Effect of early lactation foot trimming in lame and non-lame dairy heifers: a randomised controlled trial

O. J. R. Maxwell, C. D. Hudson, J. N. Huxley

Foot trimming is a common management intervention in prevention of lameness in dairy cattle. Despite this, there is surprisingly limited experimental evidence on its efficacy, especially in regard to primiparous heifers. A randomised, negatively controlled trial was conducted to investigate the association between an early lactation foot trim on primiparous animals and production outcomes. 282 heifers were enrolled from eight farms in the UK, and randomly assigned to treatment or control groups. Milk yield (305-day-adjusted whole-milk yield) was not significantly different between groups (trimmed 7727 litres, untrimmed 7646 litres). However, multivariate regression analysis demonstrated that this relationship was confounded by lameness state. Animals that were lame at the time of trimming gave significantly more milk (734 litres, P=0.02) than those that were non-lame and untrimmed. The present results suggest that, based on milk production alone, it would not have been cost beneficial to trim all heifers; however, a targeted intervention aimed at lame animals would have delivered a substantial return on investment. As a very minimum, the authors recommend heifers should be regularly assessed in early lactation, and treated as soon as they are identifiably lame. The high prevalence of lesions identified suggests routine trimming for all heifers may be justifiable on welfare grounds even if the milk-yield benefits are marginal.

Introduction
Routine foot trimming is a common management intervention aimed at preventing lameness in cattle. Despite its widespread adoption by the industry, lameness remains a common condition in the UK dairy herd (Barker and others 2010). Historically, much of the management advice provided by vets and consultants has had its roots in expert opinion, and a solid evidence base has been lacking (Potterton and others 2012). Efforts to ameliorate this knowledge gap have seen research on the importance of early treatment intervention (Groenevelt and others 2014), improvements in cattle mobility through increased frequency of routine trimming (Manske and others 2002a, Smith and others 2007) as well as studies aimed at preventing lameness in cattle. Despite its widespread adoption, lameness remains a common condition in the UK dairy herd (Barker and others 2010). Historically, much of the management advice provided by vets and consultants has had its roots in expert opinion, and a solid evidence base has been lacking (Potterton and others 2012). Efforts to ameliorate this knowledge gap have seen research on the importance of early treatment intervention (Groenevelt and others 2014), improvements in cattle mobility through increased frequency of routine trimming (Manske and others 2002a, Smith and others 2007) as well as studies aimed at improving the present understanding of the pathophysiology of lameness lesions, both infectious and claw horn. There is, however, still a lack of understanding of how to prevent or minimise the incidence of claw horn disease in primiparous heifers despite evidence suggesting that they are at an increased risk (Cook and others 2009).

Lameness can be particularly painful in cattle (Whay and others 1998), and has significant effects on production (Archer and others 2010, Huxley 2012). Lame cows have been shown to produce less milk for up to four months before and five months after identification of the lesion (Green and others 2002), which, for some cows, may encompass an entire lactation. The magnitude of production loss depends on the type and severity of lesion as well as the effectiveness of any treatment administered (Amory and others 2008). However, it has been demonstrated that, even with successful intervention, cows, which have gone lame previously, are more likely to suffer from lameness in the future (Reader and others 2011), making prevention an important aspect of lameness control.

Previous work investigating the effects of claw trimming found that a single intervention resulted in lower odds of lameness and claw horn lesions when animals were trimmed and re-examined six months later (Manske and others 2002a). The authors were unable to attribute the reduction to either a preventative or a therapeutic effect as no intermediate examinations were made. This intervention was conducted irrespective of the stage of lactation of the cow. In another study by Hernandez and others (2007), cows, which had no previous history of lameness, were trimmed at 200 days post calving (cows with previous treatments for lameness were excluded). The trimmed group experienced a reduction in lameness incidence (25 v 18 per cent), but this difference was not significant. While the study conducted by Manske and others (2002a) included nulliparous heifers within two months of calving as well as primiparous heifers, data on these animals were not analysed separately, and no conclusions were drawn about them.
The aim of the present trial was to evaluate whether a single, foot-trimming intervention of dairy heifers’ feet at 50–80 days post calving was beneficial in terms of production parameters during the first lactation.

