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Evaluating an intervention to reduce lameness in dairy cattle

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ABSTRACT

Lameness in dairy cattle remains a significant welfare concern for the UK dairy industry. Farms were recruited into a 3-yr study evaluating novel intervention approaches designed to encourage farmers to implement husbandry changes targeted toward reducing lameness. All farms completing the study were visited at least annually and received either monitoring only (MO, $n = 72$) or monitoring and additional support (MS, $n = 117$) from the research team. The additional support included traditional technical advice on farm-specific solutions, facilitation techniques to encourage farmer participation, and application of social marketing principles to promote implementation of change. Lameness prevalence was lower in the MO (27.0 ± 1.94 SEM) and MS (21.4 ± 1.28) farms at the final visit compared with the same MO (38.9 ± 2.06) and MS (33.3 ± 1.76) farms on the initial visit. After accounting for initial lameness, intervention group status, and year of visit within a multilevel model, we observed an interaction between year and provision of support, with the reduction in lameness over time being greater in the MS group compared with the MO group. Farms in the MS group made a greater number of changes to their husbandry practices over the duration of the project (8.2 ± 0.39) compared with those farms in the MO group (6.5 ± 0.54). Because the lameness prevalence was lower in the MS group than the MO group at the start of the study, the contribution of the additional support was difficult to define. Lameness can be reduced on UK dairy farms although further work is needed to identify the optimum approaches.

Key words: lameness, dairy cattle, facilitation, social marketing

INTRODUCTION

Lameness in UK dairy cattle remains an important welfare concern that has been highlighted as an area

for priority action by the Farm Animal Welfare Council (FAWC, 2009) and by the National Farmers Union (NFU, 2010). Previous studies reported prevalence figures for lameness on UK dairy farms. These include 21% reported by Clarkson et al. (1996), based on observations made between 1989 and 1991, and 22.1% for observations made in 2000 and 2001 (Whay et al., 2003). Barker et al. (2010) reported the initial lameness prevalence found on the 227 farms recruited to the intervention study described here. During the winter housing period (2006–2007), herd lameness prevalence ranged from 0 to 79.2% with an overall mean of 36.8%. Other studies have reported prevalence in different systems: 15% for grazing herds and 39% for zero-grazing herds (Haskell et al., 2006), and 16.2, 16.3, and 19.3% in autumn-, winter-, and spring-calving herds, respectively (Rutherford et al., 2009).

Studies have explored the husbandry-related risk factors associated with lameness. For example, using information from the farms recruited for this study, Barker et al. (2010) reported that risk factors in the housing and grazing environments associated with increased lameness were the presence of damaged concrete in pens, cows pushing each other or turning sharply near the parlor entrance or exit, cattle grazing pasture also grazed by sheep, and the use of automatic scrapers. In addition, the management factors associated with increased lameness included not treating lame cows within 48 h of detection; insufficient time given to detecting lameness across the entire herd; and the common occurrence of severe heel erosion, interdigital growths, or toe necrosis as reported by the farmer. Other studies have shown that lameness or claw lesions were associated with comfort in the lying area (Barker et al., 2007; Fregonesi et al., 2007), quality of walking surfaces (Chesterton et al., 1989; Dembele et al., 2006), and exposure to slurry in the housing environment (Gregory et al., 2006).

The substantial amount of information available about lameness-related risk factors led the UK Farm Animal Welfare Council (FAWC, 2009) to suggest that “Dissemination of existing knowledge about lameness to many farmers and stockmen is also needed.” When Bell et al. (2009) provided detailed advisory support

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to 30 dairy farmers based on the specific lameness risk factors present on their farms, no significant reduction in lameness prevalence in heifers was observed over the course of 1 yr. Apart from a relatively small intervention study with organic farms (March et al., 2008), no reported intervention studies have demonstrated a positive effect on levels of lameness in dairy cows.

Lameness improvement is likely affected by the perceptions and attitudes of farmers on their own farms. For example, Mill and Ward (1994) reported that the prevalence of lameness in 15 herds was lower on those farms with greater knowledge, level of training, and awareness of lameness conditions. Whay et al. (2002) reported that farmers often underestimated the number of lame cows within their own herd. Leach et al. (2010a, b) reported that farmers often placed relatively low importance on lameness control compared with other health issues and that time, labor, and finance were barriers to improvement. Farmers were motivated by the pain and suffering of lame cows and pride in a healthy herd.

