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Risk factors associated with reproductive disorders in dairy cows in Algeria

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ABSTRACT: In Algeria, there is a lack of information about the prevalence of reproductive health disorders in dairy farms. In this light, the aim of the present study was to determine the effect of parity, body condition score (BCS), calving season, calves' status at delivery and gender of the calf on the prevalence of dystocia, retained fetal membranes (RFM) and metritis under Algerian field conditions. The study took place from October 2016 to April 2019. It was conducted on 449 dairy cows from 22 commercial dairy farms located in Algerian highland regions (Medea, Tiaret and Tissemsilt areas).The prevalence of dystocia, RFM and metritis was 12%, 16.9%, and 11.8%, respectively. Cows with BCS ≤2.75 were the most affected by RMF (Odds ratio [OR] = 3.66). The main risk factors for RMF were calving abnormalities (OR=3.03), calving in warm season (May to October) (OR= 1.85) and the birth of male calves (OR= 1.75) (P<0.05). Stillbirth, dystocia and RFM were identified as potential risk factors for metritis (P<0.05). These findings confirm again the importance of herd management in prevention of these reproductive disorders.

***Keywords*:** dystocia; retained fetal membranes; metritis, prevalence; risk factors

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INTRODUCTION

Dystocia, retained fetal membranes (RFM), and metritis are the major reproductive disorders that have a direct impact on farm profitability which lead to severe economic losses. Economic losses are related to the costs of treatment, perinatal mortality, maternal death, decline in milk production, and decrease in reproductive performances (De Amicis et al., 2017; Kim and Jeong, 2019). Dystocia is a welfare problem of cows and calves (Kaya et al., 2015). It is associated with a higher incidence of calf losses (25%) (De Amicis et al., 2017), which increases as the degree of calving difficulty increases (Lomabard et al., 2007; Kaya et al., 2015). Dystocia occurs in 10 to 30% of calvings (Lomabard et al., 2007). Feto-pelvic disproportion (FPD), fetal malposition, multiple fetuses, uterine inertia, and uterine torsion are the main causes of dystocia (Mee, 2008). There are several predisposing factors for dystocia such as gestation length, parity, gender, sire, breed, nutrition, climate, age and weight at service (Mee, 2008). One of the sequels of dystocia is RFM (Giuliodori et al., 2013). Normal expulsion of fetal membranes occurs within 8h after calf delivery (Qu et al., 2014). The breakdown collagen that links the interface together at several sites is likely to be a key factor in placental separation (Opsomer, 2015); nevertheless, the precise reason of failure of detachment of fetal membranes is still not fully understood (Szenci, 2016). The prevalence of RFM ranges from 5.8 % to 19.1% (Vergara et al., 2014), but it can be increased in cows with twins, and after dystocic calving (Sheldon et al., 2008), and even more in herds with infectious diseases such as bovine viral diarrhea (BVD) and brucellosis (Opsomer, 2015; Szenci, 2016). Reported risk factors for RFM include breed, parity, stillbirth, abortion, cesarean section, fetotomy, induction of parturition, shortened gestation, and management during the dry period (Tucho and Ahmed, 2017; Daros et al., 2017). Metritis is the inflammation of all the layers of the uterus (Deori and Phookan, 2015). As clinical condition, metritis is observed during the first 21st days of postpartum and characterized by abnormally enlarged uterus and the presence of putrid uterine discharges detectable in the vagina, with or without fever (Sheldon et al., 2006). *Arcanobacterium pyogenes*, *Escherichia coli*, coliforms and the Gram-positive cocci, *Fusobacterium necrophorum*, *Trueperella pyogenes* and *Clostridium spp* are the most isolated microorganisms in cases of metritis (Deori and Phookan, 2015; Ordell et al., 2016). The prevalence of metritis varies from 1 to 29.5% (Bruun et al., 2002, Vergara et al., 2014). Breed, herd, parity, climatic conditions, RFM, dystocia, fetal maceration, shorter gestation length, twins and stillbirth calves are the relevant risk factors of metritis (Piccardi et al., 2015; Kumari et al., 2015).

To the authors' knowledge, the prevalence and the risk factors of reproductive disorders in dairy farms of Algeria has been scarcely studied. The purpose of the present study was to report the prevalence and the main risk factors associated with dystocia, RFM and metritis under Algerian field conditions.

