Prevalence and risk factors of postpartum health disorders in dairy cattle: first report in Algeria

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ABSTRACT

The postpartum period in dairy cows is vital for their health and herd productivity. Effective management, including proper nutrition and disease prevention, helps prevent metabolic and reproductive issues, ensuring optimal milk production and enhancing cow longevity and farm sustainability. The study aims to determine the main postpartum disorders in dairy cows from seven Algerian wilayas: Oran, Tipaza, Mila, M'sila, Setif, Medea, and Ghardaia..A total of 1153dairy cows were concerned. Overall, 37.21% of cows were having 1 postpartum disorder and 25.59% of cows having ≥2 postpartum disorders ($p<0.0001$). Inflammatory disorders (31.66%) were more frequent than metabolic disorders (24.89%) ($p<0.0001$). The most frequent postpartum disorders were acute metritis (AM) and lameness (LAM), followed by retained placenta (RP) and mastitis (MAS) ($p<0.01$). Holstein cows were more prone to mastitis (17.98%) and delayed uterine involution (6.07%) and Montbeliarde cows exhibit a high prevalence of lameness (52.61%) ($p<0.001$). Inflammatory disorders (metritis, delayed uterine involution) decrease as the number of lactations increases. Lameness is particularly frequent starting from the third lactation (>30%) ($p<0.001$). Cows that experienced dystocic calving show a higher prevalence of inflammatory and metabolic disorders compared to those with normal calving ($p<0.001$). Multiparous cows exhibit higher rates of metabolic and inflammatory disorders ($p<0.001$). Postpartum disorders in dairy cows require careful management to minimize their negative effects on milk production, reproduction, and overall health. Effective monitoring and timely interventions during the early lactation transition period are crucial for maintaining herd performance and profitability.

Key words: postpartum disorders, dairy cattle, transition period, performance

1. Introduction

The postpartum transition period in dairy cows is critical that affects both the animal's health and the overall productivity of the herd. Postpartum disorders, such as hypocalcemia, ketosis, retained fetal membranes, mastitis, and uterine diseases (endometritis and metritis), are strongly associated with reduced fertility and pregnancy rates, increased embryonic loss, and decreased milk production. These disorders, associated with metabolic and immunological imbalances, have a significant impact on animal welfare and the economic performance of dairy farms. Its can reduce conception rates, prolong calving intervals, and increase culling rates (1, 2).

Recent studies have highlighted that factors such as peripartum nutrition, metabolic status, and management practices strongly influence the prevalence of these disorders (3, 4). Notably, subclinical hypocalcemia has been identified as a major predisposing factor, compromising cows' resilience during the early days of lactation (5). Similarly, thermal management during the prepartum period, particularly in hot climates, has been shown to have a significant impact on postpartum inflammatory diseases (6).

In the Algerian context, dairy farming holds a strategic position, contributing to food security and rural economic development. However, production systems often face challenges related to management practices, nutrition, climate, and limited infrastructure (7). These constraints can increase the prevalence of postpartum disorders, the management of which remains a critical issue for improving farm performance.

Despite the importance of this subject, specific data on the prevalence and risk factors of postpartum health disorders in Algerian dairy farms remain scarce. Understanding the underlying causes, whether related to genetics, the environment, or management practices, is essential for developing appropriate prevention and intervention strategies tailored to the local context.

Based on field-collected data, this study seeks to provide a scientific foundation to improve management practices and support the sustainable development of dairy production in Algeria.Therefore, to the best of our knowledge, for the first time in Algeria this study aims to examine the frequency of postpartum health disorders in dairy farms and identify the associated risk factors.

2. Material and methods

2.1. Study area and population

This study was based on field data collected between April 2023 and July 2024 on 7 dairy herds located in 7 different regions (Oran, Tipaza, Setif, Mila,M'sila, Ghardaia and Medea) in Algeria. Oran is located in the northwest of Algeria on the Mediterranean coast, while Tipaza is found in the north-central region, also along the seafront. Sétif and Mila are situated in the northeast. M'sila is located in the center, in a region of semi-arid High Plains. Ghardaïa is in central Algeria, at the heart of the Sahara in the M'zab Valley, and Médéa is situated in the north, in the Tell Atlas (Figure 1).

