


## ORIGINAL ARTICLE

## Experts' Opinion on Lameness in Iranian Dairy Herds: A Qualitative Study

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## ABSTRACT

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Lameness is one of the most serious issues in the dairy industry; it has severe effects on animal economics and welfare. Lameness is a multifactorial condition with a wide range of risk factors on the herd and cow levels. The aim of this study was to determine the responsible factors using expert clinicians' opinions across the country. Eighteen experts agreed to participate, and 13 of them (response rate = 72%) completed the questionnaire. The highest agreement among the experts for the prevention factor was "increasing the resting time of the cows and their comfort", to which eight assigned a score of 5. According to the experts' opinions freestall design, flooring and alleys, nutrition, stocking density, incorrect hoof trimming, infectious lesions, and insufficient resting time are the most important determinants of lameness prevalence.


### Introduction

Lameness is one of the most important challenges facing the dairy industry worldwide in terms of economics and animal welfare.<sup>1</sup> It is defined as any painful condition that causes a cow to reduce the amount of weight bearing down on the affected limb.<sup>2</sup> Economic losses of lameness include reduced milk production, reduced reproductive performance, treatment costs, and increased possibility of animals contracting other diseases and culling.<sup>3-6</sup> Furthermore, lameness induces pain and suffering, reducing the welfare of dairy cows.<sup>7</sup>

Lameness is a common issue among dairy cows worldwide.<sup>8-15</sup> The mean prevalence of dairy cow lameness is estimated at 22.8% (range: 5.1% to 45%).<sup>1</sup> The prevalence of lameness in dairy cows in Great Britain, Canada, Egypt, Pakistan, Germany, and Malaysia has been reported at 29.5%, 20.7%, 43.1%, 14.20%, 32.5%, and 19.1%, respectively.<sup>5,16-20</sup> In Iran, depending

on the detection rate, the lameness frequencies differ from herd to herd. The seasonal lameness prevalence from a Khorasan study was more than 17%, which was recorded as less than 17% in Esfahan in the same study. Another study estimated the prevalence of lameness in Shahrekord province 54.66%.<sup>21,22</sup>

Lameness is a multifactorial and complex condition with a wide range of risk factors that are generally evaluated on the herd and cow levels. The risk factors at the herd level are mainly in three categories: breeding system, housing facilities, and management, which include herd size and overstocking, feeding, bedding depth, flooring type, distance to water and milking, speed of movement to the milking parlor, claw trimming routine, farm health condition, foot bathing frequency, heat stress, and the use of automatic scrapers. Breed, age, body condition score (BCS), parity, milk yield, stage of lactation, and claw disorders as the cow level risk factors were studied.<sup>11,20,23</sup>

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Qualitative study methods are often used to discover factors influencing decisions and behaviors. Qualitative research provides an in-depth investigation of human experiences that can be represented numerically. In fact, in the present qualitative study, non-numerical data is used in the form of words from the experience and expertise of experienced people. Qualitative methods are widely used in dairy cattle health and welfare research.<sup>24,25</sup>

In Iran, usually only severely lame cows are identified and presented for treatment. Also, limited studies have been published regarding lameness, and according to the information obtained in this research, only a limited number of veterinarians are specialized in lameness. According to the authors' knowledge, this is the first study that was conducted with the aim of determining the responsible factors using expert clinicians' opinions across the country.

## Materials and Methods

This study was conducted using a qualitative method, drawing on the opinions of experts across the country.

### Expert Selection

The main criterion for selecting an expert to enter the study was a veterinarian (general or specialist) with at least 5 years of experience in the field of lameness management in the dairy industry.

The research objectives were communicated to all participants, and their agreement to participate in the study was obtained through a phone call or email. The anonymity of all participants and the confidentiality of responses were guaranteed. Also, the contact number and email of the research team were made available to them to solve any questions or ambiguities during the study.

