RELATIONSHIPS BETWEEN BUILDING DESIGN, MANAGEMENT SYSTEM AND DAIRY COW WELFARE

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Abstract *Animal Welfare 2003, **12**: 547-552*

As part of a larger on-farm dairy cow welfare and behaviour project, data were collected from 22 commercial dairy farms over two winters (2000–2001 and 2001–2002). A further winter of farm sampling will complete the project (2002–2003), with five types of housing and production systems being assessed: high-, medium- and low-milk-production herds with cubicle housing, high-production herds with zero grazing and cubicle housing, and medium-production herds with straw courts. All cows in one early or mid-lactation group from each farm were observed. For the current analysis, locomotion, cleanliness and body condition were scored for the group, and an audit of building quality was carried out. Analysis of the available data shows that some aspects of building design affect the welfare of dairy cows. A positive correlation was found between mean body condition score of the cows and mean locomotion score ($P = 0.047$). Body condition score correlated negatively with the number of cows in the group ($P = 0.049$). Negative correlations were found between locomotion score and the ratio of cubicles to cows ($P = 0.033$) and between the size of cubicles and leg cleanliness ($P = 0.012$). Trends were also seen in the relationships between farm type and locomotion score ($P = 0.048$), production level and locomotion score ($P = 0.074$) and cow cleanliness and cubicle size ($P = 0.061$). These results indicate that the quality of the housing and the management system can affect cow welfare. These measures may be useful to include in on-farm welfare assessment schemes.

Keywords: *animal welfare, dairy cow, housing, lameness, management, welfare assessment*

Introduction

The need to assess and monitor standards of animal welfare on commercial farms is becoming more of an important issue as quality assurance schemes are created and expanded. This is largely driven by consumer demand for welfare-friendly products, and by the need to provide information for farmers on how to attain high standards of animal welfare for inclusion in codes of practice and farmer guidelines.

It has been suggested that welfare assessment should consider both housing design criteria, such as space allowance and feeding regimes, and performance criteria, which are the actual symptoms of reduced welfare that can be compared between systems (Rushen &

de Passillé 1992). Consideration of these aspects of a husbandry system would allow any welfare compromise to be identified as well as indicating the possible cause.

With regard to the welfare of dairy cows, it is already well documented that aspects of housing design have a significant impact on welfare (Potter & Broom 1990). Likewise, the management system under which cattle are kept has the potential to place stress on the animals and therefore be detrimental to animal welfare (Logue 1996). To assess the effect that the housing design and management system has on the welfare of the cows, the consequences for the animal must be measurable, and therefore health, behaviour and physical condition should be considered. Cow lameness is an important problem on dairy farms, and has a huge impact on dairy cow welfare as it affects all of the Five Freedoms (Potter & Broom 1990). Both the type and frequency of social interactions and housing design can affect lameness (Potter & Broom 1990). Poor body condition may be a reflection of high levels of stress, or of inadequate feeding, while cow cleanliness may be the result of poor housing conditions. The objective of this project is to combine design and performance criteria to assess and compare dairy cow welfare on-farm across different management systems. This study, as part of a larger on-farm study of dairy cow welfare (see Haskell *et al* 2003, pp 553–556, this issue), aims to elucidate the relationships between housing, lameness, cleanliness, body condition, management system and production, and to suggest how these factors might be used in on-farm welfare assessments.

Methods

Data were collected from 22 commercial Holstein–Friesian dairy farms over two winters. Farms were split into five farm types — low-yielding cubicle housing (n = 4), medium-yielding cubicle housing (n = 4), high-yielding cubicle housing (n = 4), zero-grazing cubicle housing (n = 6) and medium-yielding straw-court housing (n = 4). Although this did not give us sufficient numbers to fully investigate the effect of farm type in this paper, the subsequent inclusion of data from a further 15 farms will provide adequate numbers for full statistical analysis. When the project is completed, there will be at least seven farms of each type. Level of production was considered as an additional factor at three levels: low (<7000 litres/cow/year, n = 4), medium (7000–8500 litres/cow/year, n = 8) and high (>9000 litres/cow/year, n = 10). On each farm, all cows in one early- or mid-lactation group were observed. Lameness was assessed by scoring locomotion on a five-point scale, where 1 = sound and 5 = unable to move. Cow cleanliness was assessed using the UK Government Meat Hygiene Service scoring system (Meat Hygiene Service 1987) and a more specific five-point scale for four body areas (body, legs, rear and udder), where 1 = little or no dirt or faeces, and 5 = caked dirt or faeces on most of the area. These scores were totalled to give an overall cleanliness score out of 20. The body condition score of each cow was measured on a five-point scale, with 2.5 being the optimum score for dairy cows (ADAS 1986). The number of cows in the group was recorded, and an audit of building quality was carried out measuring the dimensions of the building, sizes and numbers of passages, feeding stations, water troughs and cubicles, and flooring and scraping method.

