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Short Communication

A note on possible link between behaviour and the occurrence of lameness in dairy cows

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Abstract

Lameness in cattle is a major welfare problem and has important economic implications. It is known that lameness has a multifactorial causation; however, it is still not clear why some individuals are more susceptible than others to present foot lesions under the same environment. Social and individual behaviour is thought to play an important role. The aim of this study was to assess the possible relationships between social behaviour, individual time budgets, and the incidence of lameness in 40 dairy cows. The incidence of lameness in the group of cows observed was 42%. There were no differences in the mean time standing between low-, middle- and high-ranking cows. Low-ranking cows spent more time standing still in passageways and standing half in the cubicles than middle- and high-ranking cows. No differences were found in the mean time standing between cows that got lame and cows that did not get lame. However, cows that got clinically lame spent longer standing half in the cubicles and had a significantly lower index of displacements than those cows that did not get lame. This study may offer a starting point to better understand the relationships between behaviour and the occurrence of lameness in dairy cows. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

One of the major welfare problems of dairy cattle is lameness (Potter and Broom, 1990). Due to its high incidence and prevalence, lameness has important economic

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implications for the dairy industry (Whitaker et al., 1983; Peterse, 1987; Greenough et al., 1997).

Behaviour seems to play an important role in the occurrence of foot disorders. Under intensive conditions, resources such as food and shelter are distributed in a reduced space. The way each cow copes with this environment, including social interactions, will affect her priority of access to these resources (Wierenga, 1991), influencing the time she has to stand in slurry and on concrete floors, and hence, the amount of time that the hooves of an animal are exposed to risk factors of sole and soft tissue lesions (Galindo, 1994). It is known that under overcrowding conditions, low-ranking cows have to spend more time standing in the passageways (Wierenga, 1990) and that first-lactation cows that stand for more time during the housing period than adult cows suffer more from sole haemorrhages (Singh et al., 1993). Therefore, it is likely that the susceptibility of a cow to lameness depends on how the social and physical environment influences the duration and location of lying and standing times. The aims of this study were to identify differences in the social behaviour of dairy cows, and to relate these differences to individual time budgets and the occurrence of clinical lameness.

2. Subjects, housing and methods

Forty Holstein–Friesian high-yielding cows (age 3–6 years; mean = 4.75) were observed. They had their feet trimmed during the first week of housing. They were housed in a loose cubicle building, from October 1st to April 2nd of the next year, where they were fed on an ad libitum stage-based diet. The building has Newton Riggs cubicles (2.10 × 1.15 m² each) arranged in parallel lines separated by a passageway of 2.10 m with flooring made of solid concrete. The cow:cubicle ratio was 1:1 during the housing period and the passageways were cleaned twice a day after each milking session.

2.1. Behavioural observations and measurements

Direct observations as well as video recording were carried out to record information on social interactions as well as individual time budgets using a combination of scan and behaviour sampling techniques (Martin and Bateson, 1986). The cows were observed for 8 consecutive days, 1 week after being introduced to the cubicle house. None of the cows was lame during the week of observation. On each observation day, the cows were observed for 4.5 h distributed throughout the day. Behaviour sampling was used to record agonistic interactions (i.e., butts to head, neck, and ribs; chases; threats; and active avoidances) were considered when a cow actively moved away from another individual without any previous interaction between the two individuals). During the week, the cows were observed in the cubicle house building; they were also videotaped on five alternate days, each recording lasting 24 h. This was used to collect information on individual time budgets. At the end of the week, data had therefore been recorded for 36 h from direct observations and 120 h from video filming.