**Materials and methods**

**Study design and reporting**

A negatively controlled, randomised clinical trial was designed to evaluate the benefit of a single, functional and, if warranted by the presence of lesions, therapeutic foot trim between 50 and 80 days post calving in primiparous Holstein dairy heifers.

The primary hypothesis was that the milk yield of study animals was affected by the trimming intervention. The primary outcome measure was 305-day-adjusted whole-milk yield in the lactation in which the intervention took place. The secondary hypothesis was that fertility would be affected by the intervention. The secondary outcome was 100-day-in-calf rate (a fertility metric quantifying the proportion of cows, as a percentage, confirmed in calf again to a service within 100 days of the previous calving) in the lactation in which the intervention took place. Both outcomes were measured at the individual animal level. A cost-benefit calculation estimated that an increase in production of 346 litres in 305-day yield would be required to generate a 3:1 return on an intervention investment of £15 (approximate cost of a four-foot-trim). Margin over all feed was used as the primary profitability index; a value of 13 pence per litre (ppl) was used (based on a 25 ppl milk price) in the calculation. The sample size required to detect this difference was calculated to be 170 animals in each treatment group (power value=0.8, P=0.05).

The trial was conducted under the UK Veterinary Surgeons Act 1966, and the protocol was reviewed and approved by the University of Nottingham’s School of Veterinary Medicine and Science Ethical Review Committee before commencement of the trial. The study manuscript has been prepared in accordance with the guidelines outlined in the Reporting guidelines for randomised controlled trials (REFLECT) statement for reporting randomised controlled trials in livestock (O’Connor and others 2010).

**Herd selection**

Convenience samples of dairy farms with Holstein cows were selected for inclusion in the trial on the basis of their meeting the following criteria: average herd 305-day lactation milk yield more than 8500 litres (whole milk), currently conducting routine monthly milk recording, not currently routinely foot trimming heifers post calving, sufficient heifers likely to be available for enrolment over the study period, willingness to participate in the study. Eight farms were identified and recruited through their veterinary surgeons in five practices geographically distributed throughout England. Descriptive information on the enrolled farms is outlined in Table 1. Descriptive information on the enrolled farms is outlined in Table 1. Descriptive information on the enrolled farms is outlined in Table 1.

**Randomisation and data collection**

Farms were visited every 30 days between July 2013 and March 2014 when eligible heifers were available to be recruited to the study. A list of animal identification numbers of all heifers between 50 and 80 days post partum on the planned visit day was generated before the visit. Randomisation was blocked by farm; heifers were allocated alternately to each treatment group as their identification numbers were drawn with the guidelines for reporting randomised controlled trials (REFLECT) statement for reporting randomised controlled trials in livestock (O’Connor and others 2010).

**Lesion classification**

Lesions identified in treatment-group animals were classified into one of six categories:

1. Sole haemorrhage: evidence of historical bleeding from the corium, ranging from a few specks of blood in the sole horn to large areas of haemorrhage.
2. Sole ulcer: an area of complete interruption of horn formation.
3. White-line haemorrhage: evidence of haemorrhage in the white line.
4. White-line separation: complete separation (with or without infection) of the white line.
5. Digital dermatitis: presence of a characteristic lesion.
6. Slurry heel: significant erosion to the horn around the heel, requiring corrective trimming to remove.

