

PREDISPOSING FACTORS INFLUENCING OCCURRENCE OF DOWNER COW SYNDROME IN DAIRY ANIMALS IN SELECTED DISTRICTS OF TAMIL NADU

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ABSTRACT

A study was conducted to assess the factors influencing the occurrence of downer cow syndrome in Tamil Nadu. For this, primary data from the 67 dairy farmers (60 cow and 07 buffalo farmers) from Namakkal and Karur districts of Tamil Nadu having downer cow syndrome affected dairy animals were collected. Using logistic regression model, Wald statistic were obtained for the independent variables which indicated that the coefficients for parity, stage of lactation, summer and winter season, previous occurrence of metabolic diseases, feeding of green fodder, feeding of concentrate, proximity to parturition (near term) and species of dairy animal were observed significant. The log odds of the animal going to be affected by downer cow syndrome enhanced by 8.199 and 4.581, when parity and mid-stage of lactation were changed from 0 to 1. These findings suggested that more concentration on these factors were warranted to minimise the risk of incidence of downer cow syndrome in bovines.

Key words: Downer cow syndrome, Logistic regression, Metabolic diseases, Probability

INTRODUCTION

India has a huge livestock population comprising of 535.82 million of which 192.52 million cattle, 109.85 million buffaloes, 148.88 million goats, 74.26 million sheep and accounts for about 57.3 per cent of the world's buffalo population.

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The milk production has increased from 176.3 million tonnes in 2017-18 to 187.7 million tonnes in 2018-19 registering a growth of 6.5 per cent. Also, the per capita availability of milk has increased from 233gm/day in 2004-05 to 394gm/day in 2018-19 (BAHS, 2019).

The livestock sector particularly dairy farming plays a significant role in securing the livelihood of rural farmers by providing income and employment generation in rural areas. However, this sector is facing several disease problems due to introduction of exotic germ plasm for higher productivity

and changing global climate which cause huge economic loss resulting from mortality and low productivity of animals (Singh and Shivprasad, 2008). Dairy animals suffer from many diseases; some of these diseases are common with other livestock species, while a few are specific to dairy animals. There are several metabolic disorders identified in dairy cows during the first month immediately after parturition. In dairy farming, metabolic diseases such as ketosis, milk fever and downer cow syndrome are the most common expensive disease entities in such lactating dairy animals (Kaneene and Scott, 1990).

Among different metabolic diseases, downer cow syndrome is occurring in dairy animals mostly near parturient and management is economically most important, as it results in not only reduction in production but also loss of animals (Thirunavukkarasu *et al.*, 2010). In Australia (Fenwick, 1969) downer cow is defined as any cow with milk fever that did not get up within 10 minutes of first treatment with intravenous calcium, Bjorsell *et al.* (1969) from Sweden considered a downer cow to be one that had not risen within 24 hours after first treatment with calcium for milk fever. Different terminologies used to describe this syndrome are 'downers', 'alert downers', 'atypical milk fever' or 'creeper cows' and 'fat cow syndrome' (Morrow, 1976 and Morrow *et al.*, 1979). Downer cow diseases are more complicated resulting from hypocalcaemia with muscle, tendon or nerve injuries (Littledike *et al.*, 1981). Other syndromes in this disease complex are not as easy to characterize indeed, various combinations of diseases

may be in the same. Downer cow syndrome has no universal definition. We favour the definition used by Cox *et al.* (1986), who stated that downer cow is the one down for at least 24 hours without apparent reason for being down. Hypothesis of the present study is that the dairy animal, feeding practices, post-partum disorders and other management factors have positive influence on the incidence of downer cow syndrome, while the economic losses due to the occurrence of downer cow syndrome have the negative influence on profitability of dairy farming. In the present study, it is employed to estimate the probability of a particular dairy animal is affected with downer cow syndrome or not.

MATERIALS AND METHODS

Namakkal and Karur districts of Tamil Nadu were purposively selected for the present study, as these districts are experiencing frequent occurrence of downer cow syndrome in dairy animals. A total of 67 (60 cow and 07 buffalo) downer cow syndrome affected dairy animals were selected through purposive sampling technique from these districts. From the dairy farmers so selected, the data were collected during the months of October 2012 and June 2013 by personal interview method, using pretested interview schedule. The data collected from the sample respondents included information on breed, parity, stage of lactation, frequency of occurrence, stage of calving, feeding practices, milk yield, disease occurrence and post-partum disorders were collected. The data so collected were analysed by using of logistic regression model.

It is also used to predict whether an event will occur or not, as well as identifying the variables in making the prediction. It is used in estimating empirical values of the parameters in a qualitative response model. Logistic regression model predicts the log odds for a dependent variable as an additive function of the independent variables (Grohn *et al.*, 1991).

