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Association of Animal Health Indicators with Welfare Status in Frieswal Cattle at Organized Dairy Herd

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Forty-two lactating Frieswal cattle divided into three sheds were included for the present study with the objective to assess the welfare status in the conventional barn and to suggest improvement of welfare measures. The health indicators of animals like Body Condition Scores (BCS), Lameness Scores (LS), Hock Lesion Scores (HLS) and Mastitis Incidences (MI) were considered for investigation. The BCS, LS and HLS were determined by scoring system through clinical description, gait, posture and motion based on a 5-point scale. The statistical analysis implied that average BCS for all animals was 2.38 ± 0.66, the average LS was recorded as 2.28 ± 0.66, whereas, average HLS for all animals was observed as 2.39 ± 0.65. Significant ($P<0.05$) positive correlations were found between BCS and HLS whereas, highly significant ($P<0.01$) positive correlations between BCS and LS, LS and HLS was also recorded. Shed-wise significant ($P<0.05$) variations were also reported for BCS, LS and HLS. Higher incidence of mastitis found in the sheds with low cleanliness.

Introduction

The farm level welfare assessment can be used as an advisory tool by farmers, as source of information for management and as a component of quality assurance schemes for consumers. People have high interests in farming and the associated animal welfare standards due to its impact on health and productions of animals and subsequent good impact upon public health. More and more consumers are becoming aware of dairy welfare upon public health, food security and environmental protection. Though this recent interest and concerns about animal welfare are growing day by day, however, the assessment of animal well-being is a complex matter (Rushen *et al.*, 2011). A good welfare is such management where there is no stress which plays an important part in welfare research (Broom *et al.*, 2001). Different methods of on farm monitoring of animal welfare have been developed (Johnsen *et al.*, 2001) in Europe. Some of these methods are concerned with design criteria (Bartussek *et al.*, 1999), which comprise of structural and technical elements (space, facilities, etc.) and management-related factors such as hygienic and climatic conditions (Sundrum *et al.*, 1996). Others use animal-based variables or parameters dealing with behaviour, health and physiology of the animals. However, a combination of design and performance criteria is generally recommended to obtain a valid and holistic assessment of animal welfare (Rushen and de Passille 1992, Sandoe *et al.*, 1996, Sundrum *et al.*, 1996). From the economical point of view, the assessment of animal welfare is really important, because it allows in the first stage the detection of imperfections and their correction in the second stage. Thus, retrieval of shortcomings assures the integral development of genetic productive performances by the animal and by the other hand, perfecting the technologies. Thus, evaluation can be based on behavioural, physiological, psychopathological parameters or productive performances. All the indicators have inconveniences and, in this way, most of it is not reliable, used as sole assessment techniques. The BCS (Singh and Singh, 1994), LS (Murray *et al.*, 1996), HLS (Drissler *et al.*, 2005) and mastitis incidences are important health indicators for welfare assessment. Under the present investigation health indicators were taken under consideration to assess the animal welfare condition in the conventional barn with the objectives to assess the welfare standard of dairy cattle in the dairy herd and to suggest improvement of welfare measures of crossbred dairy cattle.

Materials and Methods

The experiment was conducted from January 2019 to May 2019 at Livestock Farm Complex under the Faculty of Veterinary & Animal Sciences, West Bengal University of Animal and Fishery Sciences, Mohanpur Campus, Nadia, West Bengal, India, located at a 22˚94´ N latitude and 88˚52´ E Longitude. Forty-two lactating Frieswal cattles were included for the present investigation. The dairy animals for this study were kept in three sheds, marked as A, B and C having 15, 11 and 16 animals, respectively. The welfare assessment was carried out based on BCS, LS, HLS and MI. BCS score was prepared (Table 1) from 1 to 5 point scale (Ferguson *et al.*, 1994) based on the clinical condition of the appearance of the spinous and transverse processes of the lumbar vertebrae, the ileal and ischeal tuberosities, the ilio-sacral and ischeal-coccygeal ligaments, and the thurl and tail head regions.