**Data collation and statistical analysis**

Fertility and milk yields were collected from milk recordings and on-farm management systems. Data were collated between

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**Table 1**

| Enrolled Farms | Description |
|---------------|-------------|
| Farm A | Located in Yorkshire, home to a medium-sized dairy producer |
| Farm B | Situated in the Midlands, owned by a large-scale dairy operation |
| Farm C | Based in the West Country, operated by a medium-sized dairy farm |
| Farm D | Located in the East Midlands, managed by a small-scale dairy enterprise |
| Farm E | Based in the West Midlands, owned by a medium-sized dairy producer |
| Farm F | Located in the East of England, managed by a small-scale dairy enterprise |
| Farm G | Situated in the North West, operated by a large-scale dairy operation |
| Farm H | Based in the South West, owned by a medium-sized dairy producer |
May 2013 (the calving date of the first enrolled animal) and November 2014 (the point at which the last animals reached 305 days post partum). The data were recorded on data capture sheets and then transcribed into a relational database (Access 2007, Microsoft). Data were audited for validity and spurious records by manually scanning for outlying data points following sorting within each data category. A small number of errors (<10) were identified and corrected.

Study randomisation was tested by comparing body condition score and mobility score between treatment and control groups using the Mann-Whitney U test. Days in milk at enrolment was normally distributed and compared using a two-sample t test. The primary outcome (305-day yield) was compared between groups using a two-sample t test, after testing yield distribution for normality. One-hundred-day in-calf rates were calculated for each group, with proportions compared using a chi-squared test. The significance probability was set at $P \leq 0.05$ for a two-tailed test.

The associations between treatment group and the outcome variables were further tested using multivariate regression analysis. Two regression models were built. Model 1 was designed to investigate associations between treatment intervention and 305-day yield, while accounting for potentially confounding associations between milk yield and body condition score, mobility score and herd. Model 2 was a logistic regression model designed to investigate associations between trimming and 100-day in-calf rate, while accounting for confounding associations between reproduction and body condition score, mobility score and herd. In order to represent the interactions between treatment and lameness status at the time of trimming, these variables were combined into a single variable with four categories (non-lame/trimmed, non-lame/untrimmed, lame/trimmed and lame/untrimmed). Mobility scores 2 and 3 were considered lame, and scores 0 and 1 were considered non-lame.

Models were built using forward selection, with variables retained in the model if the magnitude of the coefficient estimate for at least one category of the variable was greater than twice the se of the estimate (equivalent to $P \leq 0.05$). Rejected variables were reoffered to the final model and retained if they then met the criteria above. Model assumptions for model 1 were checked by visual assessment of distribution of heifer-level residual errors to evaluate normality, and assessment of a plot of predicted value versus residual error to evaluate homoscedasticity. Model fit for the logistic regression model (model 2) was tested using the Hosmer-Lemeshow goodness of fit test. Where model fit criteria were not met, inclusion of additional model terms was considered. Model building and testing were carried out using R V3.1.2 (R Core Team 2014).

### Results

#### Study inclusions and exclusions

Between July 2013 and March 2014, a total of 281 heifers from eight farms were enrolled with 139 trimmed and 142 left untrimmed. The breakdown of heifers in the treatment and control groups is included in Table 2.

A total of six animals (one treatment animal on farm 1 and five treatment animals on farm 5) were eligible for inclusion, and were allocated to a group (without the farmers knowledge), but were not presented on the day of the farm visit. These animals were not enrolled. The number of heifers recruited fell short of the target sample size of 170 in each treatment group, predicted by the power calculation.

No adverse events were noted in any study animals. Sixteen animals were culled before reaching 305 days post partum. Of these, seven were in the treatment and nine were in the control groups (farm 1: two treatment, two control; farm 2: one control; farm 3: one control; farm 4: two treatment; farm 5: two treatment, three control; farm 6: one treatment, two control). Detailed information on why animals were culled was not collected. These animals were excluded from statistical analysis for the primary study outcome (305-day milk yield); they were included in other analyses as appropriate.

### Descriptive results and univariate analysis

Distributions of body condition score, mobility score and days in milk were similar between groups (Table 3, no significant differences), suggesting that randomisation was successful. The 305-day corrected yields of trimmed (n=132) and untrimmed heifers (n=154) were not significantly different; sample means (sd) in the trimmed and control groups were 7727 litres (1611 litres) and 7646 litres (1555 litres), respectively. One-hundred-day in-calf rates (trimmed 45 per cent, not trimmed 53 per cent) were not significantly different between groups.

