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Odds ratio of dystocia in Holstein cows in Iraq

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Abstract

The objective of this research was to determine the effect of some factors on dystocia in Holstein cows. The analysis consist of 19090 records of parturitions belonged to 3181 cows from 1990 to 2004 in the Nasr Dairy Cattle Station in Iraq. A logistic regression model was used to predict dystocia. The model included effects of year of birth, season (winter or other seasons), parity (first or later), birth weight (kg), and sex of calf. Results revealed that odds of dystocia decreased by 5% per year. Calves born in the winter have higher risk of dystocia by 27% than calves born in the other seasons. Male calves associated with dystocia were greater than female calves by 39%. First parity cows had a 2.04 times higher risk of dystocia than cows in later parities. Odds of dystocia increased with increasing birth weight by 16%/kg. It was concluded that dystocia was affected by all the factors under consideration.

Keywords: Odds Ratio, Dystocia, Heritability, Holstein Cattle

Introduction

The main objective in animal breeding is to obtain the desired products more efficiently in relation to the present generation by changing the genetic merit of animals in coming generations (Groen et al., 1997). In dairy cattle, the traditional breeding goal has been to obtain high-yielding cows to increase milk, fat, and protein yields. Presently, however, as a consequence of the milk quota system and decreased milk prices, economic efficiency can be further improved by adequate emphasis on other characteristics, called functional or secondary traits (Essl, 1998; Pryce et al., 2004). The term "functional trait" is used to summarize those characteristics of an animal that increase economic profit, not by higher output of products but by reduced costs of input (Groen et al., 1997). Examples of these traits are fertility, calving ease, or milking speed. Calving ease is one of the most economically significant secondary traits (Dekkers, 1994; Dematawewa and Berger, 1997), especially for first-calf heifers since it measures the presence or absence of dystocia.

There are different definitions of dystocia, and methods of data collection are not uniform (Berger et al., 1992). Dystocia, defined as a prolonged or difficult parturition, affects the profitability of herds (Pollak and freeman, 1976; Carnier et al., 2000). In general most researches scored dystocia on a scale of 1 to 5 (Berger et al., 1992; Adamec et al., 2006). Dystocia is an undesirable phenomenon that may arise from several environmental and genetic causes (Burfening et al., 1981). Age, parity of dam and sex of the calf are genetic factors that affect dystocia. Season and year of calving and nutritional level of the cows during gestation are also associated with dystocia (Meijering, 1984). Many studies have found the effect of sire of calf to be larger than that of the sire of the cow (Thompson et al., 1981; Meijering, 1984; Ron et al., 1986; Weller et al., 1986).

Difficult births increase direct costs of the herd (veterinary fees, calf or cow death or both and extra farmer labor), as well as indirect costs, such as an increase in the risk of subsequent unfavorable health events, an increase in culling rate and a reduction in yield (Philipsson, 1976; Dekkers, 1994; Dematawewa and Berger, 1997). Moreover, dystocia can negatively affect reproductive traits such as days open or number of services per pregnancy (Dematawewa and Berger, 1997). Thompson et al. (1982) reported that increased calving difficulty resulted in more days open, longer interval to first breeding, more breeding per conception and lower milk yield in first 30 days but no depression in production after 30 day. Martinez et al. (1983) found that across all parities, in the most difficult births (score 5) 57% of all calves died, and for the next most difficult calving ease category (score 4), 27% of all calves died. Differences in production and reproduction associated with difficult births represent substantial economic losses, and more emphasis should be put on reporting of dystocia by dairy personnel (Djemali et al., 1987).

Dystocia may also contribute to additional management costs for continuous surveillance of parturient cows. Dematawewa and Berger (1997) estimated costs associated with dystocia to be \$0.00, 50.45, 96.48, 159.82, and 397.61 for no assistance, slight assistance, needed assistance, considerable force needed, and extreme difficulty respectively. Also, Dematawewa and Berger (1997) estimated total average cost of dystocia for primiparous cows was \$28.01 compared with \$11.10 for multiparous cows. In a different analysis, Dekkers (1994) calculated dystocia costs to be \$43.11 and \$20.25 for first and later parities respectively.

The objectives of this study were 1) to determine the frequency of dystocia in field data for Holstein cows 2) to determine the factors affecting dystocia and 3) to estimate heritability of dystocia by using the sire of calf as a source of variation in estimation of variance component.

