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Identification of Cow-related Health Disorders Affecting the Culling in Torbat-e Jam Dairy Farms

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Abstract

An experiment was conducted to assess characterization of cow-related health disorders affecting the culling in Torbat-e Jam dairy farms. In total, the data of 5874 lactating cows have been used in this study (1997 to 2017). The logistic regression was applied to investigate the associations between the response variable, the risk of culling, and predictor variables including the parity, calving ease, birth type, calving season, and age at the first calving. The risk of culling increased with parity and twinning (P< 0.001). The odds ratio (OR) of a cow leaving the herd were 1, 1.17, 1.35, 2.06, 2.95 and 3.55 for parities 1 to 6, respectively, 1 and 1.14 for twinning. The OR increased with increasing in calving difficulty score (P< 0.001). The OR were 1, 1.21, 1.26 and 2.30 for calving difficulty score 1 to 4, respectively. Calving in hot season increased the risk of culling (P< 0.001). The OR were 1, 1.59, 1.46 and 1.06 for spring, summer, fall and winter respectively. Cows that calved first at about 24 months of age had a lower risk of culling (P< 0.001). These findings help farmers reduce their involuntary culling rates in dairy herds by improving the management of dairy cows in Torbat-e Jam.

Keywords: Culling, Holstein dairy herds, Torbat-e-Jam, Iran

1. Introduction.

The health and proper conditions for breeding livestock are very important issues due to focus of consumers on the livestock products quality and safety, in recent years. It is always said as a principle that optimum conditions guarantee the proper growth of the livestock. Exposure of the animals to various diseases and bred in inappropriate conditions may cause decrease quality and safety of domestic animal productions (HAS, 2013).

Lack of attention to the health status of the cow increases the risk of culling from the herd. The departure of the cow from the herd for some reason such as sale, slaughter, death, aging and infertility, is known as culling (Fetrow *et al.*, 2006). Culling rate has been rising recently due to sub-optimal health and inadequate welfare and management practices (Thomsen *et al.*,

2006 and McConnel *et al.*, 2008). Culling is complicated issue and influenced by many voluntary and involuntary factors such as management style, herd and cow-related characteristics (Booth *et al.*, 2004; Didarkhah *et al.*, 2013; Bahrampour *et al.*, 2016). However the information about the connection cow-related characteristics and culling is little.

Further knowledge about herd health status and cow-related characteristics may lead to development of programs for better animal welfare, reducing of involuntary culling and increase quality and safety production in Iranian dairy farms. So this experiment was carried out to identify characterization of factors affecting animal health and culling rate in Torbat-e Jam dairy farms, one of the biggest dairy producing regions in Iran, Khorasan Razavi Province.

2. Materials and Methods.

2.1 Data

The experiment was conducted in Khorasan Razavi Province, Torbat-e Jam area, as one of the most important centers for producing dairy product in Northeast of Iran. A commercial dairy herd milking Holstein cattle were used in this study. Herd sizes were 5874 lactating cows for 20 years period. This herd were used because of the completeness records farmer compliance and full time on-staff veterinarian. Any missing information about parity number, calving and culling date were not included in the study. Also the data related to cow with calving intervals more than 600 d and lower 300d and cow with first calving before age 20 or after 40 months and with parity more than 12 were removed from the study.

2.2 Outcome and Predictor Variables

The outcome variable was the risk of culling regardless of reason. The predictor cow-related characteristics variables included the calving season: spring (21 March to 21 June), summer (22 June to 22 September), fall (23 September to 21 December) and winter (22 December to 20 March), birth type: single or twins, calving difficulty scores: 1= normal (not assisted), 2= moderate assistance (farmer), 3= moderate assistance (veterinarian culled as precaution), 4= very difficult (extraction by farm staff and veterinary assistance), and parity: 1, 2, 3, 4, 5 and ≥ 6.

2.3 Statistical Analysis

The logistic regression was used to analyse the associations between predictors and response variable. The effect of variables of interest on the odds ratio (OR=P/1-P) and risks of culling was estimated by using the logit-link in GLIMMIX procedure (SAS, 2008). The logistic regression model used for analysis was:

$$Y_i = \beta_0 + \beta_1 X_{i1} + + \beta_2 X_{i2} + \ldots + \beta_{p-1} X_{(p-1)i}$$

Where:

Y_i= response variable
X_{1i}, X_{2i}, ..., $X_{(p-1)i}$ = indicate the independent variables

$\beta_0, \beta_1, \beta_2, ..., \beta_{p-1}$= indicate the regression parameters

3. Result and Discussion.

3.1 Descriptive Statics

Descriptive statics and distribution of studied variables in herd through the years are shown in table 1. During the 20 years, the highest percentage of calving cow was observed in the parity 1 and 6 or more. Also the highest percentage of culling rate was reported in parity 1 and 2. The percentage of twins was much lower than singleton. However the number of culled singleton calf was much higher. In 20 past years, summer and fall have highest proportion of calving and spring and summer have highest proportion of culling. The percentage of culling course of 20 years is shown in Figure 1.