### Factors Associated with Lameness in Dairy Cows

**Part one.** To identify factors associated with lameness in dairy herds, an open-ended questionnaire with two general questions "Factors associated with predisposing of lameness in dairy herds" and "Factors associated with prevention of lameness in dairy herds" was designed and sent to three experienced clinicians (with more than 20 years of experience) in the field of dairy cow lameness from three different regions of Iran.

**Part two.** Based on the responses from part one, the main research questionnaire was developed. It consisted of 20 questions: 10 questions addressing factors contributing to lameness in dairy herds and 10 questions focusing on effective factors in preventing lameness. These questions were presented to 18 experts across the country, all of whom collaborated with freestall farms, to assess the significance of the factors affecting lameness. Participants were asked to rank the risk factors and

prevention measures for lameness in dairy farms by assigning a score from 1 (low) to 5 (high). They were also given the option to add any additional factors to the questionnaire. The questionnaire was sent to all participants who agreed to take part in the study, and data were collected accordingly.

### Data Analysis

All questionnaires were collected and recorded in a Microsoft Excel spreadsheet (Microsoft Software, 2016). The extracted median was considered a criterion for prioritizing factors associated with lameness and the prevention of lameness in dairy herds.

## Results

Based on the responses provided by participants in Part one, freestall design, flooring and alleys, nutrition, heat stress, season, stocking density, incorrect hoof trimming, infectious lesions, insufficient rest time, and systemic infections are listed as determinants of lameness prevalence. Additionally, correct hoof trimming, management of heat stress, management of the transition period (i.e.,  $\pm 3$  weeks of calving), repairing the flooring and alleys, reviewing and repairing the freestall design to standard dimensions, improving and modifying water, feed pads, and other facilities in the pen, adjusting supplements (copper, cobalt, zinc, manganese, etc.), enhancing farm hygiene, increasing resting times and comfort, and adjusting locomotion scoring time are included as prevention factors for lameness in herds.

In part two, out of the 18 participants who were chosen and expressed their consent, only 13 of them responded to the questionnaire (response rate = 72%). The average number of years in dairy veterinary practice was recorded as 20 years (range: 5–50 years), 54% of participants were academic staff. Regarding the geographical distribution of the respondents, 62%, 15%, 15%, and 8% of the experts were from the central part of Iran, the northeast, northwest, and west of the country, respectively. None of the experts from southern Iran who had previously expressed their consent to participate in the study responded to the questionnaire.

The highest agreement among the experts for the prevention factor was "increasing the resting time of the cows and their comfort", to which eight experts assigned a score of 5 to this factor (Tables 1 and 2). Freestall design, flooring and alleys, nutrition, stocking density, incorrect hoof trimming, lesions of infectious etiology, and insufficient rest time were recorded as the most important determinants (Table 3). Increasing cows' resting time and comfort was recorded as the most important preventive measure (Table 4). Based on the estimated median scores of part two, the factors listed as determinants of lameness prevalence and prevention in

three groups were prioritized in order of importance (Table 5).

## Discussion

Understanding the determinants of lameness is crucial for preventing it in dairy cows and ensuring both high production and animal health. In our study, experts identified ten factors associated with lameness (prevalence and prevention of lameness) across three

priority levels within a dairy herd. Similar to other studies in the literature, we found that flooring type, freestall design, nutrition, claw trimming, farm health status, daily time budget, and stocking density are among the most influential determinants.<sup>19,26</sup>

The results of this study show that the daily time budget of lactating dairy cows is a crucial consideration for lameness prevalence and prevention. According to expert opinions, inadequate rest time is a factor