Materials and Methods

Records on Holstein parturitions were analyzed from 1990 to 2004 in the Nasr Dairy Cattle station in Iraq. Twin calves were ignored from the analysis, because we were primarily interested in what causes correctly single-born calves to be difficult to deliver. However, twins are noted to have higher dystocia rates than singletons (Johanson et al., 2001). The data of the present study were divided into two categories (assisted and unassisted). Johanson and Berger, (2003) point out that the best way to align the recording system was to condense the five dystocia categories down to only two, assisted and unassisted. Season was classified as winter and other seasons, because of the weather in Iraq was hot in most months and nearly cold in a few months. Winter included December, January, February and March while other seasons included the residual months.

Because dystocia is binary trait, a traditional regression model for a continuous trait cannot be used. We chose to use logistic regression to model dystocia. Logistic regression handles binary variables well and gives results that are easy to interpret. The logistic regression analysis was done using PROC LOGISTIC in SAS (2001). Odds ratios (OR) are another useful way to interpret results from a logistic regression analysis (Kleinbaum, 1994; Hosmer and Lemeshow, 2000). An OR compares two opposing probabilities to determine which is more problematic. For example, we may want to compare dystocia in male calves versus dystocia in female calves. If the OR is exactly equal to 1, then there is no difference between the sexes for the odds of dystocia. In that case, sex of the calf would not be a good predictor of dystocia. If the OR is 1.5, we interpret this value as meaning male calves have a 50% greater chance of dystocia than female calves given that all other variables are the same. An OR of 2 is double the risk. The OR above was for a discrete variable such as sex of calf. An OR can also be calculated for a continuous variable. This type of OR can be interpreted as a linear trend over the range of the variable. For example, an OR of 1.05 for year is interpreted as a 5% increase in the OR for dystocia for the next year while the other variables are held constant. Suppose all calves born in 1990 have a 10% chance of incidence of dystocia, then all calves born in 1991 have a 10.5% (10% × 1.05) chance of incidence of dystocia.

Statistical analysis

Odds ratio for dystocia was estimated by using the following model:

$$Log\,(\Pi DYS/\,(1-\Pi DYS)) = \beta 0 + \beta 1Y + \beta 2\,S + \beta 3\,G + \beta 4P + \beta 5BW,$$

Where ΠDYS is the probability of dystocia.

Y is year of calving (Linear trend), S is season of calving, G is sex of calf, p is parity, and BW is birth weight of calf (Linear trend).

Variance components were obtained by MIVQUE (Rao, 1971) using the following model:

$$Yijklmno = \mu + Ai + Yj + Gk + Pl + Wm + Sn + eijklmno$$

Yijklmno denotes a 0 or 1 for normal vs. dystocia,

μ = the overall mean,

Ai = fixed effect of the ith season of calving,

Yj = fixed effect of jth year of calving,

Gk = fixed effect of kth sex of calf,

Pl = fixed effect of lth parity,

Wm = fixed effect of weight of calf,

Sn = random effect of calf's sire

$e$ijklmno = residual effect.

Results and Discussion

The overall means of dystocia was 15.24% (Table 1), the present estimation is within estimates obtained by several researchers 5.08 – 16.3% (Weller et al., 1988; Manffredi et al., 1991; Heins et al., 2001; Cassell, 2005). Table 2 gives parameters along with their estimates for factors affecting dystocia. The first thing that one may notice is the significant effect of all factors on dystocia. Also note that the quadratic term for birth weight is not necessary to predict dystocia. This is due to the fact that smaller than average birth weights do not need assistance as often as larger than average birth weights. Hence the linear trend of birth weight is sufficient to model the increase in dystocia (Johanson and Berger, 2003).

Table 3 presents estimates of the OR for the factors affecting dystocia. Results revealed that birth season has significant effect ($P<0.01$) on dystocia. Calves born

Table 1: Least square means of factors affecting dystocia

Effect	No. of Observation	Least squares means ± SE %
Overall means	19090	15.24 ± 0.07
Calving season		
Winter	5256	15.26 ± 0.14
Other seasons	13834	15.89 ± 0.09
Parity		
1	5079	16.65 ± 0.14
2 +	14011	14.51 ± 0.09
Sex		
Male	9808	16.44 ± 0.11
Female	9282	14.72 ± 0.11

Table 2: Parameter estimates for dystocia

Parameter	Pro>	Estimate ± SE
Intercept	0.0001	84.2193 ± 14
Season	0.0001	0.2398 ± 0.06
Year	0.0001	- 0.0476 ± 0.007
Sex	0.0001	0.3300 ± 0.02
Parity	0.0001	0.7141 ± 0.05
BW	0.0001	0.1519 ± 0.007