This study aimed to reduce lameness in dairy cattle by using preexisting knowledge of both the risk factors for lameness and the likely motivators of farmers. The aim was to develop and evaluate an intervention approach that used facilitation techniques and social marketing principles in addition to the traditional advisory model of providing detailed practical solutions.

MATERIALS AND METHODS

Participating Farms

Initially, 227 farms were recruited, as described by Barker et al. (2010), either via contact with dairy companies that purchased their milk or by direct contact. The recruitment criteria were that farms had a herd size of more than 35 cows and that they intended to continue dairying for the next 4 yr. Farms were allocated into 3 conventional (nonorganic) groups in different geographical regions and 1 organic group, as previous studies had shown differences in lameness prevalence according to region (Whay et al., 2003) and organic status (Rutherford et al., 2009). The Southwest (**SW**) conventional group ($n = 50$) included farms from Cornwall, Devon, Somerset, Wiltshire, Gloucestershire, and south Wales. The Northeast (**NE**) conventional farms ($n = 30$) were based in the East Midlands (Leicestershire, Nottinghamshire, and Derbyshire). The Southeast (**SE**) conventional farms ($n = 42$) were based in Berkshire, Buckinghamshire, Dorset, Hampshire, Surrey, and Sussex. Organic farms ($n = 67$) were mostly based in the SW region and all were within a 200-mile radius of Bristol. These farms were managed

under organic principles and had been certified by a UK certification body as compliant with the European Union's organic regulation (EEC, 1991).

The intervention study was conducted over a 3-yr period starting in October 2006. Each farm was visited at a similar time each year, normally during the winter housing period, on 4 occasions by 1 of 4 researchers. The study included elements of both monitoring and support, which are described in more detail below. Farms were placed into either a monitored and supported group (**MS**) or a monitored-only group (**MO**). Farms in the MS group were provided with both monitoring and support over the 3 yr of the study. Farms in the MO group were provided with lameness monitoring only and no additional advisory or implementation support until the conclusion of the study.

To minimize overlap of the project support between groups and to utilize communication methods available to preexisting groups of farms, such as those supplying particular dairy companies, farms were allocated into MO or MS groups based on the following recruitment process. Nonorganic farms in the NE and SE regions were allocated to the MS group after their nomination from a dairy company operating in the relevant area. Other nonorganic farms in these 2 regions were recruited into the MO group by direct contact. Nonorganic farms in the SW were recruited by nomination from a single dairy company and allocated to the MS group if they were within 6 mo of an assurance scheme visit that verified compliance with food safety and animal welfare standards. Organic farms were recruited via an organic milk purchaser. Farms from one organic certification body were allocated to the MS group and farms from another certification body were allocated to the MO group.

The NE MS group was eligible for a financial incentive (£2,500 per farm) to support husbandry changes that could improve lameness. The distribution of this incentive was agreed upon at a meeting to which all participating farmers had been invited. The group decided to allocate up to £2,000 per farm (in 2 annual £1,000 payments) to those farmers who had implemented actions that had been defined in the previous year's individual farm lameness action plan. The remaining £500 per farm was put into a central fund to subsidize foot-trimming courses. In addition, the group requested the option of receiving an additional summer lameness monitoring session during yr 2 and 3 of the project.

Lameness Monitoring

During each annual visit to all farms (MO and MS groups), the locomotion of all cows in the milking herd was assessed using a 4-point score (0 = sound, 1 =

imperfect locomotion, 2 = lame, 3 = severely lame) as described by Whay et al. (2003) and Barker et al. (2010). Cattle were normally assessed for lameness as they left the parlor; however, for those farms where observation or identification of the cows was difficult, lameness was assessed in a loafing pen. Each farm was assessed by the same researcher each year (Barker et al., 2010). Regular group scoring sessions with all assessors throughout the data collection period were used to minimize any potential variation between assessors.

Because it was considered unethical not to provide information to farmers on individual lame cows that might benefit from treatment, all farms in the project (MO and MS groups) received this feedback information at the end of each visit. The format for reporting these lameness assessment results to the farmer evolved during the project. At the first visit, all farms were given a report that specified the lameness scores for all cows and the herd lameness prevalence. As with previous studies (Barker et al., 2010), herd lameness prevalence was reported as the proportion of cows with a lameness score of 2 or 3. From the second visit onward and based on feedback from farmers, all farms (MO and MS groups) were given information identifying individual animals that were "likely to benefit from treatment" (i.e., score 2) and those that were "likely to need immediate treatment and nursing, possibly vet advice or culling" (i.e., score 3). On the first visit, all farmers were given forms encouraging them to record lameness cases and, where possible, identify the main lesion types. Unless the farmer refused consent, which occurred on 3 farms, the results of the lameness assessment were sent to the farm's veterinarian for information.

