TÜBİTAK

Turkish Journal of Veterinary and Animal Sciences

http://journals.tubitak.gov.tr/veterinary/

Research Article

Turk J Vet Anim Sci
(2015) 39: 87-95

doi:10.3906/vet-1404-13

Effects of dystocia on milk production and reproduction in subsequent lactation in a Turkish Holstein herd

İbrahim KAYA*, Can UZMAY, Tarık AYYILMAZ
Department of Animal Science, Faculty of Agriculture, Ege University, Bornova, İzmir, Turkey

Received: 04.04.2014 • **Accepted:** 24.10.2014 • **Published Online:** 12.01.2015 • **Printed:** 09.02.2015

Abstract: The study investigated effects of dystocia on milk production, reproduction, calf loss, and cow culling in a Turkish Holstein herd at the Agricultural Faculty, Ege University, İzmir, Turkey. Data were from 653 single calvings between 2006 and 2010. Considering a greater dystocia incidence in primiparous cows, data was divided in two; 223 primiparous and 430 multiparous calvings scored on a 1-to-5 scale. Scores were categorized into no dystocia and dystocia. With few related observations, all multiparous data were excluded since sample size for multiparous dystocic calvings was too small to make reliable estimates. Milk yields, days to first service, and days open were analyzed using general linear model univariate procedure. Rates of calf losses, culled cows, retained placenta, and conception within 150 days were compared by chi-squared analysis. Primiparous cows with dystocia produced 85 and 219 kg less milk in 100 and 305 days, respectively ($P < 0.10$) and showed a higher stillbirth incidence ($P < 0.01$) than cows without dystocia. However, dystocia had no effects on days to first service and days open. No significant associations existed between dystocia and retained placenta, conception within 150 days, and culling ($P > 0.10$). One should consider relieving dystocia for good welfare in cows and calves and decreasing its adverse effects on milk yield in primiparous cows.

Key words: Dystocia, primiparous Holsteins, milk production, reproductive measures, calf loss, cow culling

1. Introduction

Dystocia is defined as difficulty or prolongation of parturition as opposed to eutocia, i.e. normal parturition (1) and requires assistance varying from slight to extreme during delivery. There are a variety of risk factors for dystocia such as breed, parity, weight and condition of cow at calving, sex and birth weight of calf, malpresentation, multiple calving, and year and season of calving (2). Dystocia is much more common in primiparous than in multiparous cows (3–7), but primary risk factors for dystocia are different in primiparous and multiparous cows (5).

Dystocia is a welfare problem of cows and calves and is also of economic importance. It causes pain or pain and injury to the cow. Therefore, it directly leads to poor welfare in cows (8). Moreover, dystocia may have negative effects on levels of milk yield and reproductive performance, causing stillbirth, cow death, retained placenta, uterine infections, or increased involuntary culling (3,5,9–14). Other consequences of dystocia include veterinary fees, extra labor, and other management costs (3,15). Considering losses in yield (305-day milk, fat, and protein), fertility (days open, number of services), cows, and calves, Dematawewa and Berger (3) found that given all parities costs of dystocia were $0.00, $50.45, $96.48, $159.82, and $379.61 for dystocia scores 1 (no problem), 2 (slight assistance), 3 (needed assistance), 4 (considerable force needed), and 5 (extreme difficulty), respectively. Total cost of dystocia (sum of costs associated with dystocia scores weighted by the probability of occurrence) was $24.24 for an average cow in any parity.

To our knowledge, there is no published research into effects of dystocia on milk production and reproductive measures in dairy cows in Turkey, which ranked 25th in total number of cattle (12,386,337 head) in the world in 2012 (http://faostat.fao.org; accessed March 2014). On the other hand, complete records on dystocia in cows are rare. The objective of the study was to investigate effects of dystocia on milk production during both early and complete lactation periods, reproductive measures comprising days to first service, days open, and conception rate within 150 days after calving, retained placenta, calf loss, and cow culling in a Turkish Holstein herd whose data have been fully recorded. A computerized milking and herd management system has been used there since 2005.

* Correspondence: ibrahim.kaya@ege.edu.tr

2. Materials and methods

2.1. Herd, management, and data

Data used in the study were extracted from records of the Holstein herd at the Menemen Research and Application Farm of the Agricultural Faculty of Ege University in İzmir, Turkey. Geographical coordinates of the dairy herd are 38°34′51″ N, 27°02′01″E, and its altitude is about 5 m. The years between 2006 and 2010 involving the study data showed an average of 120 and 20 per year for milking cows and dry cows, respectively. General herd management was in line with requirements of the Directive on the Welfare of Farm Animals (16). Cows were housed in a dairy barn with 156 sand-bedded free stalls and milked twice a day in a 2 × 8 herringbone parlor. They were fed on total mixed ration to meet requirements for maintenance and 15 kg milk yield. As for requirements for milk over 15 kg, individual concentrate feeding was applied by computerized concentrate feeders. Since 2005, a project has been carried out in the herd to increase effectiveness of the progeny testing program conducted for over 10 years by the Cattle Breeders Association of Turkey under the supervision of the Ministry of Food, Agriculture, and Livestock. Within the context of the project, much of the insemination in the herd has been by the semen of Turkish candidate bulls.