Following the system (Wells *et al.*, 1993), the animals were examined for LS (Table 2) based on their gait and posture. Animals were observed closely during the time when animal was in motion and also at the time of standing condition.

HLS of the animals were estimated (Regula *et al.*, 2004) including skin lesions at the hock region of the animals (Table 3). The hock region is the joint area between the tarsal bone and tibial bone, which was examined in naked eye for any presence of lesions.

Mastitis incidents were also recorded for animals in three sheds from health register. The means, standard error and standard deviation for the health indicators under study were computed with the help of standard statistical procedure (Snedecor and Cochran 1968). Modified Duncan’s multiple range test was used to test the difference among sub means. Data were analysed by using IBM SPSS 23.0 statistical software to analyse the relationship among the health indicators. Correlation (Pearson’s r) analysis was performed to estimate the relationship between different health indicators. The mean significant differences of health indicators were estimated by Analysis of variance (ANOVA).

Results and Discussion

The average BCS for all animals was 2.38 ± 0.66, the average LS for all animals was recorded as 2.29 ± 0.66, whereas, average HLS for all animals was observed as 2.39 ± 0.66. Nine animals (21.42%) scored as very good BCS, where the ischeal or ileal tuberosity was not visible here and the lines between hooks and pins were straight. 11.90% animals were severely dull which scored greater than 3.5 or 4 and there was a prominent "V" shape between the hooks and pins. Rest of the animals had an average to moderate BCS.

Overall, 19.04% of all the animals were clinically lame (Lameness score ≥3) and two animals were found with inability to bear weight on hind limbs. Prevalence of lameness for individual sheds ranged from 0 to 27.5 %, with an interquartile range of 0 to 7.12 %. This might be due to poorly designed barn, and animals might have been recovering from acute injuries sustained in that housing system. Animals stand and walk with a normal level back posture were 59.52%, which scored up to 2. The prevalence of hair loss ranged from 15.25 % to 22.25 %, with an interquartile range of 3.25 to 5.70 %. Nine animals exhibited normal to mild hock lesions. Hock lesions were most likely to be still present or healing in all the sheds.

33 animals (78.57%) had skin lesions on the hock, of which eight animals (19.04%) had lesions on both legs, 59.52% had lesions on more than one location on the hock, and 14.28% (six animals) had lesions with a severity score greater than 3.5 or 4. Only animals (11.90%) scored as having swelling of the entire tarsal joint. The prevalence of lesions also varied with respect to location on the hock. Lesions were rarely observed on the medial surface of the tarsal joint. Lesions were more common on the lateral and medial surfaces of the tuber calcis and on the lateral surface of the tarsal joint.

No mastitis incidence was found in the shed A, whereas, four and two incidences of mastitis were recorded in shed B and C respectively. Dirty udders in low cleanliness condition could be considered as a potential cause to mastitis in some of the sheds evaluated in this study.

Shed-wise population pyramid regarding BCS, LS and HLS was constructed. The pyramid revealed (Fig. 1) that shed A was having more numbers of animals with Good to Very Good BCS scores followed by shed C and B respectively. LS was normal to mild in shed A (Fig. 2), followed by shed C and B. In case of the HLS, shed A showed better (Fig. 3) condition of the animals followed by shed C and B.

From statistical analyses, it was observed (Table 4) that mean LS (1.90 ± 0.16) of shed A differed (Fig. 4) significantly ($P<0.05$) from that of shed B (2.59 ± 0.18) and C (2.44 ± 0.15), whereas the difference of mean (Fig. 5) LS of shed B and C was not significant ($P<0.05$). In case of the HLS it was observed (Fig. 6) that mean of shed A (1.90 ± 0.14) differed significantly ($P<0.05$) from that of shed B (2.73 ± 0.17) and C (2.63 ± 0.14) but difference between shed B and C was not found to be significant ($P<0.05$).