At the second, third, and final visits, all farms were asked to describe what lameness-related husbandry changes they had implemented within the previous year on their farm. These changes were later classified into 6 categories that reflected potential targets for husbandry improvement. Farmers were asked to describe any lameness-related educational or training events that they had attended and any lameness relevant information that they had received, in addition to the project-specific support provided to MS farms.

Additional Support

For those farms in the MS group, additional lameness-specific support was provided. During the first visit, the researcher conducted a detailed risk assessment based on potential lameness risk factors identified in a previous study aimed at reducing lameness in dairy heifers (Bell et al., 2009). The farm-specific

risk factors were entered into a web-based lameness risk assessment (http://www.rvc.ac.uk/RVCSE/Projects/HealthyFeet_RiskAssessment.cfm).

The website generated a list of farm-specific management strategies that were then either forwarded by e-mail or printed out and mailed to the farm. All MS farms were offered a follow-up visit, usually within 2 mo, by a veterinarian, who provided farm-specific advice based on the risk factors identified during the first visit and agreed with the farmer on a farm-specific action plan designed to reduce lameness.

During the visits that took place at the beginning of yr 2 and 3, the researchers took a facilitator approach to discussing with the farmers their plans to reduce lameness over the upcoming year. Facilitation involved the use of discussion and questioning to assist the farmers' exploration of lameness-related issues on their own farms (Hogan, 2003). This was in contrast to the advisory approach used in yr 1 and was aimed at helping the farmers identify and formulate their own plans rather than offering direct advice. This process again led to the formulation of a farm-specific lameness action plan.

Using social marketing principles, where commercial marketing techniques are applied to a social benefit, farmers were encouraged to implement and sustain actions outlined in the lameness action plan. The intervention approach was based on the community-based social marketing principles described by McKenzie-Mohr and Smith (1999). In summary, the researchers encouraged farmers to openly discuss the potential benefits and barriers to actions being considered and countered concerns by sharing views that they had gathered from other farmers. The researchers used techniques that encouraged commitment to the project, reassured farmers that lameness management behaviors were normal practice, and incentivized and prompted implementation of agreed actions (Whay and Main, 2010). Details of the tools used in this project are included in Table 1. A distinct project brand identity "Healthy Feet Project" and logo, which included the UK flag, was used on all project resources to promote a sense of pride in project participation. In response to continuous (informal) appraisal by farmers during visits and policymakers on the steering group, these resources evolved during the project.

Data Analysis

Comparisons of lameness prevalence between MO and MS farms and between the different groups (SW, SE, NE, or organic) were made using analysis of co-variance. Statistical analysis was carried out using PASW

Table 1. The materials used by the researchers to promote lameness-related positive behaviors based on social marketing principles

Materials available from second visit onward	Materials available from third visit onward
	Facilitation: promoting “ownership” of problems and solutions
• Farm-specific facilitated action plan describing the action points agreed during the farm visit	• Farm-specific seasonal calendar that summarized the incidence of lameness during the year and was a basis for a discussion on the root causes of lesions
	Benefits and barriers: ensuring all parties understand positive and negative motivations
• Sharing of messages arising from farmer focus groups on benefits of specific actions that should reduce lameness and overcoming barriers limiting introduction of such changes	• Poster detailing the estimated costs of lameness cases
	Commitment: promote long-term motivation
• Window sticker and lapel badge using the project logo	• Wool hat with the project logo
• Insulated mugs with the project logo given to farmers participating in the group meetings	
• Signing the facilitated action plans	
	Norms: knowing that others are also changing
• Verbal reports of activities on other farms	• Cards giving the contact details of farmers (with their consent) who had experience of a particular husbandry change
• Showing pictures of examples of good husbandry practice and changes undertaken by other farmers in the project	
	Prompts: reminding people of agreed actions
• Externally generated technical information including slurry management and foot bath regimens	
• Catalogue containing the details of lameness related equipment and services	
• Follow-up telephone calls between visits were used to prompt the farmer to undertake the previously agreed actions	
• Cartoons reminding farmers of the key target areas they need to consider	
• Regular newsletter that gave examples of farmers positively responding to the project	

Statistics 17 (SPSS Inc., Chicago, IL). Significance was at $P < 0.05$. The effect of the support provided to farms was analyzed by the construction of a multivariable model. MLwiN v.2.01 (Rasbash et al., 2009) was used to model the repeated measurements of lameness prevalence on consecutive annual visits to farms using a hierarchical structure with year as level 1 and farm as level 2. The prevalence of lameness on the baseline visit was used as a covariate in the model to adjust for between-farm differences. Lameness prevalence was the outcome measure; yr 2, 3, and 4 were entered as a continuous variable; and the MS versus MO “intervention” was a binary variable.

