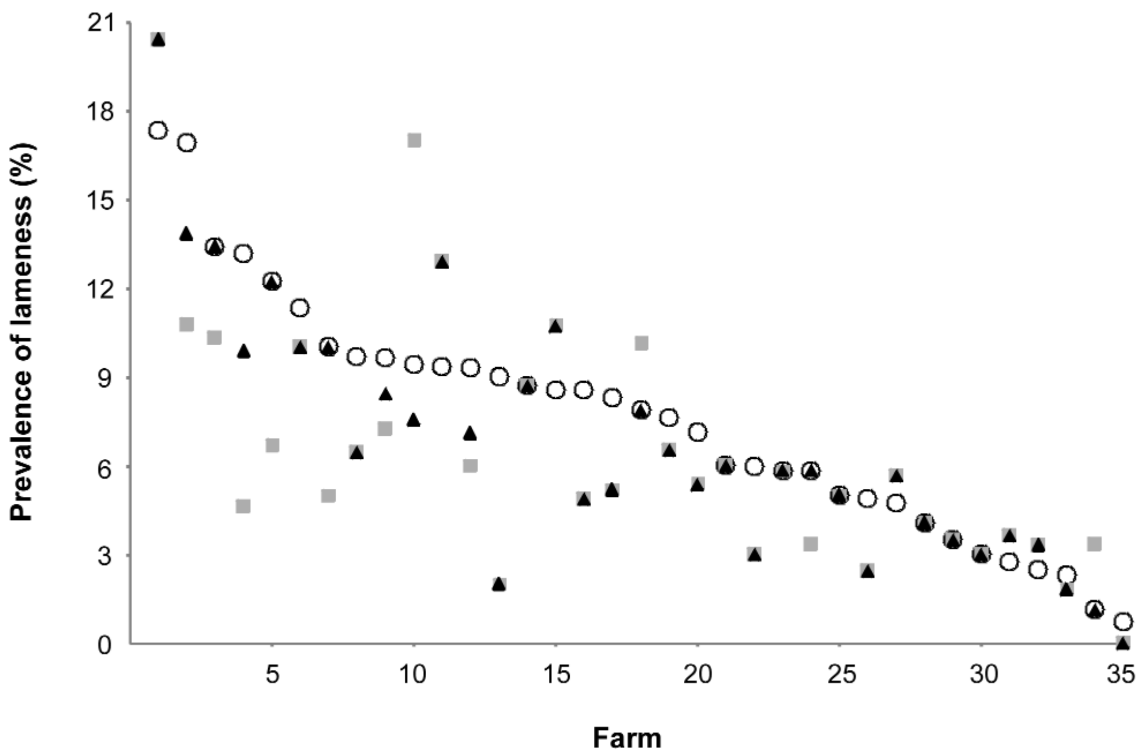
* $P < 0.05$; LS: locomotion score.

When the three farmers who said they would report a sheep lame from locomotion score 3 and above were removed from the analysis and Spearman's rank correlation tests were re-run, the correlation coefficients increased. The analysis was also re-run excluding the three farmers who said they included sheep with locomotion score 1 and above in their estimate of lameness, and the correlation coefficients decreased. These results suggest that these farmers did in fact report lameness at locomotion score ≥ 3 and ≥ 1, respectively.

Farmer recognition, reporting and catching of lame sheep

All farmers in this study considered sheep with locomotion score 2 lame. Nine (25.7%) farmers considered that sheep with locomotion score 1 were lame, but only three of these said that they would report sheep with locomotion score 1 in their estimate of prevalence of lameness (Table 1). Thirty-two (91.4%) farmers would have included sheep with locomotion score 2 in their estimate of prevalence of lameness with the remaining three

Figure 2



Prevalence of lameness in the group examined by researcher (circle), farmer initial estimate (square) and farmer re- estimate (triangle), ranked by researcher's estimate.

farmers including only sheep with locomotion score 3 or above (Table 1). Two farmers said that they caught sheep with locomotion score ≥ 1 for inspection, 16 caught sheep with locomotion score ≥ 2, 15 farmers caught sheep with locomotion score ≥ 3 and two farmers caught sheep with locomotion score ≥ 4 for inspection (Table 1). The minimum locomotion score that farmers caught a lame sheep for inspection was not significantly linearly correlated with the minimum locomotion score that they recognised as lame or reported as lame. It was also not correlated with the prevalence of lameness in the flock with increasing thresholds of severity (Table 2).