The logistic regression model is the technique of choice for analyzing binary response variable in veterinary epidemiology (Dyke and Patterson, 1952). Logistic regression analysis was used to test possible risk factors for development of metabolic diseases in dairy animals by Hosmer and Lemeshow (2000). In the present study, it is employed to estimate the probability of a particular dairy animal affected with downer cow syndrome or not. Logistic regression analysis was carried out using SPSS for Window: Release 10.0 (2000). The following logistic regression model is used in this study.

Prob (event) or $P_i = E(Y = 1/V_i)$

$$= \frac{e^{\delta + \gamma_1 V_1 + \gamma_2 V_2 + \dots + \gamma_i V_i}}{1 + e^{\delta + \gamma_1 V_1 + \gamma_2 V_2 + \dots + \gamma_i V_i}}$$

$i = 1, 2, 3, \dots, 14$

or, equivalently

$$= \frac{1}{1 + e^{-(\delta + \gamma_1 V_1 + \gamma_2 V_2 + \dots + \gamma_i V_i)}}$$

or, simply $= \frac{1}{1 + e^{-z}}$

Where,

δ, γ_i – the coefficients to be estimated from the data;

e – the base of the natural logarithms, approximately 2.718 and

Z – the linear combination such that

$$z = \delta + \gamma_1 V_1 + \gamma_2 V_2 + \dots + \gamma_i V_i$$

The probability of the event not occurring is estimated as

$$\text{Prob (no event)} = 1 - \text{Prob (event)}$$

The probability estimates will always be between 0 and 1, regardless of the value of Z . Table 1 shows the description of variables used in logistic regression analysis for downer cow syndrome in dairy animals.

Table 1. Description of variables used in logistic regression analysis for downer cow syndrome in dairy animals

Explanatory variables	Levels	Specifications	X _i
Breed	Non-descript; Crossbred cow / Graded buffalo	1-Crossbred Cow/ Graded Buffalo; 0-Otherwise	X ₁
Parity (Order of lactation)	Continuous	In number of calving	X ₂
Stage of lactation ^a	Early stage; Mid stage; Late stage	1-if Mid; 0-Otherwise	X ₃
		1-if Late; 0-Otherwise	X ₄
Average daily milk yield	Continuous	Litres per day	X ₅
Post-partum disorders (metritis and retained foetal membrane)	Present; Absent	1-if Present; 0-Otherwise	X ₆
Season ^b	Summer; Winter; Monsoon	1-if Summer; 0-Otherwise	X ₇
		1-if Winter; 0-Otherwise	X ₈
General appearance	Debilitated, Healthy	1-if Debilitated; 0-Otherwise	X ₉
Previous occurrence of metabolic diseases	Present; Absent	1-if Present; 0-Otherwise	X ₁₀
Green fodder feeding	Not practiced; Practiced	1-if Not practiced; 0-Otherwise	X ₁₁
Concentrate feeding	Not practiced; Practiced	1-if Not practiced; 0-Otherwise	X ₁₂
Supplementation with mineral mixture	Not practiced; Practiced	1-if Not practiced; 0-Otherwise	X ₁₃
Proximity to parturition (near term)	Yes; No	1-if Yes; 0-Otherwise	X ₁₄
Species of dairy animal	Cow; Buffalo	1-if Cow; 0-Otherwise	X ₁₅

^a reference category: Early lactation; ^b reference category: monsoon.

Table 2. Parameters estimated for the logistic regression model for downer cow syndrome

S. No.	Variables	Estimated coefficient	Standard error	Wald statistic	R statistic	Exp (B)
1.	Breed	23.208	2715.293	0.000	0.993	1.199
2.	Parity (Order of lactation)	2.104	0.618	11.592**	0.001	8.199
3.	Stage of lactation 2	1.522	0.660	5.311*	0.021	4.581
4.	Stage of lactation 3	2.305	0.626	13.541**	0.000	10.026
5.	Average daily milk yield	0.051	0.043	1.430	0.232	1.053
6.	Post-partum disorders (metritis and retained foetal membrane)	1.698	0.971	3.058	0.080	5.464
7.	Season summer	1.353	0.468	8.369**	0.004	3.868
8.	Season winter	-1.194	0.475	6.319*	0.012	0.303
9.	Previous occurrence of metabolic diseases	2.575	0.750	11.781**	0.001	13.137
10.	Green fodder feeding	3.304	0.822	16.144**	0.000	27.228
11.	Concentrate feeding	5.320	0.871	37.312**	0.000	204.392
12.	Supplementation with mineral mixture	-3.728	2.333	2.553	0.110	0.024
13.	Proximity to parturition (near term)	2.196	0.838	6.872**	0.009	8.987
14.	Species of dairy animal	4.019	0.964	17.401**	0.000	55.669
15.	Constant	-40.598	2715.295	0.000	0.988	0.000