A previous study of the database, different parts of which were used in this study, investigated risk factors for dystocia (6). The current study, however, aimed to investigate effects of dystocia on milk production, reproduction, calf loss, and cow culling. Accordingly, date of calving; calving score; birth type (single, twin, abort, or stillbirth); parity number; age at calving; 100-day, 200-day, and 305-day milk yield; days to first service; days open; cases of retained placenta, hypocalcemia, ketosis, and clinical mastitis; and culling reasons and dates were extracted from that database. Excluding 15 abortions and 25 twin births (4 from primiparous and 21 from multiparous cows) from the data, 653 single calvings from 4 January 2006 to 30 December 2010 remained for final analysis including 223 first, 167 second, and 263 third or greater parity calvings ranging from 3 to 9. Of the 223 first calvings, 167 (74.9%), 27 (12.1%), 18 (8.1%), and 11 (4.9%) were from Turkish candidate bull semen, natural (bull) service, imported semen, and unknown sires, respectively. Of the 167 second calvings, 152 (91.0%), 7 (4.2%), and 8 (4.8%) were from Turkish candidate bull semen, natural (bull) service, and imported semen, respectively. Of the 263 third or greater calvings, 237 (90.1%), 11 (4.2%), 10 (3.8%), and 5 (1.9%) were from Turkish candidate bull semen, natural (bull) service, imported semen, and unknown sires, respectively.

Rates of dystocia were 43.5%, 4.8%, and 2.7% for first, second, and third or greater parity cows, respectively, revealing a much higher incidence of dystocia in primiparous cows. The data were therefore divided into 2 parts to separately analyze effects of dystocia on primiparous and multiparous cows. Table 1 shows number of available records for milk production and reproduction traits by parity and dystocia group, also indicating that there were very few observations on multiparous dystocic calvings. Of the 167 second and 263 third or greater calvings, only 8 and 7 were dystocic calvings, respectively. Thus, all multiparous data were excluded because sample size for multiparous dystocic calvings was too small to make reliable estimates. Hereinafter, information was given for data including only primiparous calvings.

Lactation records of less than 270 days were not used in the analysis of 305-day milk yield data. Milk yields from lactations 270 to 304 days in duration were considered 305-day milk yield. In lactation records of over 305 days, the first 305-day milk yields were used. Days to first service values were between 35 and 268 days, and those greater than 200 days (4 observations) were assumed to be

Table 1. Number of total and dystocia records for milk production and reproduction traits by parity.

Trait	Parity					
	1		2		≥3	
	Total	Dystocia	Total	Dystocia	Total	Dystocia
Calving	223	97	167	8	263	7
100-day milk yield	215	93	159	7	238	7
200-day milk yield	212	91	152	7	220	7
305-day milk yield	197	84	136	7	191	6
Days to first service	209	90	156	7	224	7
Days open in cows conceiving	205	86	145	7	189	5
Days open in all cows	211	90	151	7	214	6

outside the normal range and excluded. Days open in cows conceiving were calculated as the interval between calving and conception, in other words, days to conception. The values of days open in cows conceiving were from 35 to 446 days, and those over 305 days (7 observations) were set to 305 days. Days open in all cows also included observations for those not pregnant and open for at least 305 days after calving, and for these cows days open were set to 305 days (6 observations).

Cows were milked twice a day with measurements of individual milk yields per milking by Metatron milk meters of WestfaliaSurge (Germany). Milk data were recorded and processed by the herd management software DairyPlan, WestfaliaSurge (17). Daily milk yields were summed by the software to obtain total milk yields for relevant periods, i.e. 100-day, 200-day, or 305-day. The first 3 days after calving were described as the colostrum period, during which mammary gland secretion was not taken into account because it was separated during milking and could not be measured by Metatron milk meters. Accordingly, total milk yields in any lactation period did not include secretion during the colostrum period.

2.2. Trait description

Calving score was determined by the herd veterinarian on a scale of 1 to 5, with 1 being unobserved but no problem, 2 no assistance, 3 easy pull, 4 hard pull, and 5 extreme difficulty (hard pull with damage to vulva or vagina or both). The present calving scoring system was adapted from the herd management software DairyPlan, WestfaliaSurge (17). Calving scores were categorized into 2 groups, no dystocia (scores 1, 2, or 3) and dystocia (scores 4 or 5), and analyses were thus made. Stillbirth was defined as dead at birth or within the first 24 h after birth. Retained placenta was defined as failure to expel fetal membranes within 24 h after calving. Clinical mastitis cases were diagnosed by abnormal milk or udder signs or both. Cows with at least one case of mastitis were considered. All first cases of clinical mastitis occurred during the first 200 days of lactation. No cases of hypocalcemia emerged, and only one ketosis case was observed in primiparous cows.

