Status of claw recordings and claw health in Danish dairy cattle from 2013 to 2017

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ABSTRACT

Since 2009, Danish claw trimmers have been able to record claw health digitally during trimming. The records are owned by the farmer and can be used locally in the herd and on a large scale by breeding organisations to improve claw health. The objective of this study was to describe data on claw recording routines and describe the prevalence of digital dermatitis (DD), interdigital hyperplasia (IH), sole ulcer (SU) and white line abscess (WLA) recorded by claw trimmers (TrimmerID) at trimming. More than 5.18 million records of cows with claw recordings and 2.75 million records of claw trimming with 2.4 million concurrent claw diseases from 62 TrimmerIDs from 705,803 animals from 1635 herds over a 5-year period from 2013 to 2017 were included in the dataset. Data on cow level was used for the descriptive statistics. The data was restricted to, and grouped by, heifers from 12 months of age, first, second and third or older parity cows from the breeds Holstein, Danish Red Dairy, Jersey and crossbreds.

The number of recorded trimmings per TrimmerID per year varied from 132 to 48,040 with a mean of 9556 and increased during the period studied. The overall prevalence across breed and parity groups of DD, IH, SU and WLA was 21%, 6%, 7% and 3%, respectively. The prevalence of the lesions remained quite constant during the 5-year period. DD was recorded in 95% of the herds in 2017. The prevalence of IH, SU and WLA increased with increasing parity. Digital recording of claw lesions may be a good indicator of claw health. However, the recording routines and quality of the recordings must be considered.

Introduction

Lameness in dairy cattle constitutes an important animal welfare issue (Whay and Shearer, 2017) and causes economic losses (Cha et al., 2010; Charfeddine and Pérez-Cabal, 2017). Recordings of claw health during routine trimming on a larger scale are desirable for the data to reflect the true claw health status. If the records are included in e.g. breeding evaluation, the recordings should be accurate. The routine collection of claw health data also offers a possibility to monitor and analyse the presence and absence of lesions at individual cow level, group level, as well as at herd level. Digital systems have been developed in several countries; most are based on claw trimmers’ records (Kofler, 2013). Since 2009, farmers, veterinarians and Danish claw trimmers have had the opportunity to perform digital recording of claw health during trimming in a common Nordic free-ware program hosted by the Danish Cattle Association, SEGES.\textsuperscript{1} In 2012 and in 2019, the program was updated, and some registrations were simplified (e.g. mild or severe digital dermatitis were merged to digital dermatitis). The data can be used locally on the farm to monitor claw health and plan targeted prevention strategies. The data is also used on a larger scale by the Nordic Cattle Genetic Evaluation (‘NAV’)

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The reasons behind the variable recordings during routine trimming have been investigated. The objectives of this study were to describe the use of digital claw trimming records in Danish herds, to describe the variation in claw health recordings between trimmers and to describe the prevalence of recorded cases of DD, IH, SU and WLA by breed and parity in Danish dairy herds during the period from 2013 to 2017.

Materials and methods

Data included claw health records from 1st January 2013, to 31st December 2017. The recordings are based on the disease definitions in the Nordic Claw Atlas.2 The program links the data collected during trimming to other data collected on the individual animal in the Danish Cattle Database. The claw trimmers receive an individual identification number (TrimmerID) and access to upload their records to the database, and the farmer owns the data from his/her farm.

Only data recorded by claw trimmers, identified by an individual TrimmerID in the database, was included in the analyses. Some claw trimmers work alone on their TrimmerID, and some claw trimming companies have several claw trimmers recording on the same TrimmerID. Recordings made by farmers or veterinarians were excluded. Herds and cows included were identified by their herd and cow numbers. In the recording, software made by farmers or veterinarians were excluded. Herds and cows included have several claw trimmers recording on the same TrimmerID. Recordings in this study were from the 2012-updated program (Klovregistrering),1 and the following claw recordings can be made: claw trimming, HE, interdigital dermatitis, DD, verrucose dermatitis, IH, SH, SU, double sole, white line separation, white line abscess (WLA), toe ulcer/necrosis, asymmetric claws, corkscrew claws, scissor claws, overgrown claws, chronic laminitis and interdigital phlegmone. The disease definitions were based on the Nordic Claw Atlas (Kviesgaard, 2013). Some claw lesions can be recorded at leg.

Table 1
Records of claw lesions and claw trimming collected by Danish claw trimmers from 2013 to 2017, the number of trimmers (TrimmerIDs), claw trimming records, herds, cows and distribution of the recorded population on parity groups and breeds.