Overall 1714 cows were observed, and the median number of cows observed per farm was 66.5. Correlations between the variables were calculated and ANOVAs were carried out.

Results

The mean condition score across all 22 farms was 2.53 ± 0.18 and the mean locomotion score was 2.04 ± 0.60. The mean Meat Hygiene Score for cleanliness was 1.83 ± 0.58, the mean total cleanliness score was 6.47 ± 1.79, and the mean leg cleanliness score was 2.16 ± 0.63. Cubicle dimensions across all cubicle house farms were 1.96 m ± 0.20 m × 1.19 m ± 0.09 m. These results suggest that although dairy cows on commercial units are generally maintained at a body condition close to the optimum (2.5), mean lameness scores indicate that cows were at least lame on one leg and showed some unevenness of gait. Mean cleanliness scores indicate that cows were not generally very dirty, having little caked dirt or faeces on their coats, although the legs were dirtier than the rest of the body.

Mean condition score was found to correlate positively with mean locomotion score ($r = 0.428$; $P = 0.047$) and negatively with the number of cows in the group (Figure 1; $r = –0.424$; $P = 0.049$). This suggests that cows in smaller groups had better body condition, but farms whose cows had better body condition also had more lameness. There was a negative correlation between locomotion score and the ratio of cubicles to cows (Figure 2; $r = –0.505$; $P = 0.033$), with farms that had more cubicles per cow having less lameness. A negative correlation was also seen between the size of the cubicle and leg cleanliness score ($r = –0.577$; $P = 0.012$), indicating that farms with smaller cubicles had dirtier cows.

This preliminary analysis also showed some non-significant trends, including that the Meat Hygiene Service cleanliness score correlated negatively with cubicle size ($r = –0.450$; $P = 0.061$). There was a trend toward a relationship between farm type and locomotion score (ANOVA; n = 22, $df = 4$, $P = 0.048$) and between production level and locomotion score (ANOVA; n = 22, $df = 2$, $P = 0.074$). Post-hoc Tukey analysis showed that the differences appeared to be between zero-grazing farms and straw courts, with straw courts (1.49 ± 0.14) having a lower mean locomotion score than zero-grazing farms (2.59 ± 0.58). Medium-yielding farms showed a tendency toward lower locomotion scores and therefore less lameness than high-yielding farms, with low-yielding farms showing large variation in locomotion scores.

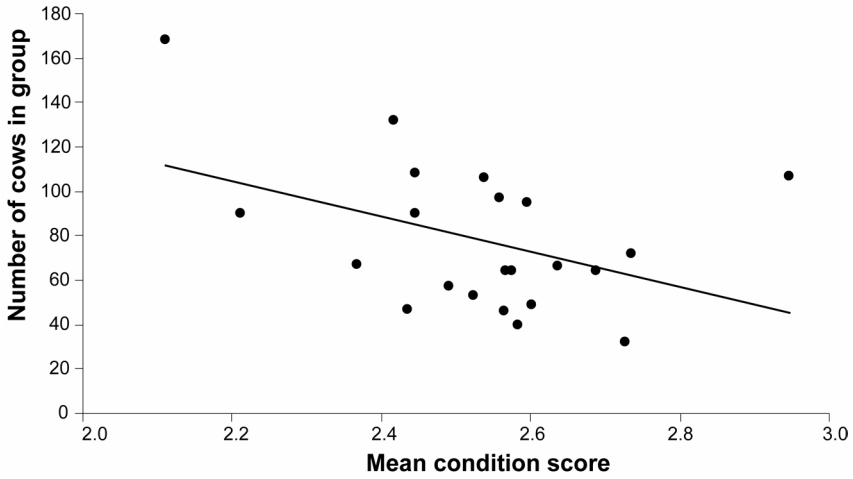

Figure 1 **Correlation between number of cows per group and locomotion score ($r = –0.424$; $P = 0.049$).**