**Table 1.** The score assigned to factors associated with lameness by experts.

Factors associated with lameness	Expert score (N = 13)%				
	1	2	3	4	5
Freestall design	0	15.3	30.7	38.4	15.3
Flooring and alleys	0	7.6	15.3	46.1	30.7
Nutrition	15.3	7.6	15.3	23	38.4
Heat stress	0	30.7	30.7	30.7	7.6
Season	0	30.7	30.7	38.4	0
Stocking density	0	0	30.7	46.1	23
Incorrected hoof trimming	0	7.6	7.6	38.4	46.1
Infectious hoof lesions	0	15.3	15.3	38.4	30.7
Inadequate rest time	0	0	46.1	23	30.7
Systemic infections	30.7	23	23	23	0

**Table 2.** The score assigned to the factors associated with lameness prevention by experts.

Factors associated with the prevention of lameness	Expert score (N = 13)%				
	1	2	3	4	5
Correct hoof trimming	0	0	0	53.8	15.3
Management of heat stress	0	7.6	61.5	15.3	15.3
Management of the transition period (i.e., $\pm 3$ weeks of calving)	7.6	7.6	38.4	23	23
Repairing the flooring and alleys	0	0	23	53.8	23
Reviewing and repairing the freestall design in standard dimensions	0	15.3	23	38.4	23
Improvement and modification of the water, feed pad, and other facilities in the pen	0	23	53.8	15.3	7.6
Supplements adjustment (copper, cobalt, zinc, manganese, ...)	15.3	23	38.4	15.3	7.6
Improving the farm hygienic	0	15.3	23	53.8	7.6
Increasing resting times and comfort	0	0	23	15.3	61.5
Locomotion scoring time adjustment	0	7.6	15.3	38.4	38.4

**Table 3.** Median, minimum, and maximum scores assigned by 13 experts to factors associated with lameness in industrial dairy farms.

Factors associated with lameness	Median	Min.	Max.
Freestall design	4	2	5
Flooring and alleys	4	2	5
Nutrition	4	1	5
Stocking density	4	3	5
Incorrected hoof trimming	4	2	5
Infectious hoof lesions	4	2	5
Inadequate rest time	4	3	5
Heat stress	3	2	5
Season	3	2	4
Systemic infections	2	1	4

**Table 4.** Median, minimum, and maximum scores assigned by thirteen experts to factors associated with preventive lameness in industrial dairy farms.

Factors associated with the prevention of lameness	Median	Min.	Max.
Increasing resting times and comfort	5	3	5
Locomotion scoring time adjustment	4	2	5
Correct hoof trimming	4	4	5
Repairing the flooring and alleys	4	3	5
Reviewing and repairing the freestall design in standard dimensions	4	2	5
Improving the farm hygienic	4	2	5
Improvement and modification of the water, feed pad, manager, and other facilities in the pen	3	2	5
Supplements adjustment (copper, cobalt, zinc, manganese, etc.)	3	1	5
Management of the transition period	3	1	5
Management of heat stress	3	2	5

**Table 5.** Expert ranking of prioritization of factors affecting lameness prevalence and prevention.

Priority	Factors associated with lameness	Factors associated with the prevention of lameness
1	Incorrected hoof trimming - Flooring and alleys - Nutrition - Stocking density - Freestall design- Infectious hoof lesions- Inadequate rest time	Increasing resting times and comfort
2	Heat stress- Season	Correct hoof trimming - Repairing the flooring and alleys - Reviewing and repairing the freestall design in standard dimensions- Improving the farm's hygienic - Locomotion scoring time adjustment
3	Systemic infections	Management of heat stress - Management of transition period - Improvement and modification of the water, feed pad, manager, and other facilities in the pen - Supplements adjustment (copper, cobalt, zinc, manganese, etc.)

associated with lameness incidence (median: 4, range: 3-5), and increasing resting times and comfort is the first priority among lameness prevention factors. (median: 5, range: 3-5). Recent research emphasizes the importance of adequate time for rest, feeding, milking, and socialization behaviors. Dairy cattle have a strong desire to rest, valuing approximately 12 to 14 hours of lying time per day. Inadequate rest can lead to health issues, including lameness.<sup>27</sup>