<table>
<thead>
<tr>
<th>Year</th>
<th>Minimum</th>
<th>First quartile</th>
<th>Median</th>
<th>Third quartile</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
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<td>3318</td>
<td>7295</td>
<td>12,955</td>
<td>35,172</td>
<td>8838</td>
<td>7113</td>
</tr>
<tr>
<td>2014</td>
<td>641</td>
<td>3332</td>
<td>7316</td>
<td>13,859</td>
<td>37,720</td>
<td>9173</td>
<td>7454</td>
</tr>
<tr>
<td>2015</td>
<td>430</td>
<td>3727</td>
<td>8066</td>
<td>13,669</td>
<td>38,418</td>
<td>9536</td>
<td>7682</td>
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<tr>
<td>2016</td>
<td>176</td>
<td>4192</td>
<td>7876</td>
<td>14,594</td>
<td>42,726</td>
<td>9946</td>
<td>8275</td>
</tr>
<tr>
<td>2017</td>
<td>613</td>
<td>4938</td>
<td>7643</td>
<td>14,871</td>
<td>48,040</td>
<td>10,203</td>
<td>8625</td>
</tr>
<tr>
<td>2013–2017</td>
<td>132</td>
<td>3580</td>
<td>7782</td>
<td>14,386</td>
<td>48,040</td>
<td>9768</td>
<td>7828</td>
</tr>
</tbody>
</table>

1 Including records with trimming and claw lesions and records including lesions without trimming.

2 The program links the data collected during trimming to other data collected on the individual animal in the Danish Cattle Database.

1 Including dairy heifers >12 months and dairy cows.

3 Does not add up to animals recorded in the column since the same animal can participate in more than one parity group during the same year and does not add up in rows to the 2013–2017 number as the same animal can participate in the same parity group in 2 consecutive years.

Table 2
Distribution of number of claw trimmings recorded per trimmer (TrimmerID) per year with minimum, 1st quartile, median, 3rd quartile, maximum, mean and standard deviation (SD).

<table>
<thead>
<tr>
<th>Year</th>
<th>Minimum</th>
<th>1st quartile</th>
<th>Median</th>
<th>3rd quartile</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>927,847</td>
<td>1,099,407</td>
<td>1,038,124</td>
<td>1,108,273</td>
<td>1,101,268</td>
<td>5,184,919</td>
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<tr>
<td>2014</td>
<td>582,300</td>
<td>562,600</td>
<td>561,200</td>
<td>571,600</td>
<td>570,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>3679</td>
<td>3516</td>
<td>3381</td>
<td>2983</td>
<td>2788</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>1200</td>
<td>1243</td>
<td>1261</td>
<td>1268</td>
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<td>54</td>
<td>57</td>
<td>58</td>
<td>59</td>
<td>60</td>
<td>62</td>
<td></td>
</tr>
</tbody>
</table>

1 Including records with trimming and claw lesions and records including lesions without trimming.

2 The program links the data collected during trimming to other data collected on the individual animal in the Danish Cattle Database.

To produce a claw health index for sires (Johansson et al., 2011).

Three studies have evaluated the accuracy of the Danish claw health records (Capion et al., 2008; Kviesgaard, 2013; Skovsgaard, 2018) and reported that the trimmers are quite accurate in their recordings during routine tests, but the accuracy varies during practical trimming conditions in the herds. The studies found claw trimmers’ recordings of digital dermatitis (DD), sole ulcer (SU) and interdigital hyperplasia (IH) to agree most often (Kviesgaard, 2013). All studies found poor agreement for heel horn erosion (HE). The program links the data collected during trimming to other data collected on the individual animal in the Danish Cattle Database. The claw trimmers receive an individual identification number (TrimmerID) and access to upload their records to the database, and the farmer owns the data from his/her farm.

The reasons behind the variable recordings during routine trimming have not been investigated. However, the implications can be severe if claw health data is used uncritically.
level; for the purpose of this study, all recordings were included at cow level.

Previous studies on quality of claw health records have reported an acceptable agreement between claw trimmers and between claw trimmers and an independent observer for DD, IH, SU and WLA (Capion et al., 2008; Kviesgaard, 2013; Skovsgaard, 2018), and data on recordings of these four lesions was used in this study. DD was defined as infection in the skin above the coronary band and/or in the interdigital cleft with erosion, strawberry-like surface, bleeding and/or pain. The definition for IH was swelling of fibrous tissue in the interdigital cleft. The definition of SU was wound in sole horn with exposed corium at the typical sole ulcer site. The definition for WLA was exposed corium with/without pus in the white line originating from a white line separation. These four lesions can cause lameness and do often require treatment (Barker et al., 2009; Thomas et al., 2015).

