FACTORS AFFECTING THE MILK PRODUCTION OF DAIRY CATTLE IN NORTHERN RURAL AREAS OF BANGLADESH

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Abstract

A cross sectional study was conducted to observe the factors affecting the productive performance of dairy cattle from northern rural areas of Bangladesh during July and September 2013. Data of 105 cows, 85 (80.95%) from local and 20 (19.05%) cows from cross breed, were randomly selected for the study. A binary logistic regression, expressed by odds ratio with 95% confidence interval, was done to determine the association of daily milk production categorized into ≤ 2 and > 2 liters (L), based on median, with the significant explanatory variables of body weight, age at first calving, lactation period, vitamin use, type of floor and milking person. The result demonstrated that the probability of milk production of >2 L was 6.16, 4.5, 20.65 and 5.7 times higher from the with animal body weight of >140 kg, age at first calving of >36 m, lactation period of >8 m and vitamin use than that of body weight of ≤ 140 kg, age at first calving of ≤ 36 m, lactation period of ≤ 8 m, and not vitamin used respectively. The chance of milk production of > 2 L was 0.25 and 0.22 times lower for mud floor, and owner milking than that of brick floor and gowala (professional milking person) respectively.

Keywords: Breed, Factors, Milk Production, Odds Ratio, Logistic Regression

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Introduction

An important component of national economy, Bangladesh has 47.51 million livestock of which 22.87 million are cattle, plays a vital role for economic development of Bangladesh (BBS, 2008). Better genotype and sound management are the major determinants of profitability of dairying at either farm or individual level (Djemali and Freeman, 1987; Rahman *et al.*, 1987) although, performances of high yielding exotic crossbred cows may differ among different geographical areas (Jahan *et al.*, 1990; Alam and Ghosh, 1994). Biological potential for milk production also depends on the age at puberty, first calving age, number of parity and calving interval (Djemali and Freeman, 1987; Rahman *et al.*, 1987). Around 2 years age of first calving and less than 13 to 14 months calving interval are the indicators of better management index of a farm (Wiltbank, 1970; Sarder, 2001). Besides, some diseases also have influence on the milk production where mastitis is one of the most devastating and farmers in Bangladesh are not well aware of the best practices to control (Rehman *et al.*, 1997). For good health and high milk yields, cows need to be fed the proper amounts of available minerals and vitamins (Weiss, 1998). The present study was therefore undertaken to detect the factors of milk production. To be specific, the goal was to quantify the significant association of milk production with other covariates and factors by implying binary logistic regression model.

Materials and Methods

A cross sectional study was conducted at Rangpur and Gaibandha districts of northern rural areas of Bangladesh. A total of 105 cows were randomly selected where 85 were local and 20 were cross breed between July and September 2013.

Statistical analysis

Logistic regression, a type of probabilistic statistical classification model can be used to predict a binary response from a binary predictor and for predicting the outcome of a categorical dependent variable based on one or more predictor variables.

The simple logistic model has the form

$$logit(y) = ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 x_1 \qquad (1)$$

After simplification,

$$\pi = Probability(Y = Outcome\ of\ interest|X = x) = \frac{e^{\alpha+\beta_1 x_1}}{1+e^{\alpha+\beta_1 x_1}} \qquad (2)$$

Where 'ln' denotes the natural logarithm, π is the probability that the dependent variable of milk production (>2 liters), α is the intercept from the linear regression, β_1 is the regression coefficient multiplied by predictor, x can be categorical or continuous but Y always categorical. According to equation 1, the relationship between logit (Y) and X is linear. Yet, according to equation 2, the relationship between the probability of Y and X is nonlinear. For this reason, the natural log transformation of the odds in equation 1 is necessary to make the relationship between a categorical outcome variable and its predictor(s) linear. A binary logistic regression model was fitted with least significant value <0.05 (Hosmer and Lemeshow, 2000) and result was interpreted by odds ratio. Data analysis was done by statistical software packages SAS 9.2 and RStudio.

Results

The average Body weight (Kg), Daily milk production (L), Lactation period (m), Age of first calving (m) and Calving interval (m) of local and cross breed were 131.49 and 253.3 kg, 1.66 and 6.63 liters, 7.41 and 10.8 months, 35.36 and 41.55 months, and, 14.96 and 15.2 months respectively presenting in Table 1.