RESULTS

In total, 189 out of the initial 227 farms were visited on all 4 occasions during the project. The most common reason given by the 38 farmers leaving the study was selling the dairy herd ($n = 15$). Other reasons were lack of interest, generally due to the perception that there was no benefit from the project ($n = 8$), being too busy ($n = 8$), changing milk buyer (3), and family circumstances (4).

Lameness Prevalence

The lameness prevalence is reported for those 189 farms remaining at the end of the study. The prevalence of lameness within the nonorganic farms from the SW, SE, NE regions and organic farms on the first visit is given in Figure 1. Each group had considerable variation, with all groups containing some farms with $<20\%$ and others with $>60\%$ lameness prevalence. A difference was observed in the initial lameness prevalence between these groups ($F_{3,185} = 9.013$, $P < 0.001$). On the first visit, the lameness prevalence was lower ($P = 0.036$) in the MS farms (33.3 ± 1.76) compared with the MO farms (38.9 ± 2.06). The SW group (33.4 ± 2.64) had a lower ($P = 0.042$) prevalence than the SE group (44.0 ± 2.65). The organic group (28.8 ± 2.05) had a lower ($P < 0.001$) prevalence than the SE and NE (44.1 ± 3.44) groups.

Over the study, lameness prevalence was reduced to a similar extent in the MO and MS groups. The mean lameness prevalence on the final visit was 27.0 ± 1.94 in the MO group and 21.4 ± 1.28 in the MS group. Lameness prevalence was lower on the final visit compared with the first visit on 54 (75%) MO farms and on 83 (71%) MS farms (Figure 2). Of these improving

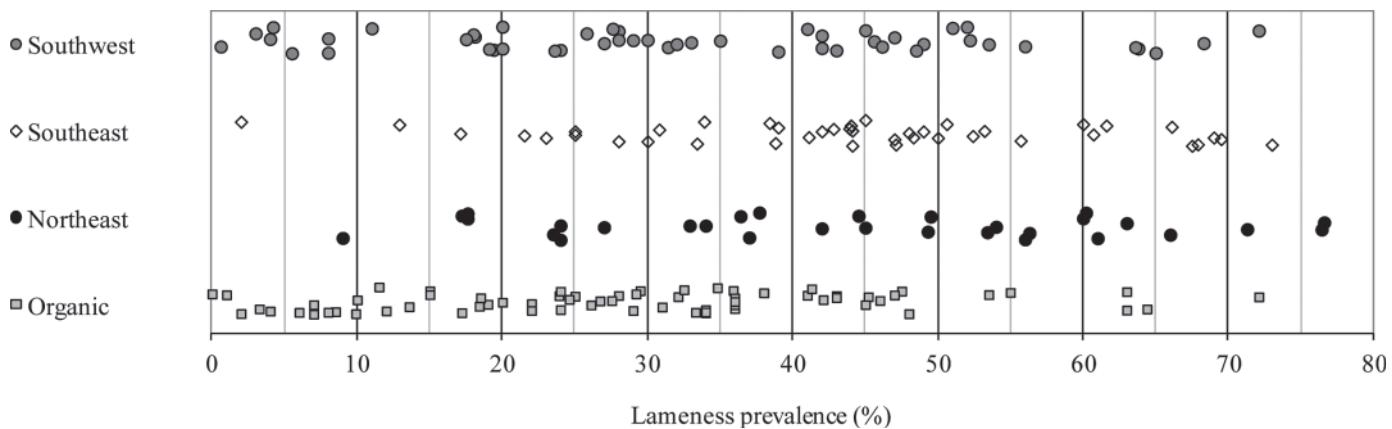


Figure 1. The prevalence of lameness observed during the first visit on farms from the Southwest ($n = 50$), Southeast ($n = 42$), Northeast ($n = 30$), and organic ($n = 67$) groups.

farms, 38 (72%) in the MO group and 60 (70%) in the MS group had reduced lameness prevalence by more than 10 percentage points.