The province of İzmir has a Mediterranean climate. Calving seasons were classified into 2 seasons, cold (November through April) and warm (May through October). Between 1975 and 2010, the average minimum temperature in İzmir by months of the cold season ranged from 5.9 to 11.5 °C, and average maximum temperature was 12.6 to 21.0 °C. The average minimum temperature by months of the warm season ranged from 14.9 to 22.8 °C, and average maximum temperature was 24.1 to 33.3 °C (http://www.dmi.gov.tr; accessed May 2011).

2.3. Statistical analyses

The following model was used to investigate effects of dystocia on milk production and reproduction traits in primiparous cows.

$$Y_{ijklm} = \mu + yc_i + sc_j + dc_k + cm_l + b\,(age_{ijklm} - \overline{age}) + e_{ijklm} \quad [1],$$

where

Y_{ijklm} = 100-day, 200-day, 305-day milk yield; days to first service; or days open,

μ = overall mean,

yc_i = fixed effect of the ith year of calving (2006 to 2010),

sc_j = fixed effect of the jth season of calving (1 = warm, 2 = cold),

dc_k = fixed effect of the kth dystocia group (1 = no dystocia, 2 = dystocia),

cm_l = fixed effect of the lth clinical mastitis group (1 = no mastitis, 2 = mastitis),

b = linear regression coefficient of the considered trait on age at first calving,

age_{ijklm} = age at first calving (month),

e_{ijklm} = random residual effects.

Possible interactions between fixed factors were not significant in all models and were therefore removed from final models. Analyses were carried out using the general linear model univariate procedure of SPSS (18). Pairwise comparisons based on estimated marginal means (EMMs) were conducted, using Bonferroni adjustment for multiple comparisons. Rates of calf losses, culled cows, retained placenta cases, and cows conceiving within 150 days after calving in dystocia groups were compared by chi-squared analysis using the Crosstabs procedure in SPSS. P values <0.05 were considered significant, and P values between 0.05 and 0.10 were called marginally significant.

3. Results

3.1. Effects of dystocia on milk production and reproduction in primiparous cows

Table 2 shows EMMs for milk yield traits in primiparous cows. EMMs are defined as least-squares means in some statistical software. Milk yield in 100 days of lactation was lower for cows with dystocia (1904.3 kg) than that for those with eutocia (1989.6 kg) ($P = 0.055$). Similarly, 305-day milk yield was lower following dystocic calvings than eutocic calvings (5296.2 vs. 5514.8 kg; $P = 0.097$). Loss in 200-day milk yield in cows with dystocia was not significant ($P > 0.10$). The effects of calving year, calving season, clinical mastitis, and age at calving on 100-day, 200-day, and 305-day milk yield in primiparous cows were significant ($P < 0.05$). Milk yield in 100 days, 200 days, and 305 days of lactation was lower in cows that calved in the warm season than in those that calved in the cold season ($P < 0.01$) and lower in those with clinical mastitis than that in those without clinical mastitis ($P < 0.05$).

Table 3 presents EMMs for days to first service and days open in primiparous cows. No effects of dystocia were found on days to first service and days open ($P > 0.10$). For

Table 2. Estimated marginal means (EMMs) for milk yield traits in primiparous cows by dystocia group and other factors.

	100-day milk yield, kg				200-day milk yield, kg				305-day milk yield, kg			
Factors	n	EMM	SEM	P	n	EMM	SEM	P	n	EMM	SEM	P
Dystocia[a]				0.055				0.255				0.097
No	122	1989.6[b]	69.8		121	3919.2	95.5		113[d]	5514.8[b]	152.8	
Yes	93	1904.3[c]	71.4		91	3819.5	96.0		84[e]	5296.2[c]	150.7	
Calving year				<0.001				<0.001				0.009
2006	46	2146.6[f]	76.9		44	4301.2[f]	112.8		44	5841.5[f]	167.6	
2007	44	1937.6[g]	75.8		44	3835.9[g]	115.7		34	5494.5[f,g]	192.7	
2008	41	1839.3[g]	84.1		41	3650.1[g]	127.9		38	5182.0[g]	201.7	
2009	51	1946.5[g]	78.2		51	3841.6[g]	117.6		50	5289.9[g]	178.9	
2010	33	1864.7[g]	87.2		32	3717.8[g]	137.6		31	5219.7[g]	207.3	
Calving season[h]				<0.001				<0.001				<0.001
Warm	92	1837.3[i]	71.7		91	3628.9[i]	99.3		83	5121.5[i]	158.9	
Cold	123	2056.6[j]	69.6		121	4109.7[j]	92.4		114	5689.5[j]	144.6	
Clinical mastitis				0.005				0.022				0.014
No	209	2136.4[i]	22.7		197	4065.2[f]	45.9		185	5744.1[f]	68.3	
Yes	6	1757.5[j]	131.9		15	3673.5[g]	164.0		12	5066.9[g]	264.9	
Calving age[k] (month)	215	36.8	6.9	<0.001	212	76.5	13.6	<0.001	197	103.5	19.9	<0.001
Overall	215	1947.0	67.1		212	3869.3	85.2		197	5405.5	136.9	