For each animal the behaviours that were thought to be relevant to the occurrence of lameness — such as time spent standing, standing still in passageways, and standing half in cubicle — were expressed as proportion of time calculated as: number of observations of a behaviour/total number of scan samplings. For the data collected on interactive behaviours, indices of displacements were calculated. These indices were used to reflect social status of each cow according her experiences in agonistic interactions. The index of each cow could therefore range from 0 to 1. Cows with an index above 0.6 ($n = 10$) were considered high-ranking cows, those with an index between 0.4 and 0.6 ($n = 16$) were considered middle-ranking and those with an index below 0.4 ($n = 14$) were classified as low-ranking individuals. This classification was used to compare time budgets between groups:

$$\text{Index of displacements} = \frac{\text{number of times she displaces another cow}}{\text{number of times she is displaced} + \text{number of times she displaces another cow}}$$

2.2. Lameness records

Weekly visits were made to the farm to record any new case of clinical lameness from the day the 40 cows were housed to the final week of the housing period. At each visit, a locomotion score was assigned to each cow as it entered the milking parlour (adapted from Mansson and Leaver, 1988). As all the behaviours were recorded before any of the cows became lame, it was valid to explain the occurrence of lameness as a possible effect of behaviour rather than as a cause of it. All cows identified as clinically lame at each visit were separated from the herd and had their feet examined. Sole lesions and soft tissue lesions, which included the interdigital space and the heel, were classified separately (Mills et al., 1986). This method of quantifying hoof disorders allowed for the calculation of the incidence rate of lameness and gave information on how many times each cow presented a new case of lameness throughout the period of the study (Clarkson, 1993). Clinical diagnosis of the hoof lesions was carried out according to Greenough et al. (1981).

3. Results

3.1. Epidemiology of foot lesions in the groups of cows observed

The incidence of clinical lameness of the cows observed during the housing period was 42%. A total of 18 cases of infectious and non-infectious lesions were recorded in 12 cows. Nine cows presented one case each and the other three cows had two, three, and four cases, respectively. Of the total cases, 17 involved the interdigital space and the heel and only one case was due to a sole lesion. Seventeen cases (94%) involved the hind foot claws (Table 1). The onset of the lesions varied. Of the 11 cases of heel horn

Table 1
Number and types of lesions recorded in the 40 cows observed

Lesion	Number of cases	Affected claw
Heel horn erosion	11	Hind foot claws
Interdigital necrobacillosis	6	Hind foot claws
Sole ulcer	1	Forefoot claw

erosion recorded, five cases were recorded during the first 2 weeks of January, three cases during the last week of January and the first week of February, and three cases were recorded separately during the last week of February and the first 2 weeks of March. The six cases of interdigital necrobacillosis were all recorded during the last week of January and the first 2 weeks of February, and the only case of sole ulcer seen was recorded in October, 1 week after the observations were carried out.

3.2. The relationships between displacement index and time budgets

The mean time standing, time standing still in passageways, and time standing half in the cubicles were compared between the low-, middle- and high-ranking groups. There were no differences in the mean time standing between groups (Kruskal–Wallis; $H = 1.53$, $df = 2$, $p = 0.46$; 53.5, 49.74, and 49.33% of the day, respectively). However, when comparing the mean time spent standing still and standing half in the cubicles, differences were found between groups. Low-ranking cows, i.e., with a lower index of displacement, spent more time standing still than middle- and high-ranking cows (Kruskal–Wallis $H = 5.9$, $df = 2$, $p < 0.05$; 51.94, 46.6, and 43.55% of the day, respectively), and also spent longer standing half in the cubicles than individuals from the other two groups (9.16, 5.6, and 4.04% of the day, respectively) (Kruskal–Wallis; $H = 7.3$, $df = 2$, $p < 0.05$; Fig. 1).

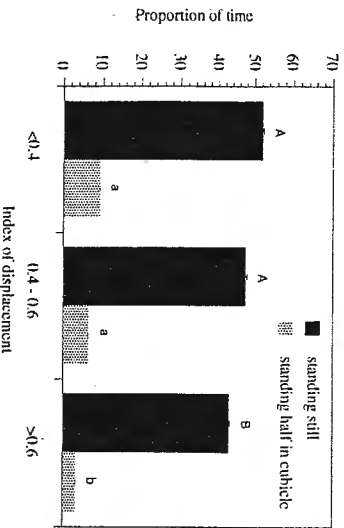


Fig. 1. Mean time standing still and standing half in the cubicle in relation to the index of displacement. Means with different letter on the bars differ ($p < 0.05$).