The mean prevalence of lameness on each visit for each group of farms is in Table 2. The group mean prevalence ranged from 25.1% (organic MS) to 45.1% (NE MS) on the initial visit and from 12.9% (organic MS) to 33.7% (NE MO) on the final visit. The mean

prevalence of lameness observed in MO and MS groups at each visit is in Figure 3a. Lameness prevalence was lower at the final visit compared with the initial visit for both the MO ($F_{1, 142} = 17.9, P < 0.001$) and the MS ($F_{1, 232} = 30.4, P < 0.001$) groups. In addition to the overall difference observed at the first visit, the lameness prevalence was lower in the MS than the MO group at the third ($F_{1, 185} = 5.04, P = 0.026$) and final

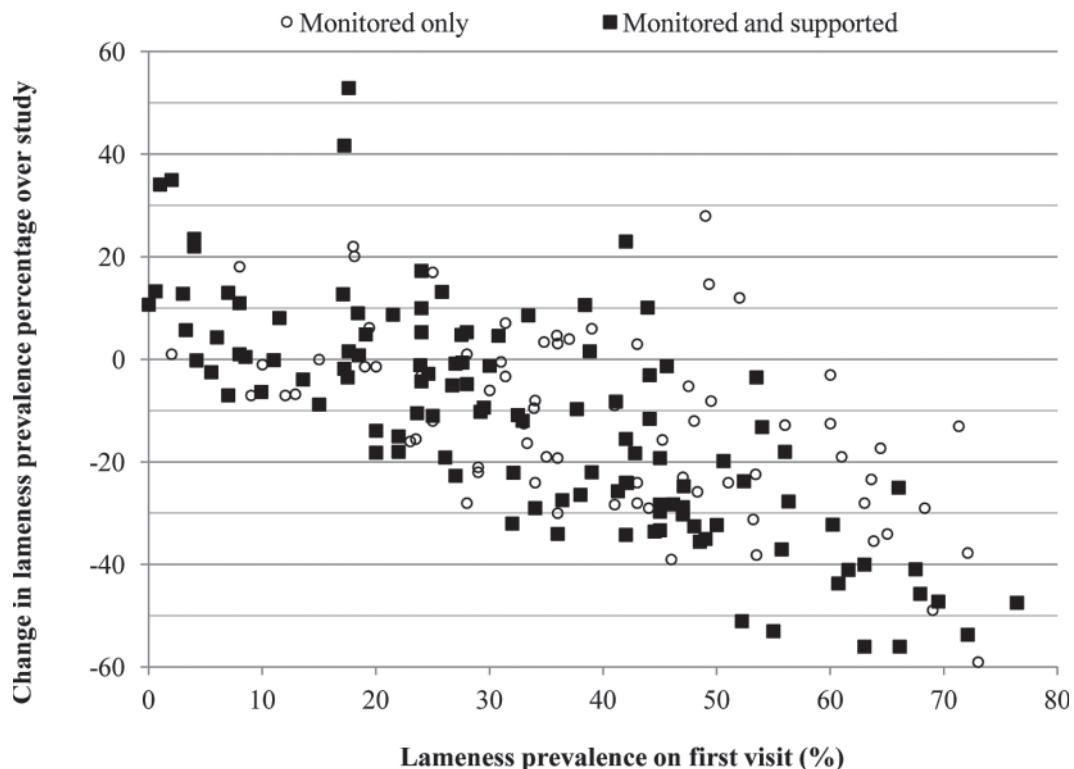


Figure 2. The change in herd lameness prevalence percentage that occurred after 3 yr compared with the lameness prevalence observed on the first visit on farms that were monitored only ($n = 72$) and on those that were monitored and supported ($n = 117$).