Table 1. Descriptive statistics of different quantitative variables

Variables	Local		Cross	
	Mean	St. Dev	Mean	St. Dev
Body Weight (Kg)	131.49	31.29	253.3	77.12
Daily milk production (L)	1.66	0.68	6.63	2.8
Lactation period (m)	7.41	2.25	10.8	3.17
Age of first calving (m)	35.36	5.4	41.55	6.18
Calving interval (m)	14.96	4.92	15.2	4.79

The bar diagram shows in Fig. 1 represent the overall frequency percent distribution where 36 (34.3%) and 34 (32.4%) cows were in third and second parities respectively. The maximum frequency of milking daily once was found 87 (82.9%), and 29 (27.6%) owner collect milk by Gowala (Professional milkers) and remaining 76 (72.4%) by himself but the proportion of vitamin used during lactation period was only 29 (27.6%). It was observed that, 98 (93.3%) owner used regular anthelmintic and anthrax and FMD vaccine were used in 20 (19%) and 23 (21.9%) cases respectively and the remaining 62 (59%) reared their cows without any vaccination.
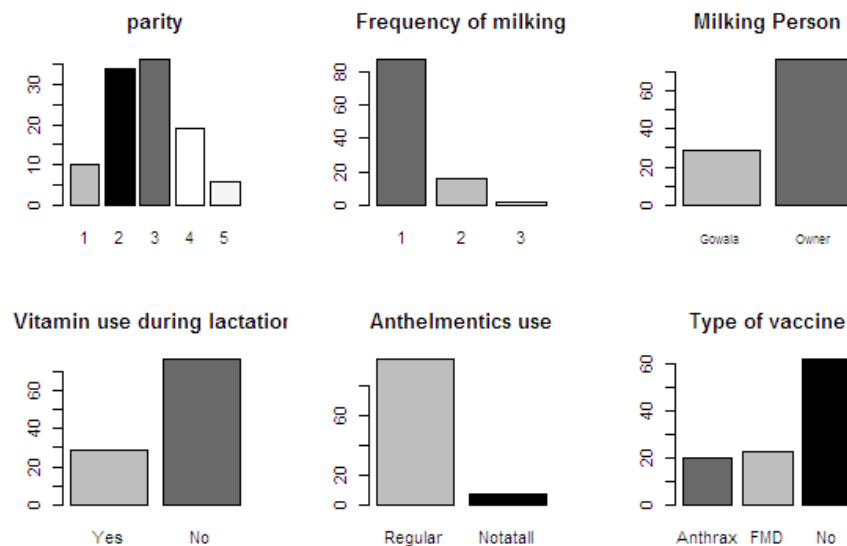

Fig. 1. Bar diagram of different categorical variables

The pie chart presents in Fig. 2 portrays the frequency and percentage distribution of different variables. Among the cows, local and cross breed were 85 (81%) and 20 (19%) where only 8 (8%) and 7 (7%) cows showed the clinical sign of mastitis and FMD respectively. The season of calving in summer, rainy and winter were respectively 50 (48%), 16 (15%) and 39 (37%). The number of vaccinated cows were only 42 makes up 41%. In case of cowsheds, the brick floor and mud floor were found 69 (56%) and 46 (44%) respectively.
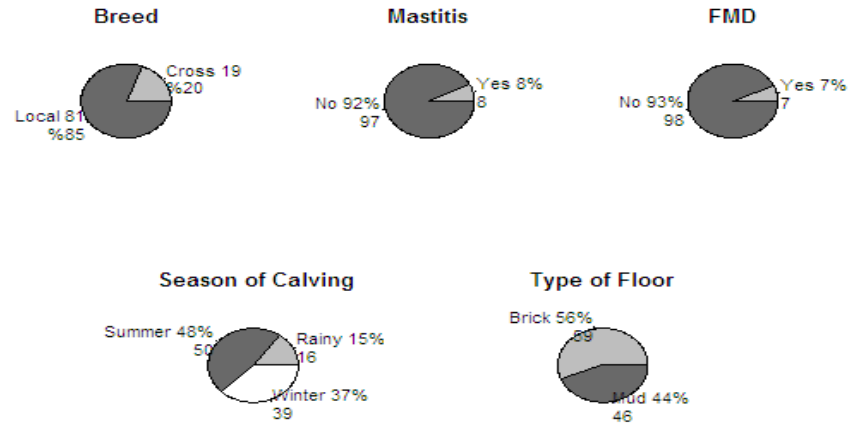