[a] Calving scores 1, 2, and 3 = No; 4 and 5 = Yes.
[b, c, f, g, i, j] Means in the same column within each factor with different superscript letters differ significantly ([i, j] $P < 0.01$; [f, g] $P < 0.05$; [b, c] $P < 0.10$).
[d] Of 113 lactations, 21 (18.6%) had a duration of 270 to 304 days and 92 (81.4%) had a duration of ≥305 days.
[e] Of 84 lactations, 22 (26.2%) had a duration of 270 to 304 days and 62 (73.8%) had a duration of ≥305 days.
[h] Warm = May to October, Cold = November to April.
[k] Covariate.

cows with dystocia and eutocia, days to first service were 81.0 and 81.8, days open in cows conceiving were 116.5 and 122.1, and days open in all cows were 122.6 and 122.2, respectively. The effects of calving year, calving season, clinical mastitis, and age at calving, each, on both days to first service and days open were not significant ($P > 0.10$), except for a marginally significant effect of calving year on days to first service ($P = 0.069$) and calving season on days open in all cows ($P = 0.096$).

Incidence of retained placenta and conception rate within 150 days after calving by the dystocia group in primiparous cows are given in Table 4. There was no significant association between incidence of retained placenta and dystocia (χ^2, $P > 0.10$) nor between conception rate within 150 days after calving and dystocia (χ^2, $P > 0.10$).

3.2. Effects of dystocia on calf loss and cow culling in primiparous cows

Percentage of stillbirths by the dystocia group in primiparous cows is presented in Table 5. The incidence of stillbirth was higher in dystocic calvings than in eutocic ones (11.3% vs. 2.4%; χ^2, $P = 0.006$).

With the exception of sale as dairy cows, culling rates within the first 200 and 300 days after calving by dystocia group in primiparous cows are given in Table 6. Although the culling rate within 200 days was numerically higher in cows with dystocia than in cows with eutocia (5.2% vs. 2.4%), there was no significant association between culling rate and dystocia (χ^2, $P > 0.10$). On the other hand, it should be noted that all the cullings (5 out of 97) in cows with dystocia within 200 days after calving were due to dystocia-related problems. There was no significant association between culling rate within 300 days and dystocia (χ^2, $P > 0.10$).

4. Discussion

4.1. Dystocia scoring

Our study scored calving on a scale of 1 to 5, and analyses categorized scores into 2 groups, no dystocia (scores 1, 2, or 3) and dystocia (scores 4 or 5). There is no homogeneous

Table 3. Estimated marginal means (EMMs) for reproduction traits in primiparous cows by dystocia group and other factors.

	Days to first service				Days open in cows conceiving				Days open in all cows			
Factors	n	EMM	SEM	P	n	EMM	SEM	P	n	EMM	SEM	P
Dystocia[a]				0.858				0.569				0.970
No	119	81.8	4.7		119	122.1	10.8		121	122.2	11.6	
Yes	90	81.0	4.7		86	116.5	11.1		90	122.6	11.8	
Calving year				0.069				0.574				0.577
2006	46	71.6	5.5		45	113.9	12.6		45	112.6	13.5	
2007	44	83.8	5.7		41	133.6	13.5		42	135.8	14.4	
2008	37	89.2	6.5		39	124.7	14.6		41	130.4	15.5	
2009	50	76.5	5.8		49	113.7	13.4		51	118.3	14.2	
2010	32	86.1	6.8		31	110.7	15.6		32	114.8	16.6	
Calving season[b]				0.289				0.188				0.096
Warm	92	83.7	4.9		89	112.8	11.4		90	113.5[c]	12.2	
Cold	117	79.1	4.6		116	125.9	10.5		121	131.2[d]	11.2	
Clinical mastitis				0.417				0.564				0.442
No	194	84.8	2.3		191	124.9	5.2		197	130.4	5.5	
Yes	15	78.0	8.0		14	113.7	18.8		14	114.3	20.2	
Calving age[e] (month)	209	0.6	0.7	0.381	205	2.1	1.5	0.172	211	1.6	1.6	0.320
Overall	209	81.4	4.2		205	119.3	9.8		211	122.4	10.5	

[a] Calving scores 1, 2, and 3 = No; 4 and 5 = Yes.
[b] Warm = May to October, Cold = November to April.
[c, d] Means in the same column within each factor with different superscript letters differ significantly ([c, d] $P < 0.10$).
[e] Covariate.

and internationally applied dystocia scoring system. Dystocia scores differ by number of scores and their definitions. Various studies coded dystocia as a 6-point (11), 5-point (3–5,9,19), 4-point (15,20–22), or 3-point score (10,23), or as a 2-point score indicating whether dystocia occurred or not (12,24,25). Dystocia scores were used as presented, categorized into 2 groups (4,10), as in the present study, or into 3 groups (5,9,22).