Table 2. The mean (\pm SEM) prevalence of lameness (%) at each visit to dairy farms in different areas of the UK and the mean number (\pm SEM) of changes made in each group over the whole project

Group/region	n	Visit 1	Visit 2	Visit 3	Visit 4	Husbandry changes
		Oct. 2006 – May 2007	Oct. 2007 – May 2008	Oct. 2008 – May 2009	Oct. 2009 – May 2010	
Monitored only						
Southwest	24	39.4 (3.6)	34.9 (3.0)	33.7 (3.2)	32.7 (3.6)	7.4 (1.0)
Southeast	11	41.0 (7.7)	26.3 (4.7)	27.3 (5.1)	20.9 (5.3)	7.7 (2.0)
Northeast	10	41.9 (5.8)	35.1 (7.0)	36.0 (7.1)	33.7 (6.5)	7.1 (1.8)
Organic	27	35.0 (2.9)	23.3 (2.7)	21.6 (2.1)	21.1 (2.9)	4.9 (0.6)
Monitored and supported						
Southwest	26	26.6 (3.6)	31.2 (4.5)	24.7 (3.4)	22.7 (3.0)	6.8 (0.7)
Southeast	31	45.0 (2.5)	35.4 (2.8)	29.1 (3.2)	26.8 (3.4)	8.2 (0.9)
Northeast	20	45.1 (4.3)	39.0 (5.2)	33.9 (5.7)	29.8 (5.9)	10.4 (0.8)
Organic	40	25.1 (2.9)	16.6 (2.0)	15.3 (2.0)	12.9 (1.6)	8.2 (0.6)

($F_{1,187} = 6.91$, $P = 0.0093$) visits, but not at the second visit.

A multivariable 2-level model was used to investigate the effect of the treatment (MO vs. MS) over the study period. The Q-Q plots of the residuals showed these were normally distributed, and the plot of residuals versus predicted values gave no cause for concern. Using the prevalence on the second, third, or final visit as the outcome variable, the effect of year of the visit was significant ($P = 0.025$). The covariate of lameness prevalence on the initial visit was highly significant ($P < 0.001$). The treatment effect alone was not significant ($P = 0.108$). We observed a significant interaction between intervention and year ($P = 0.008$).

The model and estimates (SE) took the form below:

$$\begin{aligned} \text{Lameness prevalence}_{ij} &= 13.310 (2.746) \\ &+ [0.497 (0.042) \times \text{lameness prevalence at visit } 1_j] \\ &+ [4.483 (2.782) \times \text{MS intervention}_j] - [1.327 (0.593) \\ &\quad \times \text{year } ij] - [1.991 (0.753) \times \text{MS intervention} \\ &\quad \text{and year interaction}_{ij}], \end{aligned}$$

$$\text{Between-farm variation } (\sigma_u^2) = 97.809 (11.859),$$

$$\text{Between-visit variation } (\sigma_e^2) = 50.577 (3.678),$$

where i = year and j = farm.

Lameness-Related Husbandry Changes

The mean number of changes per farm (Table 2) made by each group over the course of the project ranged from 4.9 (organic MO) to 10.4 (NE MS). The total mean number of changes per farm was greater

($P < 0.05$) for the farmers in the MS group (8.2 ± 0.39) than for those in the MO group (6.5 ± 0.54). The mean number of changes undertaken in the MS and MO farms in each year is shown in Figure 3b. The MS farms undertook more lameness-related changes in the year before the second and third ($P < 0.05$) visits, but not the fourth visit.

Each change was classified into 1 of 6 target areas (Table 3). For each target area, the 2 most common changes across both groups were as follows. Changes targeted at improving “underfoot surface and cow flow” included new (109) or resurfaced lanes or gateways (46). Improvements to “lying and standing time” included changes to group composition during milking (53) and freestall design (45). Better “treatment of lame cows” was demonstrated by modification of handling facilities (34) or use of an external foot trimmer (32). “Footbath” modifications included increased frequency of bathing (43) and providing new facilities (34). Changes relating to “foot hygiene” were the least common target area, including purchase of scraper (21) and increased frequency of scraping (12). Other changes included general activity such as staff changes (89) and major changes to diet (76). The MS farms undertook more changes ($P < 0.001$) for 3 of 6 target areas (Table 3).

During the 3-yr intervention period, many farmers attended lameness-related educational events and received lameness-specific information from the project and from other sources. Farmers in the MS group generally responded positively to the additional support provided by the project. The majority (90%) of MS farms accepted the offer of a veterinary advisory visit in the first year. Farmers who declined such an offer occurred in all treatment groups and declined largely because they considered that they had low levels of lameness and did not need advice. We did not observe any obvious pattern to the geography or organic status

Table 3. The mean (\pm SEM) number of changes per farm classified on their likely effect on lameness and their relevance to 6 target areas on either monitored only (MO, $n = 72$) or monitored and supported (MS, $n = 117$) farms

Item	Mean (SEM) changes/farm		
	MO	MS	Significance ¹
Total changes made during project	6.5 (0.54)	8.2 (0.39)	*
Changes made in each target area:			
Underfoot surface and cow flow	1.15 (0.15)	2.18 (0.13)	***
Lying and standing time	0.92 (0.16)	1.51 (0.15)	***
Lameness treatment	0.88 (0.13)	1.39 (0.12)	***
Footbath	0.85 (0.11)	0.84 (0.09)	NS
Foot hygiene	0.28 (0.06)	0.33 (0.06)	NS
Other	2.40 (0.25)	1.96 (0.15)	NS

¹Difference between MO and MS farms: * $P < 0.05$; *** $P < 0.001$.