Correlation (Pearson's r) analysis was performed and scatter-plots were estimated to assess the strength of relationship between different health indicators (Table 5). Significant ($P<0.05$) positive correlations were found between BCS with HLS and HLS with LS. Highly significant ($P<0.01$) positive correlations between BCS and LS was also recorded. Scatter diagrams were constructed to get the pictorial presentation of the correlations (Fig. 7 to 9).

It was noticed that on all the sheds animals were frightened, upset, agitated and expressed discomforts or distress. The cause may be their constant stay in the stall, lack of space, lack of movement and lack of social interactions. In comparison among all the three sheds, animals belonging to shed A were in better welfare condition which revealed well body condition. In a similar study (Garnsworthy *et al.*, 1982), they stated that excessive loss of body condition has been associated with low welfare, there was poor reproductive performance and reduced milk production. Thus, BCS has been receiving considerable attention as a tool to aid in the management of nutritional programs in dairy herds.

Table.1 Criteria used to assign BCS Scores as per clinical description of animals

BCS	Clinical description	Assessment criteria
1	Very good	The ischial or ileal tuberosity is not visible, thick fat at the thurl and tail head regions, lines between hooks and pins are straight.
2	Good	The ischial or ileal tuberosity partially visible, the thurl and tail head regions filled with fat, lines between hooks and pins are slightly curved.
3	Average	The ischial or ileal tuberosity is round, less fat in the thurl and tail head regions, lines between hooks and pins are near to u shaped.
4	Poor	The ischial or ileal tuberosity is angular-round, the thurl and tail head regions are near to dull condition, the lines between hooks and pines are close to V shaped.
5	Very poor	The ischial or ileal tuberosity is angular, the thurl and tail head regions are in very dull condition, and the lines between hooks and pines are prominent V shaped.

Table.2 Criteria used to assign Lameness Score, of animals

LS	Clinical description	Assessment criteria
1	Normal	The animal stands and walks with a level-back posture. Her gait is normal.
2	Mildly lame	The animal stands with a level-back posture but develops an arched-back posture while walking. Her gait remains normal.
3	Moderately lame	An arched-back posture is evident both while standing and walking. Her gait is affected and is best described as short striding with one or more limbs.
4	Lame	An arched-back posture is always evident and gait is best described as one deliberate step at a time. The animal favours one or more limbs/feet.
5	Severely lame	The animal additionally demonstrates an inability or extreme reluctance to bear weight on one or more of her limbs/feet.

Table.3 Criteria used to assign Hock Lesion Score to animals

HLS	Clinical Description	Assessment criteria
1	Normal	There is no visible skin change or absence of lesions.
2	Mild Lesions	Hairless skin is visible at the joint area
3	Moderate Lesions	Swollen condition is found around the joint area.
4	Prominent lesions	Wound can be observed at the joint area.
5	Severe lesions	In severe condition, there is open wound can be observe.

Table.4 Shed wise Mean and Standard Error of health indicators

Health Indicators	Shed A	Shed B	Shed C
BCS	$2.10^{a} \pm 0.17$	$2.50^{a} \pm 0.19$	$2.56^{a} \pm 0.16$
LS	$1.90^{a} \pm 0.16$	$2.59^{b} \pm 0.18$	$2.44^{b} \pm 0.15$
HLS	$1.90^{a} \pm 0.14$	$2.73^{b} \pm 0.17$	$2.63^{b} \pm 0.14$

* Row wise similar superscripts do not differ significantly (P<0.05)