4.2. Effects of dystocia on milk production

Primiparous cows with dystocia produced 85 kg marginally significantly less milk in the first 100 days of lactation than cows with eutocia. Decreased milk yield in the first trimester of lactation in cows with dystocia may be associated with trauma in parturition and increased risk of postpartum complications. Decreased milk yield in cows with dystocia, as reviewed by Barrier and Haskell (11), could result from several factors including hormonal changes and reduced appetite. In the second 100 days of lactation (101 to 200 days), however, milk yields of cows with dystocia were similar to those of cows with eutocia. In the second 100 days, EMMs for milk yields were 1822.4 and 1850.8 kg (model 1; $P > 0.10$) for cows with dystocia and eutocia, respectively (not given in tables), and there was no significant difference in the first 200-day milk yield between cows with dystocia and eutocia. On the other hand, cows with dystocia again produced significantly less milk in the third trimester of lactation (201 to 305 days) than cows with eutocia, when EMMs for milk yields were 1480.7 and 1605.0 kg (model 1; $P = 0.022$) for cows with dystocia and eutocia, respectively (not given in tables). Reasons for loss of milk yield in the third trimester of lactation in cows with dystocia are unclear. Considering the entire 305-day milk yield, cows with dystocia produced 219 kg marginally significantly less milk than cows with eutocia.

Similar to our findings, many studies showed that dystocia had a negative effect on milk yield. However, results are inconsistent regarding presence and degree of effect in different parities and duration of negative effects. Moreover, different scoring systems were applied to dystocia, as mentioned above. Based on a fixed effects model, Djemali et al. (19) reported that decreases in

Table 4. Incidence of retained placenta and rate of conception within 150 days after calving by dystocia group in primiparous cows.

			Retained placenta[a]		Conception in 150 days[b]	
			Total calving	Retained placenta	Total cows[c]	Conception in 150 days
Dystocia[d]	No	n	126	17	123	89
		%	100.0	13.5	100.0	72.4
	Yes	n	97	12	93	61
		%	100.0	12.4	100.0	65.6
Total		n	223	29	216	150
		%	100.0	13.0	100.0	69.4

[a] Pearson chi-square value is 0.061, P = 0.805.
[b] Pearson chi-square value is 1.143, P = 0.285.
[c] Number of cows in the herd during the first 150 days after calving.
[d] Calving scores 1, 2, and 3 = No; 4 and 5 = Yes.

305-day ME milk in Holstein cows with dystocia score 5 (extreme difficulty) versus score 1 (no problem) were 465, 576, and 725 kg in the first, second, and third and greater lactations, respectively. In a later study by Dematawewa and Berger (3), additional records from subsequent years were included in those used by Djemali et al. (19). Based on mixed models, Dematawewa and Berger (3) found that losses in 305-day milk yield for cows with dystocia score 5 versus score 1 were 684, 449, and 325 kg for the first, second, and third and later lactations, respectively. Contrary to the findings by Djemali et al. (19), Dematawewa and Berger (3) found that cows showed higher losses in milk yields for earlier than for later lactations. However, a study by Domecq et al. (24) on high yielding Holstein cows found no significant relationship between dystocia and milk yield at 120 days of lactation in primiparous cows, but dystocia was associated with decreased milk yield at 120 days in multiparous cows. In Finnish Ayrshire cows, Rajala and Gröhn (25) reported that dystocia decreased milk yield during the first 2 weeks after calving in cows in parities 2 and 3 but was not associated with milk loss in cows in parities 1 and 4 or higher. They also found dystocia was not associated with reduced 305-day milk yield in parities 1, 2, 3, and 4 or higher. Similarly, Thompson et al. (9) reported that calving difficulty affected 30-day milk production (unassisted cows produced more milk) but did not influence 90-day or 305-day milk production in first and second and later parities. In a retrospective case-control study, Tenhagen et al. (23) found that mild and severe cases of dystocia did not affect milk production, whereas milk production in cows with a cesarean section dropped by 5% to 10% on the first 6 monthly milk test days postpartum compared with control cows.

Table 5. Percentage of stillbirths by dystocia group in primiparous cows.

			Total calving	Stillbirth[a]
Dystocia[b]	No	n	126	3
		%	100.0	2.4
	Yes	n	97	11
		%	100.0	11.3
Total		n	223	14
		%	100.0	6.3

[a] Pearson chi-square value is 7.477, P = 0.006.
[b] Calving scores 1, 2, and 3 = No; 4 and 5 = Yes.