Lameness prevalence is more common in freestalls compared to other housing types.<sup>26</sup> In this study, we surveyed freestall barn design, which experts identified as an important factor contributing to lameness incidence (median: 4, range: 2-5). Freestalls should be designed to encourage cow rest, allow easy rising and lying movements without obstacles, and provide adequate resting space based on cow size. Additionally, the design should also ensure that the cows remain clean and dry to help reduce the risk of lameness by increasing rest time and maintaining hoof clean.<sup>27</sup> Stall dimensions (width, bed length, brisket board, neck rail height), stall bedding type, quantity and layout of the stalls are important because they directly affect lying times and consequently affect lameness prevalence.<sup>26</sup> The brisket board and the concrete-filled space behind the brisket board were known as barriers to normal cow rising movements.<sup>28</sup> Also, according to Kohansal *et al.* (2023) reported, the neck rail, the brisket board, and the increase in the mean

horizontal distance (the distance from the neck rail to the end of the stall) in each barn are the most contentious elements of the freestall that cause lameness in Iranian dairy herds.<sup>29</sup> Numerous studies verify that deep bedding provides a comfortable lying surface, improving cows' lying time. It reduces the time spent standing on wet, hard surfaces and ultimately reduces the risk of lameness. The risk of digital dermatitis also increases in farms with inadequate bedding depth.<sup>19,24</sup>

On freestall farms, flooring type can create challenging circumstances for cows' locomotion. Rough, slippery, and abrasive floors may contribute to an increased incidence of lameness.<sup>18</sup> For instance, concrete floors, when compared to other types such as mattresses, sand bedding, or straw, lead to more severe claw horn lesions. Ouweltjes *et al.* (2009) found that the prevalence of sole hemorrhages was higher in concrete surface farms (48%) than at the rubberized floor farms (22%).<sup>30</sup> The ideal floor should be hygienic, comfortable, and feature a level, non-abrasive surface to prevent skidding.<sup>21</sup>

Experts in this study recognize nutrition as a risk factor in lameness incidence (median: 4, range: 1-5). However, multiple studies highlight the most details within nutrition. It is essential to discuss the associations between each of these and lameness separately. Nutrition is one of the most important factors affecting the quality and growth of hoof horn. Imbalances in minerals and vitamins, as well as other nutritional deficiencies, can lead

to the growth of a fragile horn, which is more susceptible to cracks and infections.<sup>31</sup> Sadeghi-Nasab *et al.* (2012) show that serum and hoof Cu concentrations in severe lameness cows (locomotion scores 4 and 5) were significantly less than in moderately lame and healthy cows. Serum  $\beta$ -carotene and vitamin A levels were low in all groups, and a significant negative relationship was observed between locomotion scores and serum vitamin A levels ( $r = -0.24, p = 0.01$ ).<sup>32</sup> Hence, according to existing studies, adjusting supplements (copper, cobalt, zinc, manganese, etc.) serves as a preventive factor for lameness. Kochakzade Omran *et al.* (2012) confirmed this finding, noting that lameness prevalence significantly decreased following the addition of oral zinc and copper supplements.<sup>33</sup> The current study's findings also support this conclusion. Furthermore, acidosis and sudden changes in feed ration, preparation method, and feeding behavior of the animals are important in lameness in dairy cows.<sup>31,34</sup> Nazari *et al.* (2015), who evaluated management-nutritional strategies on the incidence of lameness in the dairy industry in Gorgan Province (north of Iran), reported that there was no significant effect between lameness and observing the proper ratio of fodder to concentrate, use of total mixed rations, or addition of vitamin and mineral supplements. However, they found that the use of feeders and biotin supplementation had a statistically significant effect on reducing lameness prevalence.<sup>35</sup>