Fig. 2. Pie-chart of different categorical variables

A contingency analysis was conducted to observe the frequency and percentages among the different cells distribution. Table 2 depicts the frequency and percentage distribution among different categorical variables based on binary milk production categorized based on median (50%). Body weight, age of first calving, lactation period, calving interval were categorized based on median and only significant covariates were considered. In category of ≤2 L average milk production, maximum frequency and percentages were (44) 83.02%, (56) 73.68% and (59) 85.51% found within ≤140, ≤36 and ≤8 of body weight (kg), age of first calving (m) and lactation period(m), which was (29) 55.07%, (18) 62.77% and (28) 77.78% in > 140 m, > 36 m and > 8 for category of > 2 L milk production respectively. The maximum proportion was found (57) 75%, (37) 80.43% and (56) 73.68% for no vitamin use, mud floor and owner for the category of ≤2 L milk production, wherever, it was (19) 65.52%, (29) 49.15% and (18) 62.07% for vitamin use, brick floor and gowala in the category of > 2 L milk production.

From the binary logistic regression analysis, it was observed some variables were significantly associated with milk production. The odds of milk production > 2 liters for body weight >140 kg was 6.16 times than that of body weight ≤140 kg, 4.58 times higher for age of first calving of >36 m than ≤ 36 m, 20.65 times higher for lactation period >8 m than ≤ 8 m and, 5.7 times higher for vitamin use than no vitamin used cows. The probability of milk production > 2 liters for mud floor type was 0.25 times lower than that of brick floor type and 0.22 times lower in owner milking than gowala.

Table 2. Percent distribution of different categorical variables on the basis of milk production

Variables	Category	Milk production (liters)		Total	Odds Ratio(OR)	95% CI of OR
		≤2 (%)	>2 (%)			
Body Weight (Kg)*	≤140	44(83.02)	9(16.98)	53	6.16	2.50, 15.19
	>140	23(44.23)	29(55.77)	52		
Age of first calving(m)*	≤36	56(73.68)	20(26.32)	76	4.58	1.85, 11.35
	>36	11(37.93)	18(62.07)	47		
Lactation Period (m)*	≤8	59(85.51)	10(14.49)	69	20.65	7.35, 58.00
	>8	8(22.22)	28(77.78)	36		
Vitamin Use*	No	57(75.00)	19(25.00)	76	5.70	2.26, 14.38
	Yes	10(34.48)	19(65.52)	29		
Type of Floor*	Brick	30(50.85)	29(49.15)	59	0.25	0.10, 0.61
	Mud	37(80.43)	9(19.57)	46		
Milking Person*	Gowala	11(37.93)	18(62.07)	29	0.22	0.09, 0.54
	Owner	56(73.68)	20(26.32)	76		

*p-value <0.01

Discussion

From the study, it was revealed that, significant relation was pragmatic between milk production and age at first calving which was consistent with previous literature (Pirlo *et al.*, 2000; Bayram *et al.*, 2009; Bajwa *et al.*, 2004). On the other hand, no significance relation of age of first calving with milk production in Brown Swiss Cattle investigated by Bayram *et al.* (2009). Lactation period was significantly associated with milk production, which was similarly demonstrated in the research result of Baul *et al.* (2012). In case of parity, no significant relation between milk yield and 4th gives the highest production. Dhumal *et al.* (1989) found no relation between milk yield and parity. Similarly, 4th parity was detected with highest production by Bajwa *et al.* (2004) whereas Tahir *et al.* (1989) registered 5th lactation. Similar significant effect of vitamin use on milk production of this study was observed by Bregsten *et al.* (2003) for high yielding cows whereas 20 mg of supplemental biotin per day in higher producing cows (>75 lbs day^{-1}) increase milk production 2 to 7 lbs day^{-1} but no response in lower producing cows (<45 lbs day^{-1}). In this study, floor type has significant effect on milk production, in opponent, no significant relation was observed by Kremer *et al.* (2007). In this study, there was no significant relation between anthelmentic use and milk production. However, a study by Gross *et al.* (1999) delineated that a median increase in milk production of 0.63 kg/cow per day might be expected after anthelmintic treatment. Another study of meta analysis done by Sanchez *et al.* (2004) showed that on average, an increase of milk production of 0.35 kg cow^{-1} day^{-1} might be expected after anthelmintic treatment of naturally infected lactating dairy cows. Finally it was observed that the milk production was 0.22 times lower for owner milkers than gowala, this may be due to owner's inefficiency or their tendency to give the adequate milk left for calf.

Acknowledgements

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