Twenty-five farmers in this study said that their estimate of lameness included all lame sheep on the farm. Eighteen said that they would include treated sheep that were still lame in their estimate; the remaining 17 would exclude them. Nine farmers said that their estimate referred to only those sheep that were lame enough to warrant treatment, 'treatment' also included whole flock treatments, eg footbathing, rather than just individual treatment and so the estimate did not refer to what they would catch for individual treatment. In addition, farmers said they might sometimes exclude sheep from estimates if there was some known or unusual reason for lameness. For example, a long-term medical reason, such as arthritis or a prolonged recovery from a physical injury.

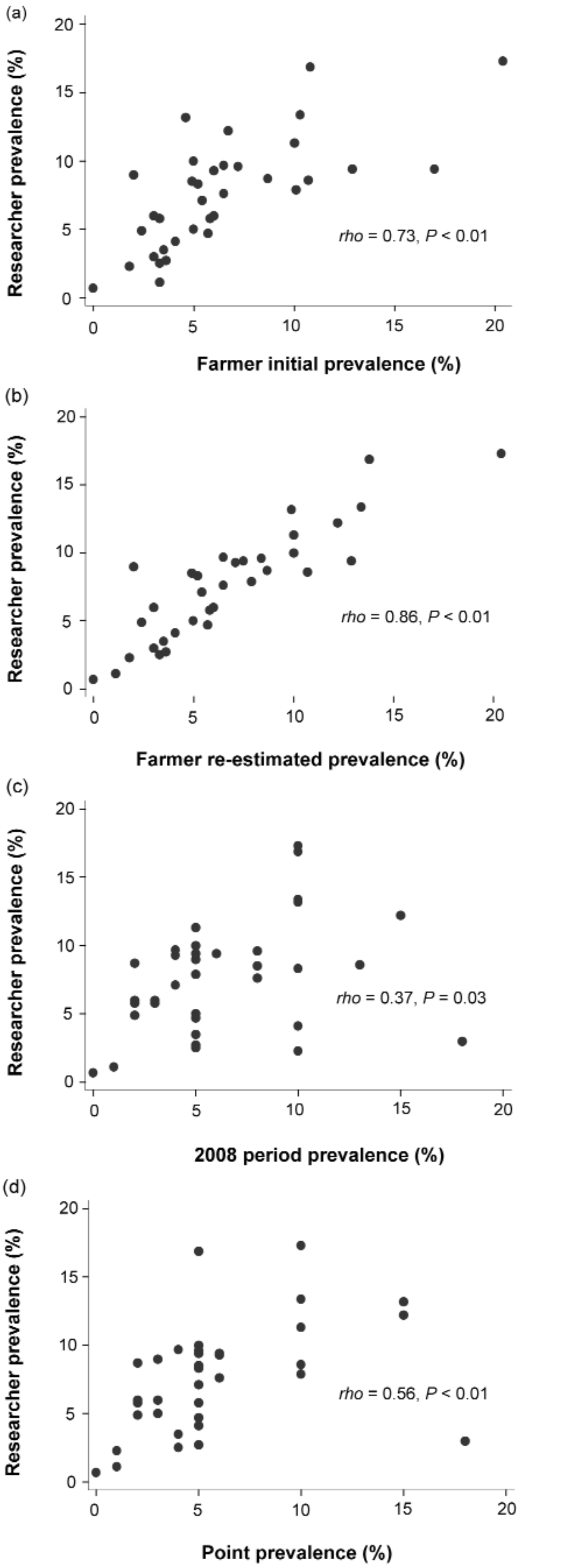
Using farmer estimates as a predictor for the true prevalence of lameness

When the prevalence of lameness recorded by the researcher was > 9% (n = 12) the farmers mean estimate was a significant 2.0% (95% CI: 0.9 to 5%) lower. When the researcher estimate of lameness was ≤ 9% but > 5% (n = 12) and ≤ 5% (n = 11) the mean estimate by farmers was 1.5% (CI: –0.2 to 3.2%) lower and 0.1% (CI: –0.9 to 0.7%) higher, respectively, these differences were non significant.