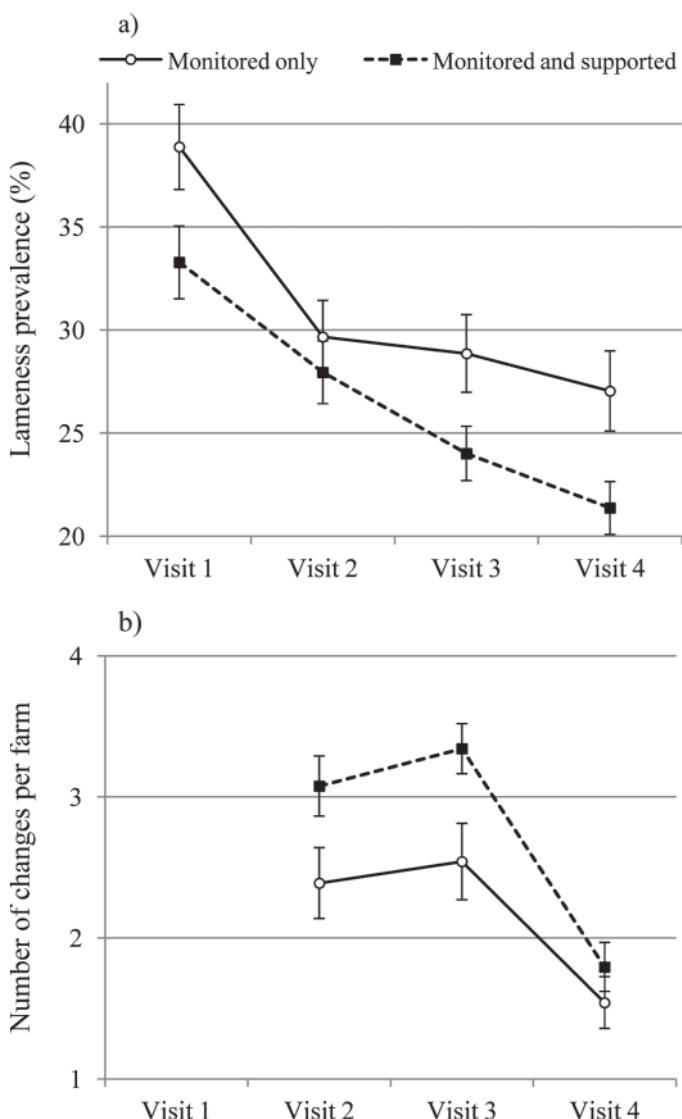


Figure 3. The mean (\pm SEM) prevalence of lameness observed (a) and number of reported changes made (b) in the previous year on each visit for farms that were either monitored only ($n = 72$) or monitored and supported ($n = 117$).

of the farms that declined this initial advisory input. All farms in the MS group received social marketing support and participated in the lameness discussion with the researchers during the second and third visits (Table 1). In total, 83 farmers in the MS group (71%) attended at least one lameness event organized either by the research team ($n = 57$) or by another organization ($n = 26$), such as dairy companies, DairyCo (Great Britain milk levy board, Kenilworth, UK), and local veterinary practices. Twenty-eight MO farmers (39%) reported that they had attended lameness events not instigated by the research team. In addition, some farmers from both the MO group ($n = 50$, 69%) and the MS group ($n = 70$, 60%) reported that they had received either general lameness information from newsletters and the farming press or farm-specific advice from their veterinarian or other consultants.