The following breeds were included in our analyses: Danish Red Dairy (RDM), Danish Holstein, Danish Jersey (Jersey) and crossbred (Cross). Animal groups were defined as heifers more than 12 months old (heifers, parity 0), first parity cows (parity 1), second parity cows (parity 2) and third or older parity cows (parity 3+). The individual cow can have more than one recording of the same lesion per day, e.g. DD on both hind legs, but only one recording of the same lesion per cow per day was included in the analyses. More than one trimmer could record the same cow on the same day, and then both recordings were included. In all but five cases, the cow received a recording of claw trimming together with a recording of a lesion. These five cases were excluded from the analyses. All results are presented descriptively as numbers, proportions etc.

Table 3

<table>
<thead>
<tr>
<th>Year</th>
<th>Minimum</th>
<th>1st quartile</th>
<th>Median</th>
<th>3rd quartile</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
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<tbody>
<tr>
<td>2013</td>
<td>37.5</td>
<td>66.7</td>
<td>81.1</td>
<td>99.7</td>
<td>176.2</td>
<td>87.4</td>
<td>31.2</td>
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<tr>
<td>2014</td>
<td>39.8</td>
<td>65.5</td>
<td>85.9</td>
<td>106.2</td>
<td>223.9</td>
<td>94.6</td>
<td>41.6</td>
</tr>
<tr>
<td>2015</td>
<td>40.4</td>
<td>65.1</td>
<td>86.3</td>
<td>115.1</td>
<td>456.8</td>
<td>101.5</td>
<td>64.0</td>
</tr>
<tr>
<td>2016</td>
<td>29.3</td>
<td>65.2</td>
<td>91.6</td>
<td>116.1</td>
<td>284.8</td>
<td>97.7</td>
<td>47.5</td>
</tr>
<tr>
<td>2017</td>
<td>32.2</td>
<td>64.8</td>
<td>98.7</td>
<td>139.6</td>
<td>341.1</td>
<td>106.9</td>
<td>57.2</td>
</tr>
<tr>
<td>2013–2017</td>
<td>29.3</td>
<td>65.3</td>
<td>86.7</td>
<td>115.5</td>
<td>456.8</td>
<td>97.8</td>
<td>50.0</td>
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Table 4

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<tr>
<th>Year</th>
<th>Minimum</th>
<th>1st quartile</th>
<th>Median</th>
<th>3rd quartile</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>2013</td>
<td>477,232</td>
<td>522,880</td>
<td>553,099</td>
<td>586,793</td>
<td>612,170</td>
<td>2,752,174</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>104,902</td>
<td>115,015 (22 %)</td>
<td>113,222 (20 %)</td>
<td>117,018 (20 %)</td>
<td>118,464 (19 %)</td>
<td>565,003 (21 %)</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>30,315 (6%)</td>
<td>30,938 (6%)</td>
<td>33,962 (6%)</td>
<td>36,688 (6%)</td>
<td>36,682 (6%)</td>
<td>168,585 (6%)</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>37,049 (8%)</td>
<td>35,257 (7%)</td>
<td>33,143 (6%)</td>
<td>37,867 (6%)</td>
<td>34,262 (6%)</td>
<td>178,569 (6%)</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>15,558 (3%)</td>
<td>14,337 (3%)</td>
<td>14,172 (3%)</td>
<td>17,173 (3%)</td>
<td>15,617 (3%)</td>
<td>76,657 (3%)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Median</th>
<th>3rd quartile</th>
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<td>76,657 (3%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Including records of claw trimming with or without concurrent records of lesions.
Fig. 1. Five-year prevalence across all recordings of digital dermatitis (DD), interdigital hyperplasia (IH), sole ulcer (SU) and white line abscess (WLA) in Danish dairy cows trimmed during a 5-year period from 2013 to 2017. X-axes indicate the number of claw trimmings recorded by each trimmer (TrimmerID) during the period. The grey lines indicate the mean prevalence of lesions recorded across all TrimmerIDs. Note the different scales on the Y-axis.