Of the animals trimmed (ie, the treatment group, n=159), 95 per cent (152 of 159) had some pathology to at least one claw. A breakdown of the number of heifers affected by each lesion is outlined in Table 4.

### Multivariate analysis

Statistically significant associations were found between 305-day-adjusted milk yields and mobility score/trimming

### Table 1: Descriptive information of participating farms in a trial designed to test a foot-trimming intervention in first-lactation dairy heifers

| Farm | Approximate milking herd size | Heifer calving pattern | Housing system for rearing heifers | Periparturient accommodation | Mean age at first calving (months) | % of herd which are 1st lactation | Lactating cow housing systems |
|------|------------------------------|------------------------|-----------------------------------|-------------------------------|-----------------------------------|---------------------------------|---------------------------------|
| Farm 1 | 400 | 8351 | Year round | Pasture (outwintered) | 27 | 27 | Sand cubicles |
| Farm 2 | 550 | 8351 | Year round | Pasture (outwintered) | 27 | 29 | Sand cubicles |
| Farm 3 | 450 | 9200 | Year round | Straw cubicles | 27 | 22 | Sand cubicles |
| Farm 4 | 320 | 7906 | Year round | Straw yard | 26 | 29 | Mattress cubicles |
| Farm 5 | 300 | 9849 | Year round | Mattress cubicles | 27 | 40 | Mattress cubicles |
| Farm 6 | 250 | 7638 | Autumn | Kennel cubicles | 25 | 35 | Mattress cubicles |
| Farm 7 | 300 | 9080 | Autumn | Straw yard | 25 | 41 | Mattress cubicles |
| Farm 8 | 350 | 9977 | Year round | Mattress cubicles | 32 | 24 | Mattress cubicles |

### Table 2: Distribution of enrolled heifers between treatment and lameness categories by farm in a trial designed to investigate a foot-trimming intervention in first-lactation dairy heifers

| Farm | Treatment | Control | Lameness prevalence |
|------|-----------|---------|---------------------|
| Farm 1 | 20 | 2 | 19 | 4 | 45 | 13 |
| Farm 2 | 10 | 2 | 8 | 3 | 23 | 21 |
| Farm 3 | 6 | 1 | 4 | 2 | 13 | 23 |
| Farm 4 | 16 | 5 | 17 | 4 | 42 | 21 |
| Farm 5 | 35 | 4 | 39 | 5 | 83 | 11 |
| Farm 6 | 15 | 1 | 14 | 1 | 31 | 6 |
| Farm 7 | 9 | 1 | 6 | 4 | 20 | 25 |
| Farm 8 | 8 | 4 | 7 | 5 | 24 | 37 |
| Total | 119 | 20 | 114 | 28 | 281 | 20 |
category, body condition score and herd of origin in model 1. Heifers that were lame (score 2 or 5) at the time of enrolment and trimmed (n=20) demonstrated an increase in yield of 734 litres (P=0.02, 95% CI 98 to 1370 litres) compared with the reference category (non-lame/untrimmed (n=114)). The other categories (non-lame/trimmed (n=119) and lame/untrimmed (n=28)) were not significantly different from the reference. However, when farms 5 and 8 (farms with significantly higher milk yields in heifers) were removed from the model, the lame/trimmed group ceased to be significant. Analysis of farms 5 and 8 alone demonstrated a trend (P=0.06) towards a greater yield difference of 959 litres in the lame/trimmed category. Parameter estimates for model 1 are shown in Table 5.

Statistically significant associations were found between the odds of pregnancy occurring by 100 days and mobility score/trimming category and milk yield in model 2. Heifers that were lame and trimmed (n=20) had significantly lower odds of being in calf by 100 days (P=0.04, OR 0.31, 95% CI 0.10 to 0.97) compared with the reference category (non-lame/untrimmed (n=114)). The other categories (non-lame/trimmed (n=119) and lame/untrimmed (n=28)) were not significantly different from the reference. Parameter estimates for model 2 are shown in Table 6. Model fit was satisfactory for model 1; in the case of model 2, the herd variable was retained in the model in order to produce a well-fitting model even though no individual herd was significantly different from the reference herd (no inference was made regarding differences between herds).