Table.5 Pearson's Correlation Coefficient (r) between health indicators

	BCS	LAMENESS	HLS
BCS	-	-	-
LAMENESS	0.510**	-	-
HLS	0.390*	0.490**	-

**Correlation is highly Significant (P<0.01)
* Correlation is Significant (P<0.05)

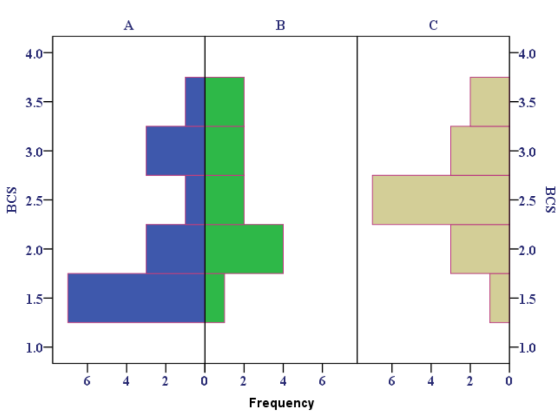


Fig.1 Shed wise BCS of animals

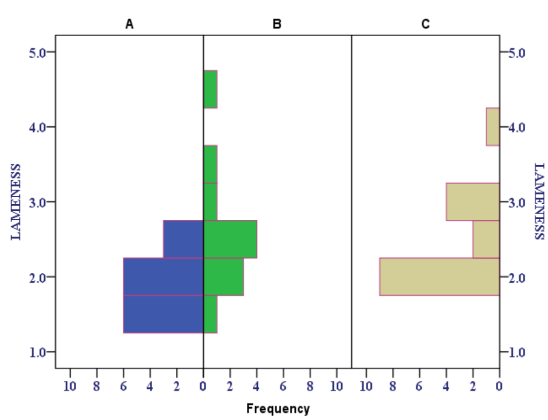


Fig.2 Shed wise Lameness Score of animals

Fig.3 Shed wise HLS of animals

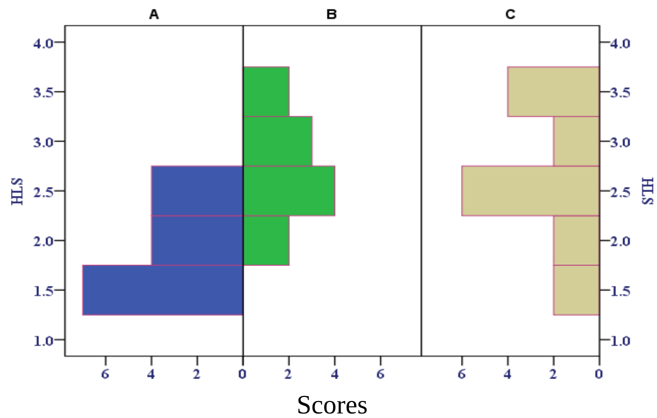