A total of 1153 cattle of two breeds, Holstein (79.37%) and Montbeliarde (20.63%), were enrolled in the study.Only one farm was sampled per region. The number of cows included in this study was 60 in Oran, 127 in Tipaza, 644 in Mila, 32 in M'sila, 42 in Setif, 208 in Medea, and 42 cows in Ghardaia.

2.2. Diagnosis of postpartum health problems

Cows were examined for uterine prolapsed (UP), retained placenta (RP), milk fever (MF), acute metritis (AM), delayed uterine involution (DUI), chronic endometritis (CE), mastitis (MAS), lameness (LAM) and abortion (ABO).All these postpartum disorders were confirmed in conjunction with the herd's veterinarians.

Cows with no health problems were considered healthy, while those with at least one health problem were considered unhealthy.

Cows classified as INF (infectious disorders) have at least one of the following conditions: uterine prolapse, retained placenta, acute metritis, delayed uterine involution, chronic endometritis and mastitis. Cows classified as MET (Metabolic disorders) have at least one of the following conditions: lameness or milk fever.

2.3. Data analyses

For statistical analysis, the Chi-square test and ANOVA were used.A significance level of $p<0.05$ was considered statistically significant.Data analysis was conducted using the R i386 3.0.2 program with a Windows GUI front-end.

Directed Acyclic Graph (DAG) provides a conceptual framework for understanding how various factors contribute to postpartum health disorders in dairy cows.

A bubble diagram was made to show the importance of each postpartum disorder. The most important factors have large bubbles. Those with little relative weight, on the other hand, have small bubbles.

The map was created using the website (http://gadm.org/).

3. **Results**

The health status of cows (healthy, one disorder, or ≥2 disorders) and the type of disorder (inflammatory or metabolic) varied significantly across the different regions ($p<0.0001$) (Table 1). Notably, Setif exhibited an extremely high proportion of inflammatory disorders (69.05%) and cows with ≥2 disorders (52.38%). Conversely, M'sila showed a proportion of healthy cows (62.50%) well above the overall average (37.38%). The highest prevalence of metabolic disorders was observed in Setif (69.05%) and Medea (55.77%) ($p<0.0001$) (Table 1).

Overall, cows with a single postpartum disorder (37.21%) and those classified as having an inflammatory disorder (31.66%) were significantly more frequent than cows with ≥2 postpartum disorders (25.59%) and those classified as having a metabolic disorder (24.89%), respectively ($p<0.001$)(Table 1).

The Directed Acyclic Graph (DAG) (figure 2) illustrates the causal relationships between various factors influencing postpartum health disorders in dairy cows. Exogenous variables (circles), such as breed, parity and calving ease, as well as ancestor variables (rectangles), such as number of lactations, acute metritis (AM), or placental retention (PR), interact directly or indirectly to affect the final outcome, represented by postpartum health disorders (blue circle). The arrows indicate causal influences, highlighting complex causal chains, such as the impact of the number of lactations via parity, or indirect effects via intermediate variables such as the delayed uterine involution (DUI).

Postpartum pathologies vary according to the number of lactations, particularly for milk fever (MF) and lameness (LAM) ($p<0.001$). Inflammatory disorders (AM, DUI) decrease as the number of lactations increases. LAM is particularly frequent starting from the third lactation (>30%) ($p<0.001$) (Table 2).

Holsteinand Montbeliarde breeds show differences in metabolic and inflammatory disorders ($p<0.001$). Holstein cows were more prone to inflammatory disorders such as mastitis (MAS) (17.98%) and delayed uterine involution (DUI) (6.07%). Montbeliarde cows exhibit a high prevalence of LAM (52.61%) ($p<0.001$) (Table 2).

Cows that experienced dystocic calving show a higher prevalence of inflammatory and metabolic disorders compared to those with normal calving ($p<0.001$). Dystocia significantly increases the risk of DUI (8.82%) and LAM (25.74%) ($p<0.001$) (Table 2).