A study by Berry et al. (10) on grazing dairy cows in New Zealand found that 60-day and 270-day milk yield was 42 and 62 kg less, respectively, and in a study in Egypt, Gaafar et al. (12) showed that average daily milk yield in Friesian cows was 1 kg lower in cows with dystocia than in those with eutocia. Barrier and Haskell (11) in a study on Holstein-Friesian cows in Scotland reported that calving difficulty impaired milk production of cows and output of saleable milk, pointing out that analysis of saleable milk yields could be more suggestive of the subsequent long-lasting biological stresses in cows.

Differences in the evidence of effects of dystocia on milk yield could arise from several factors. Rajala and Gröhn (25) stated that variations between studies might be accounted for by different statistical methods and milk measures to estimate milk loss and by differences in whether the effects of other diseases were considered in the analysis.

Table 6. Culling rates within 200 and 300 days after calving by dystocia group in primiparous cows (except for sales as dairy cows).

			Total calving	Culling within 200 days[a]	Culling within 300 days[b]
Dystocia[c]	No	n	126	3	5
		%	100.0	2.4	4.0
	Yes	n	97	5[d]	8[e]
		%	100.0	5.2	8.2
Total		n	223	8	13
		%	100.0	3.6	5.8

[a] Pearson chi-square value is 1.219, P = 0.270.
[b] Pearson chi-square value is 1.828, P = 0.176.
[c] Calving scores 1, 2, and 3 = No; 4 and 5 = Yes.
[d] All 5 cows were culled because of problems related to dystocia.
[e] Of 8 cows, 5 were culled because of problems related to dystocia.

Different definitions of dystocia could also be a reason for the variation. Barrier and Haskell (11) emphasized that variations were attributable to such factors as different scoring methods, animal genetics, livestock management, calving management, and evaluation methods.

4.3. Effects of dystocia on reproduction

There was no significant association between incidence of retained placenta and dystocia in primiparous cows. Similarly, Hur et al. (26) reported that retained placenta was not related to dystocia in Holsteins. Curtis et al. (27) in a study on multiparous Holsteins found that veterinary-assisted dystocia was not associated with retained placenta but with metritis. Conversely, Thompson et al. (9) found that incidence of both milk fever and retained placenta was higher for assisted calvings than for unassisted ones and increased with parity. Moreover, they reported that incidence of retained placenta was higher when milk fever occurred and that calving difficulty, retained placenta, and milk fever tended to occur as a complex.

In primiparous cows, dystocia had no effect on days to first service and days open, and there was no significant association between conception rate within 150 days after calving and dystocia. However, many studies found that dystocia had a significant effect on reproductive measures. Thompson et al. (9) reported that increases in days open in all cows, for those with severe dystocia versus unassisted calvings, were 17 days and 20 days and those in days to first breeding 5 days and 9 days for first and greater than first parities, respectively. Djemali et al. (19) found that for births scored 5 versus 1 there were 14, 26, and 19 more days open in Holstein cows in first, second, and third and greater parities, respectively. Dematawewa and Berger (3) found that increases in days open in all cows for those with dystocia score 5 versus score 1 were 34, 29, and 41 days for first, second, and third and later lactations, respectively. The increases in days open for cows with dystocia score 4 versus score 1 were 18, 19, and 12 days for the above, respectively. Similarly, Mangurkar et al. (21), López de Maturana et al. (22), and Gaafar et al. (12) reported that days to first service and days open increased in Holstein cows with dystocia compared to those with eutocia. Tenhagen et al. (23) found that mild dystocia did not affect reproductive performance, but compared with control cows fewer cows with severe dystocia or cesarean section conceived until 200 DIM. In a meta-analysis study by Fourichon et al. (28), summary estimates of disease effects on reproduction in dairy cows were calculated, and they reported that dystocia was associated with 2.4 more days to first service (10 studies), 8.1 more days open in cows conceiving (8 studies), and 12.8 more days open in all cows (6 studies).

Although not statistically significant, there were 5.6 fewer days open in cows conceiving for those with dystocia, but days open in all cows were almost the same both for those with dystocia and eutocia, indicating that there were more cows with dystocia that were not pregnant and open for at least 305 days after calving (4 of 6 observations). In a study on Holstein cows in the Iowa State University dairy breeding research herd at Ankeny, Shanks et al. (20) found, contrary to several studies, that cows with extreme calving difficulty had 5 fewer days open in all cows and a 17% higher conception rate than those with no calving assistance. They also stated that cows with extreme calving difficulty were described as potential problems and therefore received extra attention.