Fig.4 Shed wise mean value of BCS

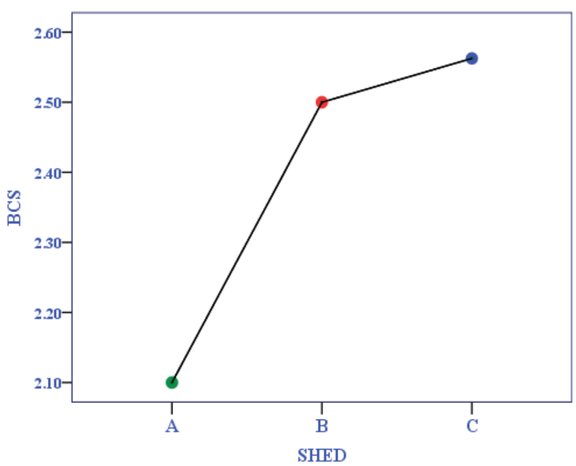


Fig.5 Shed wise mean value of LS

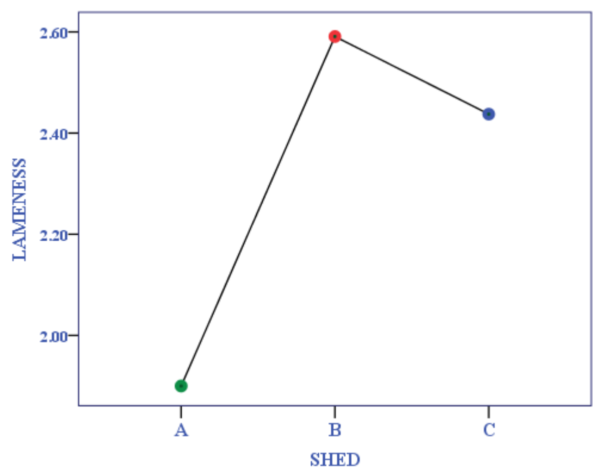


Fig.6 Shed wise mean value of HLS

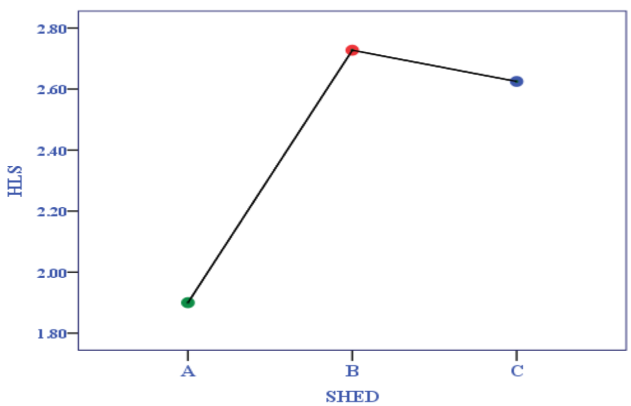


Fig.7 Correlation between LS & BCS

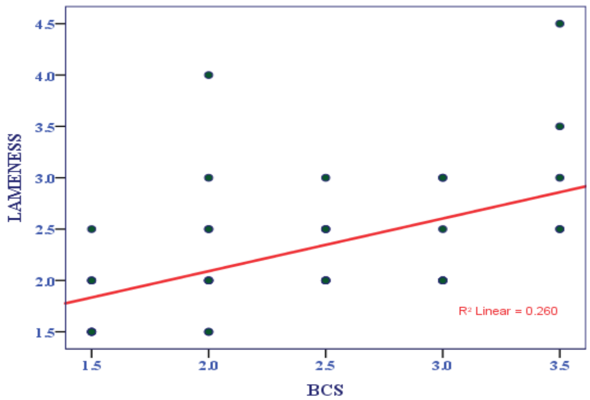


Fig.8 Correlation between HLS & BCS

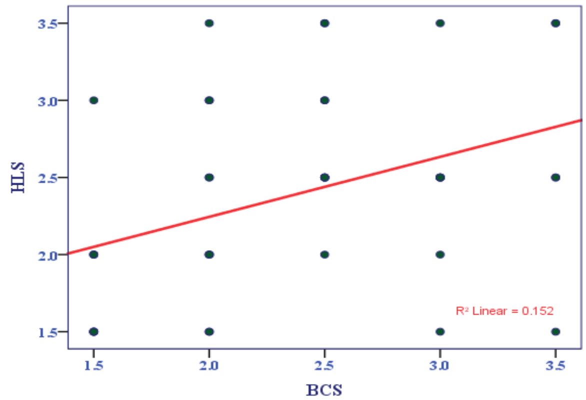
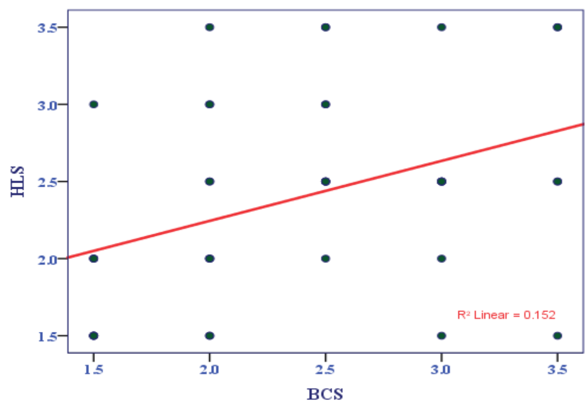