Table 2
Means for the proportion of time standing, standing still in passageways, standing half in the cubicle as well as the means for the indices of displacements during the observation period for cows that got lame ($n = 12$) and cows that did not get lame ($n = 28$)

	Lame cows	Non-lame cows
Standing	51.7 ± 3.4 ^a	50.1 ± 1.9 ^a
Standing still in passageways	48.5 ± 3.3 ^a	46.7 ± 1.3 ^a
Standing half in cubicles	6.2 ± 3.3 ^a	5.6 ± 3.3 ^b
Indices of displacements	0.51 ± 0.08 ^a	0.56 ± 0.04 ^b

Means in the same row with different superscripts differ ($p \leq 0.05$).

3.3. Differences in the behaviour of cows that got lame and cows that did not get lame

The mean time standing, standing still in passageways, and standing half in the cubicles during the observation period were compared between the cows that got lame ($n = 12$) and those which did not get lame ($n = 28$). No differences were found in the mean time standing and standing still between the two groups (Mann–Whitney; $U = 126.5$, $p > 0.31$; $U = 115.5$, $p > 0.05$, respectively; Table 2). However, there was a significant difference in the mean time spent standing half in the cubicles. Cows which got clinically lame spent longer time performing that behaviour than those cows which did not get lame (Mann–Whitney; $U = 88$, $p < 0.05$; Table 2). Also, when the index of displacements between the two groups was compared, it was seen that the cows which got lame had a significantly lower index of displacements than those cows which did not get lame (Mann–Whitney; $U = 84.5$, $p < 0.05$; Table 2).

4. Discussion

This study provides useful information for a better understanding of the development of a multifactorial disease in dairy cows such as lameness. Although the aetiology and development of foot lesions in cattle are not clearly understood, it has been suggested that prolonged standing can have a predisposing effect both on sole and soft tissue lesions. Singh et al. (1993) found that cows that stood for longer presented more haemorrhages in the sole horn which could predispose them to lameness. Phillips and Schofield (1994) observed that cows in cubicles had a reduction in heel depth compared with those kept on straw yards. Standing still in the passageways has been related to low-ranking cows which are 'blocked' in their movements and have to spend more time waiting for available spaces to move to (Miller and Wood-Gush, 1991). The fact that low-ranking cows spent more time performing this behaviour, suggests that these animals which are less successful in displacing other cows will move less freely around the building.

In studies of social behaviour of cattle, standing half in the cubicle has been regarded as a behaviour performed more frequently by low-ranking cows, as they use cubicles to hide from dominant individuals (Metz and Wierenga, 1987; Potter and Broom, 1987). In

this study, low-ranking cows also performed this behaviour for a longer time. It is possible that cows which stand half in the cubicles for longer time have a greater reduction in heel depth of the hind digits, predisposing them to infection in the interdigital space and heel, causing clinical lameness.

The social status of each individual is not easy to calculate in the normal situation of a commercial dairy farm (Wierenga, 1991). For this reason, a categorisation of individuals using indices of displacements, was useful to predict individual behaviour of a group of animals. However, this can be a somewhat arbitrary categorisation as there can be less variation between individuals of different ranking groups than between individuals of the same group. To have a better understanding about how social behaviour influences susceptibility to lameness, it is necessary to focus on the future on other indices of interactive behaviour, apart from displacements after competitive encounters, which can better predict individual strategies of behaviour in a social environment (Mendl and Deag, 1995).

This study may offer a starting point which can be useful to consider a new approach to study the relationships between behaviour and other health problems apart from lameness, such as mastitis and reproductive disorders. Further research in this area may also provide useful suggestions for how housing systems for dairy cows may be modified, reducing the incidence of health problems and improving the welfare of dairy cows.

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