Unlike many studies, the lack of significant effect of dystocia on some reproductive measures in the present study can be interpreted in various ways. The first is that

there may have been a common problem in reproduction management in the herd, and thus days to first service and days open were also high in cows with eutocia. Indeed, days to first service was 81.8 for primiparous cows with eutocia, which seems far from the optimal value of 50 to 60 days (29) or <70 days (30) for days to first service. The value for primiparous cows with dystocia was 81.0 days. Longer days to first estrus and to first service and a lower conception rate in first service can be expected in cows with dystocia (12,28). On the other hand, if cows with eutocia in the herd had been inseminated by 60 days after calving with effective heat detection, days to first service would have been shorter, and with a higher conception rate in first service, days open would have been shorter. The second interpretation is that our comprehensively studied data showed some cows with severe dystocia conceived within a short time after calving (50 to 80 days), having recovered soon. The third is that cows with dystocia may have received more attention from the herd veterinarian, and thus negative effects of dystocia on reproductive performance were decreased; however, this was not confirmed by the veterinarian, who added that no extra attention had been paid to cows with dystocia.

4.4. Effects of dystocia on calf loss and cow culling

This study showed that incidence of stillbirth was higher in dystocic calvings compared to eutocic ones in primiparous cows. Previous studies also showed that dystocia is associated with a higher incidence of stillbirth in cows, and the incidence increased as degree of calving difficulty increased. Mangurkar et al. (21) reported a close association between severity of calving difficulty and calf losses in Holsteins, finding that percentages of stillbirths were 3.24%, 4.42%, 26.77%, and 36.96% for calving-ease classes, unassisted, easy pull, hard pull, and surgical, respectively. Dekkers (15) reported that frequency of stillbirths was substantial within hard pull and surgery classes in Canadian Holsteins and was hardly affected by sex or parity. In a study on Holstein cattle in the Iowa State University dairy research farm in Ankeny, Johanson and Berger (4) found that difficult births tended to result in perinatal mortality 2.7-times more than unassisted births. In grazing dairy cows, Berry et al. (10) found an 8-times greater likelihood of stillbirth when assistance at calving was required. Lombard et al. (5) reported that incidence of stillbirth was 3.2%, 8.4%, and 37.2% for calves born with no dystocia, mild dystocia, and severe dystocia, respectively. Tenhagen et al. (23) found that ratio of dead single calves was higher in cows with mild dystocia and severe dystocia compared with their controls, but the difference was not significant in cows with a cesarean section. It is obvious that incidence of stillbirth in dystocic calvings is notably higher than in unassisted calvings; dystocia increases the risk of stillbirth. On the other hand, it should be noted that prepartum death of a calf is likely to be the cause of dystocia in some dystocic calvings (5).

Our study found no significant association between culling rates within the first 200 and 300 days after calving and dystocia in primiparous cows. There seems to be no relationship between culling and dystocia. Thompson et al. (9) reported a rising cull rate of cows as calving difficulty increased; however, the chi-square test was nonsignificant. Tenhagen et al. (23) found that the proportion of cows culled until 200 DIM in cows with mild or severe dystocia was similar to their controls, but proportion of cows culled until 200 DIM in cows with a cesarean section was higher than in their controls. Dematawewa and Berger (3) investigated the effect of dystocia on cow deaths and reported that increases in cow deaths for those with dystocia score 5 versus score 1 were 3.84%, 3.53%, and 3.99% for the first, second, and third and later lactations, respectively. The corresponding increases in cow deaths for those with dystocia score 4 versus score 1 were 1.04%, 2.93%, and 3.09%, respectively.

In conclusion, dystocia reduced milk production during lactation in primiparous Holstein cows. However, it had no significant effects on reproductive measures in primiparous cows. Incidence of stillbirth was higher in dystocic calvings compared with eutocic ones. However, there was no significant relationship between dystocia and cow culling. Dystocia is much more common in primiparous cows. In managerial and genetic terms, one is expected to consider relieving dystocia to provide good welfare for cow and calf and reducing its adverse effects on milk yield in primiparous cows.

Acknowledgments

The authors would like to thank Vet Berkan Bertan and Res Asst H Bora Ünlü for their assistance in data collection and thank the herd staff for their contribution to the management of the Holstein herd at the Menemen Research and Application Farm.

References

1. Peters AR, Ball PJH. Reproduction in Cattle. 2nd ed. UK: Blackwell Science Ltd., 1995.
2. Zaborski D, Grzesiak W, Szatkowska I, Dybus A, Muszynska M, Jedrzejczak M. Factors affecting dystocia in cattle. Reprod Domest Anim 2009; 44: 540–551.
3. Dematawewa CMB, Berger PJ. Effect of dystocia on yield, fertility, and cow losses and an economic evaluation of dystocia scores for Holsteins. J Dairy Sci 1997; 80: 754–761.
4. Johanson JM, Berger PJ. Birth weight as a predictor of calving ease and perinatal mortality in Holstein cattle. J Dairy Sci 2003; 86: 3745–3755.

5. Lombard JE, Garry FB, Tomlinson SM, Garber LP. Impacts of dystocia on health and survival of dairy calves. J Dairy Sci 2007; 90: 1751–1760.

6. Uzmay C, Kaya I, Ayyilmaz T. Analysis of risk factors for dystocia in a Turkish Holstein herd. J Anim Vet Adv 2010; 9: 2571–2577.