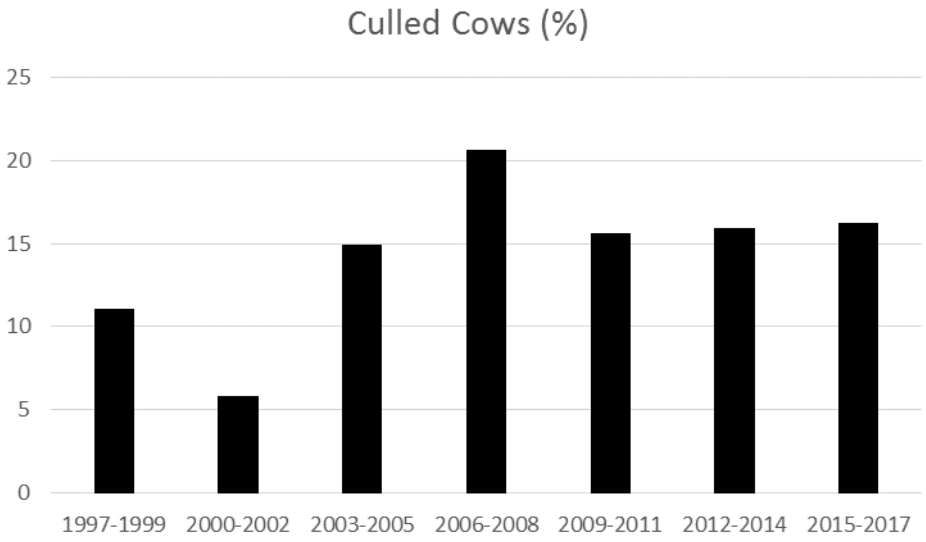

Figure 1. Percentage of culled Holstein cows through the years in Torbat-e Jam.

3.2 Parity

As shown in table 2, the rate of culling form the herd increased with parity (P< .001). The odds ratio of culling for cows removed from the herd with parity 1 to 6 or more, were 1.00, 1.17, 1.25, 2.06, 2.95 and 3.55 respectively (Table 2). These results are similar to the findings of Bahrampour *et al.* (2016) who observed an increase in risk of culling with odd ratio 1.00, 1.32, 1.55. 1.62, 1.67 and 1.88 when parity increased from 1 to 6 or more. De veries *et al.* (2010) obtained similar results. They observed in parity 1 to 6 or more, the risk of cows leaving the herd increased with score 1.00, 1.51, 2.14, 2.68, 3.11 and 3.46, respectively. Pinedo *et al.* (2010) reported an increase in mortality in dairy cattle in United State and Denmark in parity 5 or more compared parity 1 to 4. This finding is consistent with the result of current study. According to Mohammadi and Seddighi (2009) and Ansari-Lari *et al.* (2012), increase in cow age could increase mortality and culling rate in the dairy herds. The weakening of body immune system and subsequent incidence of certain disease in older ages

could be the reason for increase mortality and culling rate in the dairy herds (Miller *et al*., 2008; Pinedo *et al*., 2010; Raboisson *et al*., 2011, Shahid *et al*., 2015; Bahrampour *et al*., 2016).

Table 1. Descriptive statics and distribution of studied variables in dairy herd through the years in Torbat-e Jam.