BW = Birth weight

in the winter have a 27% higher risk of dystocia than calves born in the other seasons. These results were higher than 15% which was reported by Johanson and Berger (2003). Pollak and Freeman (1976) found that more dystocia was in winter (October through March) due to male calves were significantly larger than female and experienced more dystocia. Also McClintock et al. (2005) reported that incidence of dystocia in Holsteins was influenced by the season due to gestation lengths were longer in winter, resulting in larger calves and more dystocia. Two hypotheses explaining this, first, cows calving in summer may be in better physical condition to calve. Second, herdsmen may have more time in winter to witness and aid in delivery of calves (Pollak and Freeman, 1976).

The estimate of the OR for year indicated that there is a 5% decrease in dystocia per year. For example, if the incidence of dystocia is 16.3% in a given year, then it will decrease to 15.4% (0.163 × 0.95) the next year. The differences in dystocia due to years of calving were significant (P<0.01). These results were closed with results obtained by Johanson and Berger, (2003). Odds of dystocia was 39% higher in males than females which means that cows calving males are at more risk to face difficult of calving compared with calving female. This finding may be reflecting of differences in birth weight of males and females which was reported by AL-Samarai et al. (2006) who found that the differences between weight of male (41.56kg) and female (38.36kg) were significant (P<0.01) in the same herd. Similar results were documented by several reports (Manffredi et al., 1991; Heins et al., 2001; Cassell, 2005; Lombard et al., 2007).

The OR estimate for parity indicated that first-parity cow has 2.04 times higher risk of dystocia than later-parity cows. This finding was supported by Johanson and Berger (2003) who found that the odds was 4.7 times higher risk of dystocia in heifers compared with cows. The results of present study revealed that a 1-kg increase in birth weight corresponds to a 16% increase in dystocia, which was imitated to 13% obtained by Johanson and Berger (2003). The heritability of dystocia in the present study (0.12) was within range (0.03–0.20) obtained by several researchers (Phillipsson, 1979; Meijering, 1984; Djemali et al., 1987; Manfredi et al., 1991). The low heritability in this study supports previous result obtained by Weller et al. (1988) who revealed that dystocia has low heritability even in the threshold model analysis.

Although this study answered some questions, there is another questions, for example, several researchers (Philipsson, 1976; Cady, 1980) have suggested that dystocia in first and later parities should be considered separate traits, however, others assumed that dystocia in first and later parities represents the same trait and uses progeny from all parities of dam to rank sires for dystocia. This assumption was made because the larger volume of data from older dams should improve accuracy of sire evaluation for use on virgin heifers if the traits are similar. We need to know the correlation of sire rankings from first with sire rankings from later parity data. A large genetic correlation between dystocia in first with later parities indicates major influence of the same genes affecting

Table 3: Odds ratio (OR) estimates and interpretations for dystocia

Effect	Comparison	OR	95% CI	Interpretation
Season	Winter vs Other seasons	1.27**	1.13-1.43	27% higher odds for dystocia in winter than other seasons
Year	Linear trend	0.95**	0.94-0.96	5% decreased in odds for dystocia per year
Sex	Male vs Female	1.39**	1.31-1.47	39% higher odds for dystocia in males than female
Parity	1 vs 2+	2.04**	1.83-2.27	2.04 times higher odds for dystocia in first than later parities
BWT	Linear trend	1.16**	1.14-1.18	16% increase in odds for dystocia per kg increase in BWT

BW = Birth weight; **($P < 0.01$)

Table 4: Variance component and heritability estimates obtained with the linear model analyses

Parameter	Variance components
Sire variance	5.78
Residual variance	186.09
Heritability (h^2)	0.12

dystocia in all parities and would allow inclusion of data from later parity animals for improved accuracy in evaluating sires for use on virgin heifers. Discussion also exists as to whether dystocia should be considered a trait of the calf or a trait of the dam and what about the correlations of sire rankings as a trait of the calf with sire rankings as a trait of the dam? Finally a multitrait analysis has been suggested (Van Vleck and Edlin, 1984), but little would be gained if later parity heritability and the genetic correlation between first and later parities are low. However, a multi trait threshold analysis is considerably more complex than a single trait analysis (Foulley et al., 1987).

Results clearly demonstrate that dystocia was affected by all factors in the employed model and parity has the highest effect on dystocia. The low estimate of heritability for dystocia indicates the importance of environmental factors in the variation of the trait.

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