Fig. 2. Prevalence of digital dermatitis (DD) based on one record per cow per recording day in Holstein, crossbred (Cross), Jersey and Danish Red Dairy (RDM) for heifers and first, second and third + parity cows recorded during trimming for each year from 2013 to 2017.
Fig. 3. Prevalence of interdigital hyperplasia (IH) based on one record per cow per recording day in Holstein, crossbred (Cross), Jersey and Danish Red Dairy (RDM) for heifers and first, second and third + parity cows for each year from 2013 to 2017.

Fig. 4. Prevalence of sole ulcer (SU) based on one record per cow per recording day in Holstein, crossbred (Cross), Jersey and Danish Red Dairy (RDM) for heifers and first, second and third + parity cows for each year from 2013 to 2017.
for heifers was below 2% for all breeds. Prevalence was generally higher in older cows, and, for many combinations of breed and parity, the prevalence decreased during the study period. The recorded prevalence of WLA was generally highest in older cows and lowest in heifers (Fig. 5). For parity 3+ Holstein and crossbred cows, the prevalence decreased during the 5-year period.

Discussion

The study included data from 45% of the Danish dairy herds and 55% of the Danish dairy heifers and cows in 2017. The distribution between breeds in this study reflects the Danish dairy cattle population with a majority of Holstein cows. Nine to 10% of the recorded animals were heifers (12 months old to first calving). Ensuring good claw conformation and claw health in heifers could improve claw health in older cows (Hirst et al., 2002; Randall et al., 2016). In some herds, this may be achieved by claw trimming, and in other herds other strategies, e.g. routine locomotion scoring, could be beneficial (Mahendran et al., 2017). Thomsen et al. (2019) concluded that trimming before dry off reduces the odds of sole ulcer in the following lactation, which could indicate that trimming prior to calving could reduce claw horn lesions in heifers. Bergsten et al. (2019) concluded that the odds of severe infectious (DD, IH and interdigital phlegmon) and severe traumatic lesions (SU, WLA and toe ulcer) were reduced in cows trimmed 2 months before and 2 months after calving.

The data used in this study reflects claw trimming routines and claw health in herds where the digital recording system was used. Therefore, the results presented here are not necessarily representative for the entire population of Danish dairy herds and cows/heifers and must be interpreted with this in mind.

There was a large variation in how the digital claw recording was used by different trimmers. Some trimmers have few recordings in few herds whereas others recorded trimming on a large number of cows in a large number of herds. In some of the large herds, a smaller proportion of the cows are trimmed on a monthly or weekly basis, which will affect the number of cows recorded per day per TrimmerID. For TrimmerIDs with many records per day, there will be trimmers who trim many cows per day using a single trimming chute, and there are trimming companies where several trimmers record in the same herd on the same day using two to four trimming chutes but record on the same TrimmerID.

Even though the number of TrimmerIDs recording claw health and the percentage of herds are slightly increasing, it still accounts for approximately only 45% of the herds in 2017. There are probably many reasons why less than half of the Danish dairy herds record trimmings and lesions digitally. Since knowledge of specific claw health problems is essential when solving problems at herd level, the trimmers’ and farmers’ motivation for digital claw health recording should be investigated further.

In the present study, digital dermatitis had higher prevalence in heifers and parity 1 cows, decreasing with parity, which has been described by others (Sogstad et al., 2005; Holzhauer et al., 2006). The decrease in prevalence may be due to culling of infected cows, increasing immunity with increasing age or the fact that control strategies for DD are primarily aimed at lactating cows thus favouring older cows.

The overall prevalence of interdigital hyperplasia was 6%, which is similar to previous studies that reported a prevalence between 1.3% and 5.5% (Manske et al., 2002; Schöpke et al., 2013; Solano et al., 2016). For RDM, there was an increase in IH for parities 2 and 3+ cows; for the other breeds, this increase was not seen. In Jersey cows, the prevalence of IH was very low for all parity groups. Most studies of IH involve Holstein, and a recent study has presented new evidence of a genetic component associated with IH (Zhang et al., 2019). A genetic predisposition in Holstein and Holstein crossbred could explain the variation...
in prevalence between breeds. Another study has reported increased prevalence with increased parity similar to our findings (van der Spek et al., 2015).