Discussion
This is among the first randomised, negatively controlled clinical trials to investigate the impacts of a timed foot-trimming intervention on production in dairy cattle. In this study, heifers were trimmed between 50 and 80 days after calving. Overall, there was no difference in 305-day milk yields between groups (sample means: 7727 v 7646 litres). A power calculation conducted before the study suggested that a sample size of 170 in each group would be worth £95.42—a cost:benefit ratio of 6.4:1. Even if it is assumed that the increase in yield seen in the lame/trimmed group would be worth £37.70 or a cost:benefit ratio of 81 litres (7727 v 7646 litres) was observed. Even if this yield difference was genuine, it would only be worth £10.53 in additional milk (based on a margin over all feed of 13 ppl). The fact that only the lame/trimmed group showed a significant difference in yield from the non-lame/untrimmed group suggests that trimming had a positive effect and partially mitigated the impact of being lame. Based on a margin overall feed of 13 ppl, the increase in yield of 734 litres in the lame/trimmed group would be worth £55.42—a cost:benefit ratio of 6.4:1. Even if it is assumed that the increase in yield seen in the lame/untrimmed group is real, and the actual benefit of atrim intervention is only 290 litres (734–444 litres), this would still be worth £37.70 or a cost:benefit ratio of 2.5:1. Since this trial commenced, new evidence supporting additional treatment in newly lame cattle with claw horn lesions has been presented (H. J. Thomas and others 2015, unpublished data). The study demonstrated that lameness was significantly improved by the application of blocks to the sound claw and the administration of a foot-trimming intervention.

Importantly, multivariate regression analysis demonstrated that the relationship between this outcome and trimming was confounded by lameness state. By investigating the interaction with mobility score, this trial identified that animals that were lame at the time of trimming gave 734 litres more milk over a 305-day lactation than those that were non-lame and untrimmed. While the difference between the lame/untrimmed and the non-lame/untrimmed group was not significant, the model outcome suggested that the lame/untrimmed group also gave 444 litres more milk over 305 days, that is, the present results suggest heifers that were lame between 50 and 80 days post partum gave more milk than their non-lame counterparts. This supports other studies (Green and others 2002, Archer and others 2010), which demonstrated that lameness is a condition associated with higher yield. Indeed, when the two farms with higher-yielding heifers (farm 5 and farm 8) were removed from the model, the difference ceased to be significant. While the reduction in sample size may have played a role in this finding, it is interesting to note that when analysed independently, and despite even smaller sample sizes, farms 5 and 8 showed a strong trend (P=0.06) to a greater increase in yield (939 litres). This suggests that the trimming intervention described here may have a greater effect and, hence, be most beneficial on higher-yielding farms.

TABLE 4: Distribution of numbers and prevalence of lesions within the treatment group in a trial designed to investigate a foot-trimming intervention in first-lactation dairy heifers

| Lesion                  | Number of animals affected (treatment group) | Prevalence (treatment group) (%) |
|-------------------------|---------------------------------------------|----------------------------------|
| Sole haemorrhage        | 132                                         | 95                               |
| Sole ulcer              | 15                                          | 11                               |
| White-line haemorrhage  | 122                                         | 88                               |
| White-line separation   | 8                                           | 6                                |
| Digital dermatitis      | 15                                          | 11                               |
| Slurry heel             | 18                                          | 13                               |