Year (1997-2017)		97-99	00-02	03-05	06-08	09-11	12-14	15-17
Number of cow (n)		654	870	859	865	865	860	865
Calving Cows (n)		79	43	71	53	67	58	37
Milk 305-d (Kg)		8235.1	8386.6	8455.9	8570.0	8611.4	8820.9	9744.7
Age at first calving		788	781	770	755	798	768	769
Parity (%)	1	22.78	16.27	25.35	28.30	28.35	12.06	10.81
	2	20.25	09.30	11.26	07.54	16.41	08.62	02.70
	3	11.39	20.93	12.67	13.20	16.41	22.41	02.70
	4	10.12	16.27	11.26	15.09	11.94	24.13	18.91
	5	11.39	11.62	14.08	07.54	10.44	08.62	21.62
	≥6	24.05	25.58	25.35	28.30	16.41	24.13	43.24
Twins (%)	Singleton	91.14	90.70	90.15	90.57	91.05	91.38	91.90
	Twin	08.86	09.30	09.85	09.43	08.95	08.62	08.10
Calving season (%)	Spring	16.45	20.93	18.30	22.64	11.94	43.10	21.62
	Summer	48.10	41.86	28.16	33.96	38.80	25.86	43.24
	Fall	20.25	20.93	26.76	28.30	31.34	18.96	29.72
	Winter	12.65	16.27	26.76	15.09	17.91	12.06	05.40
Culling parity (%)	1	19.50	20.20	21.40	28.50	32.07	33.20	35.50
	2	23.80	24.10	24.40	24.30	24.30	24.50	25.50
	3	20.10	19.60	19.70	18.50	17.60	17.40	18.80
	4	13.40	13.10	13.30	12.10	11.30	11.10	12.20
	5	09.10	08.40	08.54	07.10	06.60	06.40	06.60
	≥6	14.10	14.60	13.30	09.50	07.50	07.40	07.70
Culling season (%)	Spring	26.47	30.55	27.17	28.34	27.08	27.70	28.15
	Summer	27.94	33.33	29.34	29.90	29.16	29.62	19.12
	Fall	22.05	19.44	22.82	21.25	21.87	22.22	22.33
	Winter	23.52	16.66	20.65	20.47	21.87	20.37	20.38
Twins culling (%)	Singleton	75.00	60.00	89.00	89.00	90.00	85.00	88.00
	Twin	25.00	40.00	11.00	11.00	10.00	15.00	12.00
Dystocia[1] culling (%)	1	80.00	83.30	80.00	80.00	80.00	85.70	87.50
	2	20.00	16.70	10.00	20.00	20.00	14.30	12.50
	3	00.00	00.00	10.00	00.00	00.00	00.00	00.00
	4	00.00	00.00	00.00	00.00	00.00	00.00	00.00

[1] 1= normal (non-assisted); 2= moderate assistance (farmer); 3= moderate assistance (veterinarian culled); 4= very difficult.

Table 2. Final logistic regression model, odds ratio, 95% confidence interval and P-value for dairy herd risk factors in Torbat-e Jam.

Predictor variable		Odd ratio	95% confidence interval	P-value
Parity	1	1.00	Ref	<0.001
	2	1.17	0.46-1.06	
	3	1.25	0.86-1.80	
	4	2.06	1.46-2.89	
	5	2.95	2.13-4.10	
	≥6	3.55	2.57-4.90	
Calving difficulty[1]	1	1.00	Ref	<0.001
	2	1.21	1.17-1.23	
	3	1.26	1.21-1.30	
	4	2.30	2.28-2.34	
Birth	singleton	1.00	Ref	<0.001
	twins	1.14	1.11-1.15	
Calving season	spring	1.00	Ref	<0.001
	summer	1.59	1.23-2.06	
	fall	1.46	1.13-1.19	
	winter	1.06	0.81-1.39	
Age at first calving	≤728	1.00	Ref	<0.001
	729-762	1.56	1.47-1.62	
	763-815	1.60	1.52-1.65	
	≥816	1.94	1.72-2.11	

[1] 1= normal (non-assisted); 2= moderate assistance (farmer); 3= moderate assistance (veterinarian culled); 4= very difficult

3.3 Calving Difficulty

The risk of cows leaving the herd for calving difficulty are reported in Table 2. As the dystocia score increased there was an increase in the risk of cows leaving the herd, significantly (P< .001). The odds ratio of culling for calving difficulty recorded 1, 1.21, 1.26, and 2.30 for dystocia score 1, 2, 3 and 4 respectively (Table 2). Recently, Bahrampour *et al*. (2016) observed that calving difficulty increased the risk of cows leaving the herd significantly. They reported that the hazard ratio of cow culled for calving difficulty were 1, 0.89, 1.22, and 1.49 for dystocia score 1, 2, 3 and 4 respectively (Bahrampour *et al*., 2016). Reproductive disorders and calving difficulty is positively correlated to the mortality levels (McConnel *et al*., 2008). The previous research (Dematawewa and Berger 1998) demonstrated that dystocia score 4 and 5, increase mortality level by more than 4% compared

to dystocia score 1. Previous published studies have also reported increased about 20% in hazard ratio of cow culled for dystocia score 3 and 4 compared to dystocia score 1 and 2 (Bicalho *et al*., 2007). Shahid *et al*. (2015) revealed that mortality risk was markedly greater in dystocia score 3, 4 and 5. Calving difficulty could have increased the risk of cows leaving the herd possibly due to increased reproductive disorders, decreased dry matter intake after calving, altered the hormonal status and subsequent decreased in milk and its components production (Barrier and Haskell, 2011; Atashi *et al*., 2012). Decreasing the risk of cows leaving the herd for calving difficulty score 4 to 1 could be attributable to on time presence of an assistant at parturition, provision of parturition confinement, better treatment and nutrition (Eaglen *et al*., 2011).