7. Gevrekçi Y, Akbaş Y, Kızılkaya K. Comparison of different models in genetic analysis of dystocia. Kafkas Univ Vet Fak Derg 2011; 17: 387–392.

8. EFSA. Scientific Opinion of the Panel on Animal Health and Welfare on a request from European Commission on the overall effects of farming systems on dairy cow welfare and disease. EFSA J 2009; 7: 1143: 1–38.

9. Thompson JR, Pollak EJ, Pelissier CL. Interrelationships of parturition problems, production of subsequent lactation, reproduction, and age at first calving. J Dairy Sci 1983; 66: 1119–1127.

10. Berry DP, Lee JM, Macdonald KA, Roche JR. Body condition score and body weight effects on dystocia and stillbirths and consequent effects on postcalving performance. J Dairy Sci 2007; 90: 4201–4211.

11. Barrier AC, Haskell MJ. Calving difficulty in dairy cows has a longer effect on saleable milk yield than on estimated milk production. J Dairy Sci 2011; 94: 1804–1812.

12. Gaafar HMA, Shamiah SM, El-Hamd MAA, Shitta AA, El-Din MAT. Dystocia in Friesian cows and its effects on postpartum reproductive performance and milk production. Trop Anim Health Prod 2011; 43: 229–234.

13. Ghanem ME, Higuchi H, Tezuka E, Ito H, Devkota B, Izaike Y, Osawa T. Mycoplasma infection in the uterus of early postpartum dairy cows and its relation to dystocia and endometritis. Theriogenology 2013; 79: 180–185.

14. Zobel R. Endometritis in Simmental cows: incidence, causes, and therapy options. Turk J Vet Anim Sci 2013; 37: 134–140.

15. Dekkers JCM. Optimal breeding strategies for calving ease. J Dairy Sci 1994; 77: 3441–3453.

16. Resmi Gazete. Çiftlik Hayvanlarının Refahına İlişkin Yönetmelik. Tarih: 23.12.2011, No. 28151 (Directive in Turkish).

17. WestfaliaSurge. Effektives Herdenmanagement mit dem Dairy Management System21. 9997-0958-000/ S + L: D + D/D: Stu/12.03. Germany; 2003.

18. SPSS. SPSS 15.0 for Windows. USA: SPSS Inc.; 2006.

19. Djemali M, Freeman AE, Berger PJ. Reporting of dystocia scores and effects of dystocia on production, days open, and days dry from dairy herd improvement data. J Dairy Sci 1987; 70: 2127–2131.

20. Shanks RD, Freeman AE, Berger PJ. Relationship of reproductive factors with interval and rate of conception. J Dairy Sci 1979; 62: 74–84.

21. Mangurkar BR, Hayes JF, Moxley JE. Effects of calving ease-calf survival on production and reproduction in Holsteins. J Dairy Sci 1984; 67: 1496–1509.

22. López de Maturana E, Legarra A, Varona L, Ugarte E. Analysis of fertility and dystocia in Holsteins using recursive models to handle censored and categorical data. J Dairy Sci 2007; 90: 2012–2024.

23. Tenhagen B-A, Helmbold A, Heuwieser W. Effect of various degrees of dystocia in dairy cattle on calf viability, milk production, fertility and culling. J Vet Med A Physiol Pathol Clin Med 2007; 54: 98–102.

24. Domecq JJ, Skidmore AL, Lloyd JW, Kaneene JB. Relationship between body condition scores and milk yield in a large dairy herd of high yielding Holstein cows. J Dairy Sci 1997; 80: 101–112.

25. Rajala PJ, Gröhn YT. Effects of dystocia, retained placenta, and metritis on milk yield in dairy cows. J Dairy Sci 1998; 81: 3172–3181.

26. Hur T-Y, Jung Y-H, Kang S-J, Choe CY, Kim U-H, Ryu I-S, Son D-S, Park S-J, Kim I-H. The impact of the duration of retained placenta on postpartum diseases and culling rates in dairy cows. Korean J Vet Res 2011; 51: 233–237.

27. Curtis CR, Erb HN, Sniffen CJ, Smith RD, Kronfeld DS. Path analysis of dry period nutrition, postpartum metabolic and reproductive disorders, and mastitis in Holstein cows. J Dairy Sci 1985; 68: 2347–2360.

28. Fourichon C, Seegers H, Malher X. Effect of disease on reproduction in the dairy cow: a meta-analysis. Theriogenology 2000; 53: 1729–1759.

29. Wattiaux MA. Reproduction and Genetic Selection. 2nd ed. The Babcock Institute for International Dairy Research and Development. Publication no. TDG-RG-072895-E. University of Wisconsin-Madison, USA; 1996.

30. Ptaszynska M, editor. Bovine reproduction. In: Compendium of Animal Reproduction. 10th rev. ed. Intervet International BV; 2009. pp. 19–172.