TABLE 5: Parameter estimates for a model with the outcome of 305-day-adjusted milk yield (model 1) in a trial designed to investigate a foot-trimming intervention in first-lactation dairy heifers

| Model term               | Coefficient (95% CI) | P value |
|--------------------------|----------------------|---------|
| Intercept                | 6795                 |         |
| Non-lame/untrimmed       | Reference            |         |
| Non-lame/trimmed         | 144 (−189 to 477)    | 0.39    |
| Lame/untrimmed           | 444 (−124 to 1012)   | 0.12    |
| Lame/trimmed             | 734 (98 to 1372)     | 0.02    |
| BCS ≤2.5 Reference       | −554 (−876 to −233)  | 0.001   |
| BCS >2.5                 | Reference            |         |
| Herd 1                   | Reference            |         |
| Herd 2                   | 659 (−6 to 1324)     | 0.05    |
| Herd 3                   | 943 (130 to 1757)    | 0.02    |
| Herd 4                   | 517 (−36 to 1072)    | 0.06    |
| Herd 5                   | 2081 (1603 to 2560)  | <0.001  |
| Herd 6                   | 87 (−517 to 692)     | 0.77    |
| Herd 7                   | 658 (−181 to 336)    | 0.05    |
| Herd 8                   | 2332 (1664 to 3000)  | <0.001  |

BCS, body condition score.
course of NSAIDs in addition to a therapeutic trim. Had the lame heifers in this trial been treated according to this protocol, further improvements in milk yield may have been seen.

The premise underlying this trial was that by trimming heifers’ feet early in lactation, the claw horn lesion disease complex could be halted early in its course, and the progression to severe disease manifestations (eg, sole ulcer) and their impact on production could be prevented. Heifers in the treatment group in this study demonstrated a high prevalence of foot pathology; 95 per cent of animals showing some damage to at least one claw, and 13 per cent of heifers were found to have at least one sole ulcer on the eight claws examined. Given the nature of the randomisation, there is no reason to suspect that the prevalence of lesions in the control group would be significantly different, although this remains possible. This level of pathology in early lactation supports the evidence that claw horn damage is associated with the periparturient period (Tarlton and others 2002). Despite the high levels of foot pathology identified, only 16 per cent of heifers were identifiably lame on the day of inspection, in line with UK average figures for all ages and stages of lactation according to Rutherford and others (2009), but markedly lower than the levels identified by Barker and others (2010). The poor correlation between visual foot pathology and lameness has been reported previously (Manske and others 2002b). It is not unreasonable to hypothesise that many of the animals identified with claw horn lesions were in the prelame lag phase of disease (ie, disease would continue to progress to a more severe manifestation, or relatively advanced disease was already present, but animals had not yet become lame). However, other reasons contributing to this poor correlation could be related to experience of the scorer, the method of scoring and inherent inaccuracies in subjective systems such as this. The lack of yield difference observed between groups may be because the trimming intervention was timed too late to prevent the development of claw horn lesions. Work conducted by Green and others (2002) has demonstrated that in cases of sole ulcer, yield depression can occur from as much as four months before the identification of lameness. This, together with the high prevalence of pathology found during trimming, suggests that for trimming to be effective as a preventive intervention it may have to take place earlier in the production cycle, possibly before first calving.

The present results suggest that, based on milk production alone, it would not have been cost beneficial to trim all heifers in early lactation; however, a targeted intervention aimed at identifiably lame heifers would have delivered a substantial return on investment. These results highlight the importance of early detection of lameness; as a very minimum, the authors recommend heifers should be mobility scored in early lactation on a regular basis, and treated as soon as they are identifiably lame. As only production parameters were investigated, the authors have no information on whether further cases of lameness (and their associated impacts on welfare) were prevented without having noticeable impacts on milk yield. Consequently, a routine trimming intervention for all heifers may be justifiable on welfare grounds alone even if the milk-yield benefits are marginal.