3.4 Type of Birth

The hazard ratio of cow culled for type of birth are shown in Table 2. The rate of culling form the herd increased with twining, significantly (P< .001). The odds ratio of culling for cows removed from the herd with type of birth singleton and twins, were 1.00 and 1.14 respectively (Table 2). The values from this experiment are similar to the findings of Bahrampour *et al*. (2016) who observed an increase in risk of culling with odd ratio 1.00 and 1.09 for type of birth singleton and twins, respectively. The observations from the previous experiment has shown that twining increased the risk of cows leaving the herd and mortality level by 42% compared to cow with singleton birth (Bicalho *et al*., 2007). Compared to cow with singleton birth, cows that calves twins, had higher the risk of culling and mortality level because of the experience of sever calving difficulty (De veries *et al*., 2010). Some previous studies demonstrated that twining, increase calving difficulty score and mortality level by 7% compared to cow with singleton birth (Shahid *et al*., 2015; Atashi *et al*., 2012). The reason for the observed higher levels of mortality and risk of culling in cows that calves twins probably relates to increase the incidence of some disorders such as dystocia, retain placenta, metritis, displaced abomasum and ketosis (Bell and Roberts, 2007; Fricke, 2001).

3.5 Calving Season

The present results indicate that the risk of cows leaving the herd for calving season is much greater in hot season (spring and summer) for calved cows compared to fall and winter (P< .001). The odds ratio of culling for calving season recorded 1, 1.59, 1.46, and 1.06 for spring, summer, fall and winter, respectively (Table 2). Our observation is consistent with that of Bahrampour *et al.* (2016) where the hazard ratio of cow culled for calving season decreased in the cool season (fall and winter). One of the important factors affecting the rate of culling in new born calves is the season of calving (Hadley *et al.*, 2006). Therefore, Dechow and Goodling (2008) and Alvasen *et al.* (2012) reported that seasonal adverse effect on cow survival more observed in spring and summer. In addition to, Pinedo and de Vries (2010) and Miller *et al*. (2008) indicated that calving in hot season (spring and summer) increased the risk of cows leaving the herd compared to calving in cool season (fall and winter). One of the reasons for increasing the risk of cows leaving the herd in hot season (spring and summer) may be increase the incidence of some disorders such as claw lesions (Madadzadeh *et al.*, 2013). On the other hand, increasing the risk of cows leaving the herd in

hot season (spring and summer) may also be related to the influence of seasonal characteristic differences on cow health, milk production level, feed availability, milk price, conception rate and profitability (Delorenzo *et al.*, 1992; Hadley *et al.*, 2006).

3.6 Age at First Calving

The risk of cows leaving the herd for age at first calving are reported in Table 2. According to the result of current study, age at first calving has been shown to have significant correlations with the risk of cows leaving the herd. The risk of cows leaving the herd increased with the increasing in age at first calving ($P< .001$). The odds ratio of culling for age at first calving recorded 1, 1.56, 1.60, and 1.94 for ≤728, 729-762, 763-815 and ≥816, respectively (Table 2). Vukasinovic *et al.* (2001) found that the risk of cows leaving the herd for age at first calving increased slightly when the first calving occurred very soon or very late. Similarly, Ducrocq (2005) and M'hamdi *et al.* (2010) reported an increase in the risk of cows leaving the herd with increasing the age at first calving. As the age increased at first calving, the odd ratio of cow culled for age at first calving increased for for age at first calving (Zavadilova and Stipkova, 2013; Bahrampour *et al.*, 2016). Perusal of the literature indicates that in Holstein cow a calving at about 24 months of age needs to be achieved to have best economic impacts (Heinrichs, 1993). One reason for decreasing the risk of cows leaving the herd for calving at about 24 months of age could be that, better productive and reproductive performance at this age.

4. Conclusions

This research provides evidence that increased the risk of cows leaving the herd could be partly mediated by an increase in parity, calving difficulty score, gave birth to twins, hot seasons (spring and summer) and had longer days to first calving. These findings indicate that there is a direct relationship between the management of cow-related characteristics and the culling and help farmers reduce their involuntary culling rates in dairy herds by improving the management of dairy cows in Torbat-e Jam.

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