MATERIAL AND METHODS

Herds

The current study was conducted in 22 farms located in the Algerian highland regions (three provinces: Medea, Tiaret, and Tissemsilt), during the period from October 2016 to April 2019. The study area is characterized by two types of climates prevailing, namely the semi-arid climate and the Mediterranean climate, with two distinct seasons. The summer is hot and dry with temperatures that reach up to 38°C, while the winter is cold and windy with a minimum temperature below freezing. Four hundred and forty-nine (n=449) dairy cows (108 crossbred and 341 purebred: Holstein, Red Holstein, Flechvieh and Montbeliard cows), free of tuberculosis and brucellosis, were included in the study. The cows were kept in a loose housing system, and milked two times daily. The mean milk yields were 13.7 ± 0.6 kg per cow per day. The cows were dried 60 days before the expected date of calving. Seasonably, the cows received green fodder or meadow fodder with vetch oats hay, and supplemented with commercial concentrate (17% at 20% crude protein: crushed maize grains, soybean meal, barley and vitamin-mineral mixture), and were given ad libitum access to water. All herds had 10 or more cows.

Definition of traits

The trait descriptions were as follow**:** dystocia is defined as calving that requires assistance (Mee, 2008). Retained fetal membranes is defined as the failure to expel fetal membranes more than 24h (Kim and Jeong, 2019). Metritis is defined as a cow with an abnormal distention of uterus and the presence of putrid uterine discharge with or without fever over the 21st days postpartum (Sheldon et al., 2008). Stillbirth is defined as the death of a calf that occurs at birth or within the first 48h after parturition (Bicalho et al., 2007).

Data collection

Data were collected from 449 calvings. The enrolment of the cows, diagnoses of disorders, evaluation and data collection were made by the first author. Health data and calving conditions were documented by farmers using a questionnaire. Each herd was visited at least bimonthly. Information recorded included date of calving, cows' parity, calving ease score (CES), number of newborns, calf status at delivery (alive or dead), gender of the calf, body condition score (BCS), calving season, occurrence of RFM, and occurrence of metritis. The data of parity of cows was grouped into three classes (1st, 2nd and ≥3rd lactation). Calving ease score was scored on a scale ranging from 1 to 5. A scale in which 1 means no assistance is required, 2 means minor assistance is required, 3 stands for considerable assistance, 4 signifies extreme difficulty with veterinary assistance and mechanical traction, and 5 represents caesarean section or fetotomy. Cows with a CES of ≥3 are classified to have dystocia (Bicalho et al., 2007; Kim and Jeong, 2019). The calving season was classified into two major periods (1= cold season [November-April] or 2: warm season [May-October])(Johanson and Berger, 2003). The BCS was evaluated at calving (±5days) according to Fergusson et al. (1994) and grouped into three main classes (1= BCS≤ 2.75, 2= 2.75<BCS≤ 3.25 and 3 = BCS >3.25). Gender of the calf was classified into two categories (1= birth of single female, 2= birth of single male). There were a total of 18 cows (4%) in the 22 farms that had twins. Cows having twins were excluded since the sample size for affected cows was too small to make reliable estimates (only in the study of the effect of gender of the calf). Abnormal calving included cows having dystocia or stillbirth. A value of 2 for calving abnormality was assigned to cows with one or more of the following: dystocia or stillbirth. Otherwise, cows were assigned a value of 1 (normal calving: the birth of viable calves with CES ≤2).

Statistical analyses

The test data was processed using the IBM SPSS, version 24.0. First, we determined the effect of variables (parity, age, calving season, BCS around calving, gender of the calf, and calving abnormalities) on the occurrence of each disease using the chi-square test. Thereafter, the suspected risk factors for diseases were analyzed by binary logistic regression. Results were presented as percentages and Odds Ratios (ORs) with their respective 95% confidence intervals (CIs). The level of significance was considered at P<0.05.

Table1. Estimated odds ratios and 95% confidence intervals (CI) for factors affecting dystocia in Algerian dairy cows (n=449)

variables	Num cows	Dystocia Num. cases	%	OR^Π	IC^£	P
Total	449	54	12	-	-	-
Parity *						0.523
1	143	19	13.3	1.332	0.653-2.157	
2	83	12	14.5	1.470	0.695-3.107	
3	223	23	10.3	referent	-	
Calving season †						0.762
1	291	34	11.7	referent	-	
2	158	20	12.7	1.095	0.607-1.976	
BCS ύ :						0.277
1	69	12	17.4	2.105	0.778-5.697	
2	303	35	11.6	1.306	0.556-3.065	
3	77	7	9.1	referent	-	
Gender of the calf §						0.870
1	199	23	11.6	referent	-	
2	232	28	12.1	1.050	0.584-1.890	

* Parity: 1= first lactation; 2 = second lactation, 3= third or more lactation, † Calving season: 1= cold season [November to April]; 2= warm season [Mai to October], ύ BCS: 1 = BCS≤ 2.75; 2 = 2.75<BCS≤ 3.25; 3= BCS >3.25, § Gender of the calf: 1= birth of single female; 2= birth of single male; the 18 cows that gave twins were excluded, Π Odds ratio, £ 95% confidence intervals.