In the univariate analysis, there was no significant difference in the 100-day in-calf rates between groups, although it must be noted that the study was not powered to investigate this difference. In the multivariate model, animals that were lame and trimmed had significantly lower odds of being in calf than animals that were non-lame and untrimmed. While both non-lame/trimmed groups and lame/untrimmed groups also had lower odds, the differences were not significantly different from the non-lame/untrimmed reference category. These results suggest that the impacts of being lame and being trimmed had a cumulative negative impact on fertility; the relative importance of these two factors cannot be established. The intervention in this study took place between 50 and 80 days post partum, at the time when these animals were likely to be observed for oestrus and inseminated. It is possible that the act of foot trimming a lame cow that is already hyperoestrous (as demonstrated by Whay and others (1998)) caused a temporary reduction in oestrus expression or made animals less likely to conceive. While this finding is of concern, further work is warranted to investigate the impact of trimming around this time more fully. In this context, 100-day in-calf rate could be considered a blunt indicator of fertility performance as it is based on a binary outcome around the time most animals are expected to conceive. Consequently, an extension of the average calving-to-conception interval of just a few days could push considerable numbers of animals over the 100-day threshold, artificially magnifying the apparent impact of a small decrease in fertility.

The study population was a convenience sample drawn from herds with milk yields above the UK average. While the authors have no reason to believe that they were not representative of the more intensive production systems common in the UK, the present results may not be generalisable to heifer managed under other less-intensive systems. This is especially true given the arguments the authors have alluded to around lameness being a condition associated with higher yield. The outcomes assessed in this study were restricted to indirect measures of intervention success (ie, yield and fertility parameters) due to financial constraints. This approach is justifiable as these outcomes are two of the key drivers of farm profitability and because an additional management intervention such as the one tested here needs to be cost beneficial in order for many farmers to consider implementing it. A more complete picture would have been provided with routine mobility-score data and subsequent incidence of lameness. This would have allowed inferences to be made on the effect of trimming on lesions and lameness rather than just production parameters, and could have enhanced the welfare arguments the authors outline. This study is one of the first controlled clinical trials to investigate the impact of a routine trimming intervention. Given that foot trimming is commonly practiced around the world, further trials are urgently required to improve the understanding of how trimming impacts on claw health and production parameters, and to determine the most beneficial time to apply the intervention.

**Conclusion**

In conclusion, this trial demonstrated that based on milk production alone, it was not cost beneficial to trim all heifers in early lactation. However, a targeted intervention aimed at lame heifers would have delivered a substantial return on investment. As a very minimum, the authors recommend heifers should be mobility scored in early lactation on a regular basis, and treated as soon as they are identifiably lame. Trimming all heifers in early lactation may be justified to limit disease progression in animals early in the course of claw horn disease. The negative impacts of foot trimming heifers on fertility is of concern and in need of further

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**TABLE 6: Parameter estimates for a model with the outcome representing odds of pregnancy occurring by 100 days post calving (model 2) in a trial designed to investigate a foot-trimming intervention in first-lactation dairy heifers**

| Model term          | Coefficient | P value | OR (95% CI) |
|---------------------|-------------|---------|-------------|
| Intercept           | 1.70        |         |             |
| Non-lame/untrimmed | Reference   |         |             |
| Non-lame/trimmed   | −0.36       | 0.19    | 0.70 (0.41 to 1.21) |
| Lame/untrimmed     | −0.33       | 0.45    | 0.72 (0.30 to 1.75) |
| Lame/trimmed       | −1.70       | 0.04    | 0.31 (0.16 to 0.60) |
| 305-day milk yield (‘000 litres) | −0.39 | 0.03 | 0.72 (0.56 to 0.90) |
| Herd 1              | Reference   |         |             |
| Herd 2              | −0.63       | 0.25    | 0.50 (0.18 to 1.59) |
| Herd 3              | 0.29        | 0.67    | 1.33 (0.35 to 5.08) |
| Herd 4              | −0.32       | 0.48    | 0.73 (0.30 to 1.78) |
| Herd 5              | 0.55        | 0.20    | 1.73 (0.74 to 4.05) |
| Herd 6              | 0.12        | 0.80    | 1.15 (0.43 to 2.98) |
| Herd 7              | −0.64       | 0.27    | 0.53 (0.17 to 1.66) |
| Herd 8              | −0.58       | 0.32    | 0.56 (0.18 to 1.80) |
investigation to ensure that these impacts do not outweigh the benefits of early intervention and effective lameness treatment.

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