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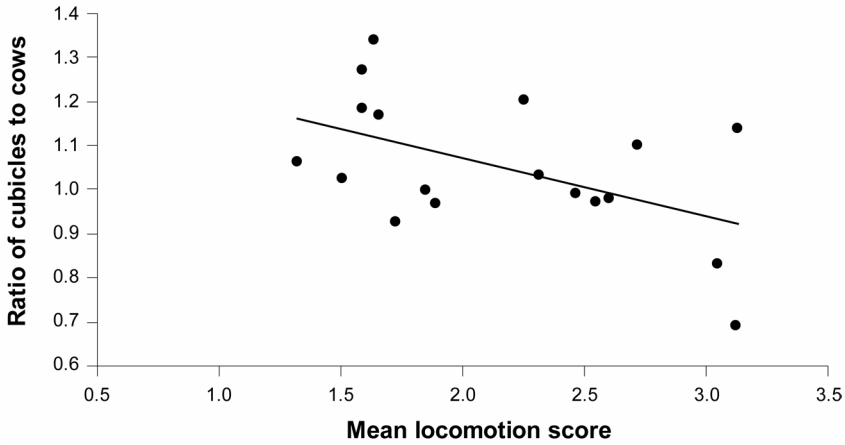

Figure 2 **Correlation between ratio of cubicles to cows and locomotion score ($r = –0.505$; $P = 0.033$).**

Discussion

This preliminary and incomplete analysis has shown interesting results for the assessment of dairy cow welfare on-farm. Although some factors were not shown to differ significantly between farm types or production levels, this may be due to low sample size, as less than two-thirds of the expected data has been collected and detailed analysis of all the factors and their interactions has therefore not yet been undertaken.

The results show that dairy cattle on all farm types and at all production levels tested are being kept with a body condition score around that which is optimal for lactating cows (ADAS 1986). Larger groups tended to have slightly lower mean condition scores, and we tentatively suggest that this could be due to more competition for space at the feeder, or due to the increased difficulty of maintaining all cows at the same body condition as group size increases. However, because of the consistency of condition score across all farms, this is unlikely to be an important effect. Likewise, the positive correlation between locomotion score and mean condition score is probably due to the effect of a third factor, possibly relating to the feeding regime.

The increase in lameness as the number of cubicles available per cow decreased supports earlier work in which overcrowding leads to an increase in foot lesions (Bergsten 2001). The lower number of cubicles to cows may increase time spent standing and lead to the development of sole lesions and therefore lameness (Singh *et al* 1993). Overcrowding may also lead to more cows spending less time lying (Wierenga & Hopster 1990) and more time standing in wet passageways, leading to an increase in hoof wear (Phillips 1990). Lame cows are disadvantaged when competing for lying areas (Metz & Wierenga 1987), and overcrowding could therefore exacerbate any lameness problems present in the herd.

The cubicles in the farms we observed had mean dimensions of 1.96 m ± 0.27 m × 1.19 m ± 0.09 m. Measurements of the imprints cows make when lying in the field indicate that their nose-to-tail length is 2.4 m and their width is 1.1–1.2 m (Hughes 2000), indicating that while cubicle widths are sufficient, they tend to be slightly too short. Farms where cows are housed in smaller cubicles have higher mean leg cleanliness scores, and tend to have cows with a higher Meat Hygiene Score. This may be a result of their standing in passages more, and therefore standing in slurry to a greater extent, as smaller cubicles are likely to be

less comfortable and therefore cows will lie down less in them (Wierenga & Hopster 1990). There may also be a problem of 'overhanging' the cubicle, so that cows' rears drop into the passageways, or their tails lie in the dirty passageways and coat their flanks with faeces as they flick them. Hughes (2000) suggested that even when cubicles are of sufficient size, cows' tails can have this effect, so it seems reasonable to suggest that smaller cubicles may exacerbate this problem. It is also likely that cows will rub against the barriers of smaller cubicles more frequently than cows in larger cubicles leading to cows in smaller cubicles being dirtier.

Our results indicate that zero-grazing herds have a tendency to have more lameness than herds kept on straw. Studies comparing cubicles and straw yards suggest that although cows kept on straw had more foot lesions, there was no correlation with a lameness score (Livesey *et al* 1998; Phillips & Schofield 1994), whereas other studies (Alban 1995) have identified zero grazing as a risk factor for lameness. Tendencies toward differences in locomotion score between medium- and high-production herds may arise from increased stress being placed on the animals as they produce more milk, but also could be a result of the differences between zero-grazing farms and straw yards.

Animal welfare implications

Following the analyses described here, all of the factors measured showed potential to be included in on-farm dairy cow welfare assessments. More comprehensive analysis of the complete data set should provide important information as to how these factors relate to each other and to other welfare measures such as behaviour, and how they should best be used to assess welfare of dairy cows on-farm.

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