Fig.9 Correlation between HLS & BCS



In this present study, LS of the animals from shed A were better as compared to the other sheds and worst at shed B. The concrete floors of all sheds were found to be responsible for lameness. It was also revealed in this study that there was no regular practice of hoof trimming. Similar results were observed, where it was noticed that hoof lesions are main cause of lameness (Webster *et al.*, 2001). It had also been associated with concrete flooring (Vokey *et al.*, 2001). The critically lame animals in the sheds were not treated with special care and management (e.g. restricted movement, use of rubber mat flooring etc) which leads animals to a more critical condition. The observations were similar (Juarez *et al.*, 2003) which revealed reduced walking activity leading to minimize the chance of lameness. The animals used to shift its weight from one leg to the other frequently to overcome the painful situation during lameness (Neveux *et al.*, 2006).

Hock lesions in severe condition mostly turned into lameness in animals. Floor conditions of three sheds were the main reason for the hock lesion among the animals, where animals got hock lesion due to rough concrete floor. In a study (Main *et al.*, 2003) similar results were found where it was concluded that lesions over joints occur because of deficiencies in the floor surface. Skin lesions on the legs of cattle likely to occur on areas where there are protrusions (Zurbrigg *et al.*, 2005). When animals lie down, the soft tissue is compressed between these protrusions and the lying surface, resulting in an interruption of perfusion to the tissue.

In a study (Bodman and Rice, 1996) similar results were found which stated that proper cleaning and maintenance can reduce the bacterial contamination in dairy farms. They also identified key areas like hygiene, environment, cleanliness, clipped udders, water use, udder wash, pre dipping, udder drying etc. contributing to elevated bacterial counts and suggested practices which can inhibit bacterial growth. This study implied that mastitis incidents were more in such sheds where the cleanliness was poor due to increased pathogenic load.

In case of LS and BCS, there was significantly ($P<0.05$) high positive correlation, where the BCS value increasing accordingly with that of the increasing value of lameness score. It implies that an animal suffering in lameness condition that will show poor body condition, similarly an animal having a good BCS will not show any lameness. The animal with lameness condition consuming less that reflects on its body condition and makes the animal dull.

In a study (Blackie *et al.,* 2011) stated that lame animals, for instance, were associated with a lower body condition and changes in behaviour which was supported by Bowell *et al.,* (2003) and Ito *et al.,* (2010). In another study (Espejo *et al.,* 2006 and Roche *et al.,* 2009) it was revealed that post-calving reduction in the body condition score is commonly associated with high milk production, reproduction and health issues such as lameness. Bewley *et al.,* (2008) and Roche *et al.,* (2009) stated that several management practices or facility designs (e.g. overstocking, cleanliness, feed bunk conditions, poor ventilation, found in this study) affect BCS by decreasing feed intake due to competition, limited feed bunk space, low feed quality (fermentations), decreased resting time and rumination, or heat stress conditions.

In comparison of lameness with the HLS in this study, it was found that the animals suffering from any HLS was lame which had been identified in its motion and standing condition. A strong proportional relation between HLS and lameness found, when the HLS increased; the LS was also increased. In a study (Cook *et al.,* 2009) similar result was found in free-stall systems, where the link between stall design and lameness was most likely due to uncomfortable stalls resulting in hock injury. However, the effect also depends on the nature of the surface on which the animals stand. Similar study (Zurbrigg *et al.,* 2005) stated that injuries to the hock and tarsal joints are characterized by hairless patches and lesions or swellings in extremely exposed areas that are sensitive to pressure when the animal is lying down on a hard and or abrasive surface with poor hygiene. Another study (Haley *et al.,* 2001) stated that these lesions are painful and may force the animal to stand up or lie down for longer intervals which further leads to lameness and infective wound on hock.

It is concluded that the deficiencies observed on management practices, health of the animals and also in constructional side of each shed need proper attention.

Many animals showed very poor welfare score and poor productive performance on different concerned indicators, some showed average to superior condition. Proper hygiene practice, good feeding practice, regular hoof trimming, use of bedding materials and maintaining cleanliness can help to improve the overall health condition, productive performance and welfare status of the animals.

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