Discussion

To reduce observer bias, a single, trained researcher was used to observe and record the prevalence of lameness in all thirty-five flocks. The locomotion scoring system used was objective with very high intra-observer agreement (Kaler *et al* 2008). Sheep were defined as lame if their locomotion score were ≥ 2 (Table 1) because this is the lowest score at which sheep can be consistently categorised (Kaler *et al* 2008). To observe as many lame sheep as possible and to maximise the opportunity for the farmer and researcher to observe the full range of locomotion scores, the group with the highest prevalence of lameness was inspected. Participants' responses can vary depending on the way in which research is conducted, with participants more likely to give more socially acceptable or morally correct

Figure 3



Scatter diagrams of researcher-estimated prevalence of lameness against farmer estimates of (a) the initial group prevalence, (b) re-estimated group prevalence, (c) the 2008 period prevalence and (d) point prevalence of lameness.

responses in face-to-face settings (Krysan *et al* 1994). As a consequence, farmers may have felt a pressure to identify lame sheep that they would normally not consider lame. To reduce this risk, the researcher asked the farmer to identify lame sheep rather than decide whether a sheep identified by the researcher was lame.

Whilst the farmers in this study did not use the locomotion scoring scale, their observations conformed consistently to the scale with 3, 29 and 3 farmers consistently including sheep with LS $\geq$ 1, LS $\geq$ 2 and LS $\geq$ 3 in their estimate of lameness. This indicates that farmers had some consistent mechanism to classify lame sheep. This was also apparent from the threshold figures where the farmer estimates of lameness were most highly correlated with the researcher estimates of sheep with locomotion score $\geq$ 2 (Table 2). This is in contrast to the results of Leach *et al* (2010) who reported that dairy cattle farmers used inconsistent definitions for lameness and so the researcher-estimated prevalence (from a defined scale) did not consistently predict the farmer prevalence.

All the farmers in the current study considered that sheep with a locomotion score of 2 (and all > 2) were lame. These were compliant farmers who were interested in research in lameness; consequently they might have been able to recognise lameness at a lower locomotion score than some of the farmers in Kaler and Green (2008b) where only 90% of farmers considered sheep with a locomotion score 2 were lame. Despite considering them lame, 50% of farmers in the current study reported that they would not treat sheep with locomotion score 2 (Table 1) with some only treating sheep with locomotion score 4 and above which has important implications for animal welfare (see later). These findings are in agreement with the findings of Kaler and Green (2008b) who used video clips to prompt farmer responses and adds evidence to the hypothesis that sheep farmers can identify even mildly lame sheep but make a separate decision on whether to catch and treat them.

The farmer estimates of lameness were slight underestimates compared with the researcher estimate in the current study, particularly at a higher prevalence of lameness. There are several explanations for this, some farmers only included sheep lame enough to warrant treatment, some excluded lame sheep that had been treated and some excluded individual sheep with prolonged lameness. A number of farmers also remarked that the figure that they had given as an initial estimate was what they had estimated a few days earlier. More precise estimates of lameness would therefore be gained by including subsidiary questions on numbers lame, lame and treated, insufficiently lame to treat and the frequency of inspections. This also probably explains the reduction in correlation between estimates on the day and for previous time-periods (Figure 3). In future, an increased precision in estimates might be obtained by requesting the current point prevalence of lameness or shorter period prevalence, eg months of the year, as in Wassink *et al* (2004).