Multiparous cows exhibit higher rates of metabolic and inflammatory disorders ($p<0.001$) (Table 2).

Overall, the most frequent postpartum disorders were acute metritis (AM) and lameness (LAM), followed by retained placenta (RP) and mastitis (MAS) ($p<0.01$) (Table 2). Bubble diagram analysis results showed that LAM and AM are the most important factors (with large bubbles at the top). However, Uterine Prolapse(UP) and Abortion(ABO) are factors with little relative weight (small bubbles at the bottom) (figure 3).

The principal component analysis (PCA) (Figure 3) of the prevalences of various postpartum disorders based on the studied factors reveals the existence of strong positive correlations between UP (Uterine Prolapse), LAM (Lameness), CE (Chronic Endometritis), RP (Retained Placenta) and DUI (Delayed Uterine Involution). MAS (Mastitis) is opposed to these disorders. Some pathologies, such as MF (Milk Fever) and ABO (Abortion), have moderate contributions and are partially independent of other pathologies (figure 4).

4. Discussion

To the best of our knowledge, this study represents the first comprehensive investigation carried out in Algeria that specifically addresses the prevalence and risk factors (parity, lactation number, breed, calving ease, and region) associated with postpartum health disorders in dairy cattle farms. This research fills a critical gap in the existing literature and provides valuable insights into the challenges faced by the dairy industry.

Changes in feed intake in dairy cows during the periparturient period must be monitored, as inadequate feed intake is associated with numerous postpartum inflammatory and metabolic disorders (8). In our study, Setif has an extremely high proportion of inflammatory disorders (69.05%) and cows with ≥2 postpartum disorders (52.38%), indicating particularly

unfavorable breeding conditions in this region. However, M'sila shows a proportion of healthy cows (62.50%) well above the overall average (37.38%), suggesting favorable management practices or local conditions.The postpartum period in dairy cows is characterized by a correlation between reduced feed consumption and metabolic disorders (8). Therefore, the high prevalence of metabolic disorders observed in our survey in Medea (55.77%) could be linked to nutritional factors or suboptimal peripartum management.

Cows with two or more postpartum health disorders had lower milk production, decreased reproductive performance, increased risk of culling and death, compared to cows with only one postpartum health disorder or to healthy cows (9). However, in our study, healthy cows (37.38%) or with one postpartum disorder (37.21%) were significantly more frequent than cows with ≥ 2 postpartum disorders (25.59%) which is in line with the findings of Macmillan et al. (9) in Canada.

The proportion of cows diagnosed with one postpartum health disorder ranging from 21.88% to 46.15%. This proportion is similar to the report of Ribeiro et al. (10) in Florida and lower in comparison with Macmillan et al. (9) in Canada.

Multi-part cows have an increased risk of mastitis (11) and milk fever (12) and a lower risk of metritis (13). This is in agreement with our study.

The overall prevalence of clinical mastitis (17.26%), milk fever (hypocalcemia) (1.47%), retained placenta (16.91%), and acute metritis (23.94%) werecomparable with Macmillan et al. (9), Rodriguez et al. (12) and Koeck et al. (14).

Regarding milk fever, the prevalence in our study was 1.47%, with values ranging from 0.84% in primiparous cows to 1.83% in multiparous cows. Our results are similar to those

reported by Macmillan et al. (9) (0.9%), but lower than those reported by Rodriguez et al. (12) (4%).

For clinical mastitis in primiparous cows, our findings (7.3%) are comparable to those of Macmillan et al. (9) (7.6%), but lower than those of Hocine et al. (15) (9.80%).

These differences may be explained by geographical, environmental, and agro-ecological variations, as well as differences in farm management, husbandry systems, production methods, study protocols, or instruments used by researchers (16).