*significant ($p < 0.05$)**significant ($p < 0.01$)

Degree of freedom for each variable is 1

RESULTS AND DISCUSSION

Table 2 displays the results of the logistic regression model for downer cow syndrome. From the table, Wald statistic obtained for the independent variables indicated that the coefficients for parity, stage of lactation, summer and winter season, previous occurrence of metabolic diseases, feeding of green fodder, feeding of concentrate, proximity to parturition (near term) and species of dairy animal were observed significant. The coefficients for the variables breed, milk yield, post-partum disorders (metritis and retained fetal

membrane) and supplementation of mineral mixture and were found to be insignificant as per Wald statistic.

As it is viewed from the table, it was evident that R statistics for all the variables chosen were positive except for non-supplementation of mineral mixture and winter season but non-significant. The increase in value of significant variables would increase the occurrence of downer cow with respect their odd ratios as shown in the table. The logit model estimated in terms of log of the odds as it below:

$$\text{Log} \left[\frac{\text{Prob (downer)}}{\text{Prob (non-downer)}} \right] = \log \left[\frac{P_i}{1-P_i} \right]$$

$$= -40.598 + 23.208V_1 + 2.104V_2^{**} + 1.522V_3^* + 2.305V_4^{**} + 0.051V_5 + 1.698V_6 + 1.353V_7^{**} - 1.194V_8^* + 2.575V_9^{**} + 3.304V_{10}^{**} + 5.320V_{11}^{**} - 3.728V_{12} + 2.196V_{13}^{**} + 4.019V_{14}^{**}$$

The log odds of the animal going to be affected by downer cow syndrome enhanced by 8.199 and 4.581, when parity and mid stage of lactation were changed from 0 to 1 (in ceteris paribus). Similarly, when other indicator variables viz., late stage of lactation, summer season, previous occurrence of metabolic diseases, green fodder feeding, concentrate feeding, proximity to parturition (near term) and species of dairy animal for being affected by the downer cow syndrome were to the tune of 10.026, 3.868, 13.137, 27.228, 204.392, 8.987 and 55.669 respectively. The same parameters were used by the authors Thirunavukkarasu *et al.* (2010). The negative coefficient variable, winter season indicated that change in season as winter leads to the downer cow syndrome occurrence being less likely (0.303 times) to occur. The other variables, such as milk yield, post-partum disorders (metritis and retained fetal membrane) and supplementation with mineral mixture

were found to be non-significant. It is in agreement with the authors Morrow *et al.* (1979). Since it is easier to think of odds rather than log odds, the logistic regression equation can be written in terms of odds as:

$$(-40.598 + 23.208V_1 + 2.104V_2^{**} + 1.522V_3^* + 2.305V_4^{**} + 0.051V_5 + 1.698V_6 + 1.353V_7^{**} - 1.194V_8^* + 2.575V_9^{**} + 3.304V_{10}^{**} + 5.320V_{11}^{**} - 3.728V_{12} + 2.196V_{13}^{**} + 4.019V_{14}^{**})$$

$$\frac{P_i}{1-P_i} = e$$

The comparisons of prediction for downer cow syndrome to the observed outcomes are presented in Table 3.

It could be seen from the table that 946 observations not affected by downer cow syndrome (99.60 per cent of the non-affected animals) were correctly predicted by the model not to have downer cow syndrome. Similarly, 52 animals affected by downer cow syndrome (80.50 per cent

Table 3 Comparison of prediction of the logistic regression analysis to the observed outcomes (classification table) for downer cow syndrome

Observed	Predicted		Per cent correct
	Non affected (0)	Affected (1)	
Non affected (0)	946	4	99.60
Affected (1)	13	52	80.00
Overall	959	56	98.30

to the total animal affected by downer cow syndrome) were correctly predicted to be affected by downer cow syndrome. Overall, 98.30 per cent of the observations were correctly classified.

CONCLUSION

The study found that parity, stage of lactation, summer and winter season, previous occurrence of metabolic diseases, feeding of green fodder, feeding of concentrate, proximity to parturition (near term) and species of dairy animal were the most important factors that influenced the occurrence of downer cow syndrome in the study area. The coefficients for the variables breed, milk yield, post-partum disorders (metritis and retained fetal membrane) and supplementation of mineral mixture and were found to be insignificant as per Wald statistic. These findings insist the importance of downer cow syndrome among dairy stock holders and bring to lime light the various causes of downer cow syndrome to avoid huge economic loss in dairy animals.

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