Table2. Estimated odds ratios and 95% confidence intervals (CI) for factors affecting RFM in Algerian dairy cows (n=449)

variables	Num cows	RFM Num.cases	RFM %	OR£	IC**	P
Total	449	76	16.9	-	-	-
Parity *						0.203
1	143	25	17.5	1.265	0.714-2.239	
2	83	19	22.9	1.772	0.940-3.341	
3	223	32	14.3	referent		
Calving season †						0.015
1	291	40	13.7	referent	-	
2	158	36	22.8	1.852	1.124-3.051	
BCS ΰ						0.026
1	69	14	20.3	3.665	1.245-10.791	
2	303	57	18.8	3.337	1.289-8.637	
3	77	5	6.5	referent	-	
Gender of the calf §						0.038
1	199	24	12.1	referent	-	
2	232	45	19.4	1.755	1.026-3.001	
Calving abnormality Π						<0.001
1	353	46	13	referent	-	
2	96	30	31.3	3.034	1.783-5.161	

*: Parity: 1= first lactation; 2 = second lactation, 3= third or more lactation, † Calving season: 1= cold season [November to April]; 2= warm season [Mai to October], ύ BCS: 1 = BCS≤ 2.75; 2 = 2.75<BCS≤ 3.25; 3= BCS >3.25, § Gender of the calf: 1= birth of single female; 2= birth of single male; the 18 cows that gave twins were excluded, Π Calving abnormality: 1= birth of viable calves without dystocia; 2= cows having dystocia or stillbirth, £Odds ratio, **:95% confidence intervals.

Table3: Estimated odds ratios and 95% confidence intervals (CI) for factors affecting metritis in Algerian dairy cows (n=449)

variables	Num cows	Metritis Num. cases	Metritis %	OR**	IC††	P
Total	449	53	11.8	-	-	-
Parity *						0.417
1	143	14	9.8	referent	-	
2	83	13	15.7	1.711	0.762-3.843	
3	223	26	11.7	1.216	0.612-2.416	
Calving season †						0.305
1	291	31	10.7	referent	-	
2	158	22	13.9	1.357	0.756-2.434	
BCS ΰ						0.941
1	69	9	13.0	1.133	0.422-3.041	
2	303	35	11.6	0.987	0.453-2.151	
3	77	9	11.7	referent		
Gender of the calf §						0.424
1	199	20	10.1	referent	-	
2	232	29	12.5	1.279	0.669-2.339	
Calving abnormality Π						0.002
1	353	33	9.3	referent	-	
2	96	20	20.8	2.552	1.388-4.692	
Retained placenta £						<0.001
1	373	27	7.2	referent	-	
2	76	26	34.2	6.664	3.603-12.323	

* Parity: 1= first lactation; 2 = second lactation, 3= third or more lactation, † Calving season: 1= cold season [November to April]; 2= warm season [Mai to October], ύ BCS: 1 = BCS≤ 2.75; 2 = 2.75<BCS≤ 3.25; 3= BCS >3.25, § Gender of the calf: 1= birth of single female; 2= birth of single male; the 18 cows that gave twins were excluded, Π Calving abnormality: 1= birth of viable calves without dystocia; 2= cows having dystocia or stillbirth, £Retained placenta: 1= disease free cows; 2= cows having retained placenta, ** Odds ratio, †† 95% confidence intervals

RESULTS

The overall prevalence of dystocia, RFM and metritis in the current study were 12%, 16.9% and 11.8%, respectively. Tables 1, 2 and 3 demonstrate detailed statistics describing risk factors associated with each disease. There was a significant difference between warm (May to October) and cold (November to April) calving seasons on the risk of experiencing RFM (OR= 1.85, P = 0.015). Also, the BCS at calving (±5days) had a significant association with RFM prevalence (P<0.05). The birth of male calves increased the prevalence of RFM to 19.4% (OR=1.75, P=0.038). Cows with abnormal calving had higher risk of having RFM compared to cows with normal calving (OR=3.03; P<0.001). The risk of diagnosing metritis was higher in cows with abnormal calving (OR= 2.5, P=0.002). Also, RMF was identified as risk factors for metritis (OR=6.6, P<0.001) (Table3).