An increasing prevalence of mastitis was also observed,in our study, with parity: 7.30%, 20.54%, 26.02%, 19.54%, 26.56%, and 38.89% for first, second, third, fourth, fifth, and more than six lactations, respectively. This trend is consistent with findings reported by Bitew et al. (17). Additionally, Jha et al. (18) highlighted the role of enhanced diapedesis and more active mononuclear leukocyte function in primiparous cows compared to multiparous cows. Furthermore, milk production declines with increasing parity and age, making cows more susceptible to infections. Older cows have been associated with an increased risk of mastitis (11), milk fever (12), and a lower risk of metritis (13).

Assisted calving has been linked to an elevated risk of postpartum health disorders, notably retained placenta (RP) and uterine diseases (1, 10). This association underscores the importance of closely monitoring cows that require assistance during calving for potential postpartum complications.Dystocia is closely associated with increased uterine bacterial contamination, trauma, and heightened risks of RP and metritis (19). It is important to recognize that while RP, metritis, and purulent vaginitis may be interconnected, the presence of one condition does not necessarily lead to the development of the others (20). This nuanced understanding is critical for effective management and treatment strategies in dairy herd health.

Lameness in dairy cows is considered the main cause of pain and discomfort, with direct repercussions on animal welfare, leading to considerable economic losses (21). These losses are due to the premature elimination of the most productive animals, decreased milk production, treatment costs and lower fertility rates (21). Despite the importance of this problem, no information is available on lameness, which prevents a proper understanding of the scale of the problem and its associated factors, in the Algerian context. In North America, lameness affecting between 20% and 55% of dairy cows (22). In a literature review, an analysis of worldwide data over a 30-year period (1989-2020) revealed an average prevalence of lameness of 22.8% (23) which is in line with our findings (24.72%). A lower prevalence was reported at 12.1% by Koeck et al. (14).

The overall incidence of postpartum endometritis revealed herein was 8.95%, which is significantly lower than the 36.6% found by Kim and Kang (24). Variations in incidence rates can be attributed to differences in diagnostic methods, the timing of endometritis detection, cow characteristics, or variations in herd management practices (25).

In our survey, retained placenta (RP), uterine prolapse (UP), and delayed uterine involution (DUI) were associated with increased odds of developing metritis. The same finding was reported in previous studies (20). This is explained by the fact that dystocia interventions were generally associated with an increased risk of contamination of the uterus and vagina due to the large amount of necrotic tissue present, delayed expulsion of lochia, and potential uterine lesions caused by manual extraction (19, 20).

Globally, the most common postpartum disorders observed in this study were acute metritis (AM) and lameness (LAM), followed by retained placenta (RP) and mastitis (MAS). Similar findings have been reported in other studies (9).

It can be concluded that 37.21% of cows were diagnosed with 1 postpartum disorder and 25.59% of cows having ≥2 postpartum disorders. Inflammatory disorders (31.66%) were more frequent than metabolic disorders (24.89%). The most frequent postpartum disorders were acute metritis (AM) and lameness (LAM), followed by retained placenta (RP) and mastitis (MAS). Inflammatory disorders (metritis, delayed uterine involution) decrease as the number of lactations increases. Cows that experienced dystocic calving show a higher prevalence of inflammatory and metabolic disorders compared to those with normal calving. Multiparous cows exhibit higher rates of metabolic and inflammatory disorders.The study highlights the importance of closely monitoring postpartum health, especially on farms at higher risk, and suggests that optimized reproductive and nutritional management could help reduce these disorders. Further research into management practices is needed to improve prevention and treatment strategies.

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Authors' Contribution

Study concept and design: R.D., N.O. and N.A.K.T.

Conducting the experiment: R.D., N.O. and N.A.K.T.

Analysis and interpretation of data: S.K., M.N., A.K., O.S., N.O. and N.A.K.T.

Drafting of the manuscript: I.O., H.D., D.M. and N.A.K.T.

Critical revision of the manuscript: R.D., N.O. and N.A.K.T.

Animal Ethics

Not applicable. The results of this study were obtained during the routine clinical examination carried out by the veterinarians.

Conflict of interests

The authors declare that they have no known conflict of interest in the conduction of the current study.

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Data Availability

Not applicable.

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