The underestimate in prevalence of lameness was approximately 20% in flocks where the researcher estimated the

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prevalence of lameness was > 9%; this is small compared with the 200–700% underestimate reported for dairy cattle farmers by Leach *et al* (2010). Farmers with a higher prevalence of lame sheep might have made underestimates if there was a threshold of lameness above which farmers might have been unwilling to report accurately, ie farmers voluntarily or involuntarily reporting a lower prevalence of lameness. Voluntary underestimates might occur if there was a negative effect of reporting high prevalence of lameness, eg The Single Payment Scheme in Great Britain requires that farmers keep minimum standards for the care and husbandry of their sheep to qualify for full payment, under cross-compliance (Animal Welfare [Statutory Management Requirement (SMR) 18]) (Rural Payments Agency 2010). If, on cross-compliance inspection, a high prevalence of lameness is observed (although a recommended ceiling of acceptability is not stated) and deemed to breach SMR 18, this will reduce the payment. Consequently, some farmers might not wish to report above a certain 'acceptable' level and voluntarily under report the prevalence. Farmers might also perceive the prevalence of lameness in their flock to be lower than it actually is through an entrenched prior belief and therefore involuntarily underestimate the prevalence of lameness; this is an example of cognitive dissonance where behaviour changes belief (Festinger & Carlsmith 1959). Finally, farmers that are exposed to lame sheep might become desensitised (Whay *et al* 2002) and underestimate the prevalence, particularly where there is a high prevalence of lameness.

The method of participant selection in this study, ie compliant farmers already interested in research in lameness in sheep probably accounts for the lower mean prevalence of lameness (5% cf 8–10%) in the flocks in this study. Based on the findings of the current study, it is likely that the estimates from Grogono-Thomas and Johnston (1997) and Kaler and Green (2008a) are underestimates, with the actual prevalence of lameness 2–3% higher than that reported by these two studies. This has both welfare and economic implications with a higher prevalence of lameness in the UK than previously estimated.

Studies of risk rely on consistent reporting of exposures and disease. The results from the current study indicate that the use of farmer estimates of prevalence of lameness in sheep is a sufficiently consistent, accurate and reliable tool in studies of risk where the prevalence does not have to be precise but the estimates do need to be consistently lower or higher so that when flocks are compared the relative risks are valid. The results from the current study add validity to the findings of previous studies that have used farmer estimates of the prevalence of lameness in sheep flocks to identify risk factors associated with lameness. The significant but lower correlation coefficients observed between the period prevalence in 2008 and the researcher's estimate, in comparison with the farmer's initial, re-estimate and point prevalence, might suggest recall bias or reduced ability to appraise an average prevalence of lameness over a period of time. However, it might be that the period prevalence simply differed from that of the point prevalence and researcher estimate because the prevalence of lameness varied over the previous 12 months. It is difficult to validate a farmer estimate of the prevalence of lameness over 12 months.

Animal welfare implications

The precision of estimates of prevalence of lameness indicate that farmers are a reliable source for such estimates. Previous research papers into risks for lameness are therefore likely to be valid and provide useful information for farmers and advisors to reduce lameness in sheep. In addition, sheep farmers can recognise lame sheep. This means that there is one less barrier to reducing the prevalence of lameness than there is in dairy cattle (Leach *et al* 2010). However, sheep farmers make a separate decision on when to catch and treat lame sheep; more than 50% in the current study would not catch sheep until locomotion score 3 or 4, a similar result to Kaler and Green (2008b). Footrot and interdigital dermatitis cause > 80% of lameness in sheep in the UK (Kaler & Green 2008a) and infectious sheep are the main source of infection for susceptible sheep. Consequently, prompt, effective, individual treatment of mildly lame sheep reduces the prevalence and incidence of lameness (Green *et al* 2007; Hawker 2008; Wassink *et al* 2010a). The results of these studies suggest that > 50% of farmers in the current study could reduce the prevalence of lameness and increase the welfare of their flock if they caught and treated appropriately sheep with locomotion score 2. Lame sheep that are untreated have reduced productivity and reduced welfare (Wassink *et al* 2010a) and therefore research into factors that influence farmers' decisions to catch lame sheep is still required.

Conclusion

We conclude that farmers recognise even mildly lame sheep but make a separate decision on whether to catch and treat them. We further conclude that the use of farmer estimates of prevalence of lameness are sufficiently accurate for studies of risk but probably underestimate the true prevalence of lameness, particularly in flocks with a prevalence of lameness > 9%. We recommend that future studies requesting farmer estimates of lameness in sheep include additional questions on numbers lame and treated, lame and not treated and lame but not sufficiently lame to warrant treatment. A further study to confirm these results with a random population of producers would be useful.

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