DISCUSSION

The prevalence of dystocia (12%) and RFM (16.9%) in the present study were in agreement with the reports of other researchers (Johanson and Berger, 2003; Nguyen-Kien and Hanzen, 2016; Daros et al., 2017), who state that the prevalence of dystocia and RFM ranges from 11% to 23.7%, and 13.9% to 19.3%, respectively. The prevalence of metritis (11.8%) coincided closely with the prevalence of 11.2% found by Daros et al. (2017). Furthermore, this prevalence was lower than others reported in recent studies, where the prevalence of metritis ranges from 22.4% to 29.7% (Cui et al., 2015; Piccardi et al., 2015; Giuliodori et al., 2013). The variation in the prevalence of metritis may be attributed to the difference of disease definitions, study area, variation of sample size and the year of study.

The season of calving was associated with the occurrence of RFM, as cows calved in warm season had more (OR= 1.85, P=0.015) risk to develop RFM than in cold season. Similarly, the higher prevalence of RFM is reported in summer season in cows (Bahri Binabaj et al., 2014) and in buffaloes (Verma et al., 2018). Furthermore, heat stress during the warm periods may contribute to impair immune system functions (Dawod and Byeng, 2014) and indirectly to increase the prevalence of reproductive diseases in dry season (Verma et al., 2018). This is in agreement with Gilbert's report (2016) in which he declares that heat stress is one of factors associated with RFM, and to preserve optimum reproductive performances, Szenci (2016) suggests reducing summer heat stress.

We found that BCS proved to be a risk factor of RFM. In the cow that calved with a BCS ≤2.75, a RFM prevalence of 20.3% was registered, which is significantly higher than in the cows calved within the other BCS classes (P= 0.026). This finding was in accordance with the observation of Islam et al. (2012). Vieira-Neto et al. (2016) state that the occurrence of RFM was negatively correlated with BCS. Low BCS is an indicator of low energy statut which is often associated with impaired neutrophil functions (Giuliodori et al., 2013). Also, Cows with lower prepartum body condition (Qu et al., 2014), or those with greater BCS loss (Roche et al., 2009) are expected to be less healthy and more susceptible to infection compared to cows with a good BCS, losing less BCS, or to those gaining BCS (Roche et al., 2009).

The birth of male calves increased significantly the prevalence of RFM compared to the birth of female calves. Our finding agrees with those of Bahri Binabaj et al. (2014), in which, they showed that the birth of male calf is a significant risk factors for RFM. Male calves, due to their higher birth weight than heifer calves, are direct causes of dystocia (Johanson and Berger, 2003), and consequently to RFM. The prevalence of RFM was 13% in normal calving, and reached to 31.3% in abnormal calving (in cases of dystocia or stillbirth)(OR= 3.03, P <0.001). This result is in agreement with other studies (Vieira-Neto et al., 2016; Buso et al., 2018). Conversely, neither dystocia (Kaya et al., 2015; Nguyen-Kien and Hanzen, 2016), nor stillbirth (Kumari et al., 2015) affect the prevalence of RFM.

The risk of developing metritis was much higher in dystocic cows, or those that deliver stillborn calves (OR=2.5, P=0.002), and RFM was present in 34.2% of cases of metritis (OR= 2.55, P<0.001), which is supported in the literature (Deori and Phookan, 2015; Piccardi et al., 2015; Daros et al., 2017). According to Giuliodori et al. (2013), the risk for metritis increased with dystocia, RFM, and dead calf [Adjusted Odds Ratio (AOR) = 2.58, 95% CI: 1.189–5.559]. The prevalence of stillbirth is higher in dystocic calvings than in eutocic ones (Johanson and Berger, 2003; Kaya et al., 2015). Prolonged manipulation in cases of dystocia increased the introduction of bacteria, and hard pulls are traumatic for the uterus. The tissue trauma facilitates adhesion and invasion of the germs (Opsomer, 2015), which may disturb intrauterine cellular defense, and lead to the loss of the ability to control the uterine infections naturally (Deori and phookan, 2015). Retained fetal membranes pose a perfect media for bacterial growth (Bruun et al., 2002). It is responsible of slowed uterine involution, impaired neutrophils functions and altered immune responses, which in turn, results in increasing the risk of metritis.

CONCLUSIONS

The current study aimed to identify the relevant risk factors for dystocia, RFM and metritis in dairy cows in Algeria. Cows at first and second lactations, and those that with low body condition, are more likely to experience dystocia and RFM. The important risk factors for RFM included dystocia, stillbirth, birth of male calves and calving in the warm season. Dystocia, stillbirth and RFM were the most implicated risk factors for metritis. The determination of relationships among disorders and the role of cows, calf and environment are important for developing an effective prevention strategy by better management of these risk factors that lead to decrease their prevalence in the dairy farms.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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