DISCUSSION

Motivating people to change behavior is important for many issues, and other studies have investigated different approaches to promote uptake of best practices in dairy cattle health and welfare (Green et al., 2007; March et al., 2008; Jansen et al., 2010a). In a previous study based on a basic innovation diffusion model (Wejnert, 2002), the provision of validated external advice over a 1-yr intervention period had limited effect on lameness in primiparous heifers (Bell et al., 2009). This study aimed to ensure that the knowledge base of farmers, either derived from the veterinary advice given as part of the project or from elsewhere, was implemented in practice. Based on concepts derived from behavior change research in other sectors, all farms in the MS group participated in a facilitated lameness discussion and received the relevant social marketing support. Researchers involved in the farm visits were knowledgeable in lameness management. Their role was to help the farmers synthesize and apply the knowledge offered

during the veterinary visit or from other sources while avoiding “telling” farmers what to do. The intention of this study was to determine the effectiveness of the support given to the MS group compared with farms that did not receive this support (MO group).

An unexpected finding was the reduction in lameness observed in the MO group over the study period. This group may have been positively influenced by other nonproject sources and unintentional influences arising directly from the project. We found some evidence of nonproject influences on the MO farms, as 39% of these farms reported that they had attended lameness-specific events and 69% had received lameness-specific information outside the project. Some of this activity was stimulated by initiatives such as the development of a nationally agreed UK mobility (i.e., lameness) score (DairyCo, 2009). Several retailers had required participation in regular lameness scoring and health-planning sessions with their veterinarians. In addition, the UK government had supported lameness-related evening meetings for farmers and had introduced lameness-specific criteria within the cross-compliance (legislation) guidance notes that were applicable to England and Wales.

The project may have had unintentional influences on MO farms. The level of lameness-related husbandry activity on MO farms appeared greater than that on farms not involved in the project, as reported by Whay et al. (2010). One important but unavoidable influence may have arisen from the lameness monitoring procedures. All farms (MO and MS) received feedback on their lameness prevalence and identity of individual lame cows after each visit. Furthermore, all farmers were encouraged to record lameness in their own herds. The increased attention to monitoring lameness undertaken on all participating farms could have contributed toward a reduction in lameness across the study, including those farms in the MO group. “Contamination” could have occurred between farms, with wider circulation of project-related information or discussion of lameness management ideas between MO and MS farms. Finally, the recognized control-group phenomenon, sometimes termed the Hawthorne effect, may have positively influenced the MO group. The subjects’ knowledge that they are in an experimental control group can positively influence their behavior (Adair, 1984). This is difficult to avoid without recruiting new, uninfluenced control farms every year.

The group that received some additional financial incentive (NE MS) had the largest mean number of changes over the course of the project (10.4 ± 0.83 compared with 7.1 ± 1.17 for the MO group in the NE; Table 3). Despite this, the improvement in lameness observed in this group was similar to that seen in other

groups. Hence, we have not shown that providing direct financial support had a dramatic effect on reducing lameness prevalence, even though financial considerations have been reported by farmers as a significant barrier to implementing change (Leach et al., 2010a). The group sizes were relatively small and the financial incentive provided may have been inadequate. Also, because the farmers had a choice in deciding how to allocate the incentive, it may have been poorly targeted at reducing lameness.

As reported in previous studies (Clarkson et al., 1996; Whay et al., 2003), the geographical location of the farm influenced the observed lameness prevalence. It is likely that farms in similar regions have similar climate and housing systems and, thereby, lameness risk factors. The breed choice, which was shown to be an important risk factor by Barker et al. (2010), was likely similar in each region. As shown previously (Rutherford et al., 2009), organic status was associated with lower lameness prevalence. It is encouraging to observe that even the group with the lowest initial prevalence (organic MS group) was able to reduce its mean lameness prevalence considerably, from 25.1 ± 2.9 to $12.9 \pm 1.6\%$.

The focus of this study was on encouraging change, and the overall response of farmers was generally positive in terms of both changes made and reductions in lameness achieved. It is clear that lameness remains a significant welfare concern for the UK dairy industry. Jansen et al. (2010b) investigated “hard-to-reach” dairy cattle farmers, who had failed to respond to mastitis interventions, and proposed that they could be classified as “proactivists, do-it-yourselfers, wait-and-see-ers, and reclusive traditionalists.” Ultimately, one mechanism that may be needed for some farmers that do not respond to positive interventions is to use marketplace or legislative requirements (Whay and Main, 2010).

CONCLUSIONS

This study has highlighted the challenges associated with undertaking “controlled” intervention studies within a commercial environment and demonstrated the importance of evaluating the effectiveness of intervention programs. The reduction in lameness seen in all groups suggests that farmers can be responsive to lameness-related initiatives. We hope that future studies will explore the optimum intervention approaches to reducing lameness in dairy cattle.

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