For WLA and SU, the prevalence of recorded lesions was higher in older cows compared to lesions recorded in heifers and parity 1 cows. Increasing parity has been described as a risk factor for claw horn disruption lesions such as SU and WLA (Barker et al., 2009; Green et al., 2014; Thomsen et al., 2019). The overall prevalence of SU was 6–8%; other studies have reported a similar prevalence (Manske et al., 2002; Schöpke et al., 2013; Solano et al., 2016). The overall prevalence of WLA was 3%, and 4–6% in parity 3+ Holstein and crossbreds. Previous studies have reported prevalence of white line fissures or white line disease, which also covers milder degrees of white line pathologies between 5.1% and 12.6% (Manske et al., 2002; Schöpke et al., 2013; Solano et al., 2016). The lower prevalence found in this study compared to others may be explained by different ways of defining white line lesions and inclusion of different age groups. In the Nordic recording program, the trimmer can distinguish between white line separation (defined as a separation in the white line without exposed corium) and white line abscess (defined as a separation in the white line extending to the corium). The lower prevalence could also be caused by early treatment of white line separation in combination with preventive measures in the herds.

There is no standardised procedure to assess claw trimmer records, and thus the claw trimmers’ performance can only be described in quantity of trimmings and lesion recordings. The median number of claw recordings per TrimmerID per day has increased from 81 to 99 during the study period. This may reflect the increase in herd size that has been seen over the past decades. There may be farmers, regardless of herd size, who require all cows in the herd to be trimmed within few days, resulting in more cows trimmed per day. It can also be explained by an increasing number of trimmers working together on the farms with multiple trimming chutes, but still recording on one TrimmerID. It could also be that the individual trimmer works longer days, and we should consider that there is a limit to the number of cows trimmed by one trimmer in 1 day. If this limit is exceeded, it may cause poorer quality of trimming, and lesion recordings could be missed.

The prevalence of lesions recorded during the study period varied a lot by TrimmerID and between herds. This variation can be assumed to be similar in herds not using digital claw health recording. Part of the variation may be due to some trimmers mainly trimming e.g. Jersey herds with a different occurrence of some lesions. However, it is quite unlikely that a TrimmerID can register a little more than 0% DD out of more than 100,000 trimmings over a 5-year period, given the prevalence of herds with recording of DD in Denmark was 95% during the same period, and the average prevalence of cows with DD was 21%. Nevertheless, this is the data available and used by breeding organisations to calculate claw health indices for sires. A cow receiving the recording ‘claw trimming’ with no lesion(s) recorded is considered healthy by breeding organisations. The consequences of only recording ‘claw trimming’ will be that data cannot be used locally in the herd to improve claw health, underestimation of lesion prevalence in scientific studies may occur, and the claw health index for breeding purposes will be misleading and could potentially have adverse effects on breeding. The trimmers have a responsibility to provide valid data of high quality, and people using the data have a responsibility to be cautious when making conclusions based on the data.

The trimmers omitting recordings of (specific) lesions has not yet been investigated. In three studies, independent observers have evaluated Danish claw trimmers’ recordings while trimming, and several claw lesions were under-recorded. This included mild cases of HE, SH and recording of claw abnormalities (asymmetric claws, scissor claws and corkscrew claws) (Capion et al., 2008; Kviesgaard, 2013; Skovsgaard, 2018). If claw health recordings should be used for monitoring lesion development in herds and for genetic improvement of claw health in the dairy cow population, there may be a need for additional studies of recording behaviour of claw trimmers.

Previous studies of quality of claw health recordings found a high level of agreement for all lesions at training and tests, meaning that the trimmers have the knowledge and skills to recognise and record lesions accurately (Capion et al., 2008; Kviesgaard, 2013; Skovsgaard, 2018). When the same trimmers were evaluated during routine trimming, this agreement was lower. Recording claw lesions will add a few seconds to the trimming time of each animal, and these extra seconds have to be prioritised and perceived as a necessary and important service provided to the farmer.

**Conclusion**

Digital recording of claw lesions has become more widely used in Denmark; between 2013 and 2017, claw trimming and claw lesions were recorded by 62 TrimmerIDs. The number of animals recorded per year, the mean number of animals recorded per day, and the percentage of herds using digital recording increased during the study period. In 2017, 38% of all Danish dairy herds used digital claw recording at claw trimming. There is a large variation between number of cows trimmed per TrimmerID and prevalence recorded by TrimmerID. Generally, Jersey cows had the lowest prevalence of recorded lesions, and Holstein had the highest. DD prevalence was highest in heifers and first parity Holstein and crossbred. Prevalence of SU and WLA increased with increasing parity.

**Conflict of interest statement**

None of the authors has any financial or personal interests or relationships that could influence or bias the content of the paper.

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