Claw trimming is one of the most important management strategies, particularly in intensive breeding systems, for preventing and managing the lameness of clinically lame cows. In our country and many others, the primary approach to controlling lameness involves claw trimming and treating locomotion disorders. While most farmers recognize the importance of claw trimming for lameness prevention, unfortunately, their awareness of proper claw trimming techniques, timing, frequency, and who should perform it remains low.<sup>36</sup> In this study, according to the experts' opinions, inappropriate claw trimming ranks among the most critical factors contributing to lameness (median: 4, range: 2-5). Implementing a correct claw trimming routine is the second key factor in preventing lameness (median: 4, range: 4-5). Hernandez (2007) and Griffiths (2018) confirmed the effectiveness of the claw trimming routine, revealing a 25% decrease in lameness prevalence due to preventive claw trimming.<sup>19,37</sup> Studies have also shown a positive correlation between the frequency of preventive claw trimming (twice during lactation) and lameness prevalence.<sup>36</sup> Espejo *et al.* (2006) found that herds practicing claw trimming only when cows have overgrown claws experience higher levels of lameness.<sup>38</sup> Solano *et al.* (2015) reported that cows with overgrown claws have 1.4 to 1.7 times higher odds of lameness.<sup>26</sup>

Additionally, Oehm *et al.* (2019) discovered that cows with overgrown claws are at increased risk (OR = 1.78; 95% CI: 1.50–2.11) of lameness compared to animals with normal-shaped claws. Proper instruments, facilities, and well-educated claw trimmers or veterinarians should be involved in claw trimming to prevent incorrect trimming, which is a major factor associated with thin soles, severe pain and discomfort.<sup>39</sup>

Visual locomotion scoring (LS) is a practical method to detecting lameness in dairy cows.<sup>40</sup> This scoring system helps evaluate the severity, duration, and prevalence of lameness. Routine locomotion scoring is valuable for early identification of individual cows in need of functional claw trimming and monitoring the prevalence.<sup>41</sup> Additionally, it provides access to real herd-level information, use as a preventive strategy, and raises awareness among farmers and veterinarians.<sup>42</sup> In this study, all participants assigned scores of 4 and 5 (on a scale of 1 to 5) to this factor. It shows the importance and value of routine scoring in dairy herds are well recognized by those involved in our country.

According to the experts' scores, heat stress and season are considered the second priority among lameness risk factors in the dairy industry (median: 3, range: 2-5; median: 3, range: 2-4), and heat stress management ranks third among the factors that prevent lameness (median: 3, range: 2-5). Cows under heat stress adjust their behavior to keep themselves cool. They stand up more, lie down less, and move less often to end the heat stress crisis by providing more surface area for heat dissipation and creating airflow.<sup>43</sup> Cook *et al.* (2007) established that there are large seasonal variations in the amount of time taken drinking, eating, laying in stalls, and standing in the alleys, but there are no significant seasonal variations in the amount of time spent standing in the stalls or milking. Additionally, from the coldest to the warmest season, there was an increase in the amount of time spent standing in the alleys, from 2.6 to 4.5 hours each day.<sup>26</sup> Lying time reduced by 30% at higher temperatures.<sup>44</sup> Gernand *et al.* (2019) reported that elevated in the Temperature Humidity Index (THI) correlated (associated) with an increased incidence of digital phlegmon and a decreased incidence of digital dermatitis. The rise in digital phlegmon cases during hot seasons has been confirmed by several studies from different parts of the world. Although some articles suggest that the increase is not exclusive to hot seasons but is most pronounced during this time. Humidity is considered the major factor in the increased digital phlegmon due to the persistence of bacterial components in high humidity. While the decrease in digital dermatitis cases under high THI conditions has been confirmed by some studies, others have refuted this finding.<sup>45-47</sup> Furthermore, Pavol Mudron's study (2022) demonstrates

that heat stress in dairy cows can be closely connected to a higher incidence of sole ulcers.<sup>48</sup> This finding has also been supported by research conducted in Iran by Jafari *et al.* (2009) who reported that claw disease was most common in the summer and least common in winter.<sup>49</sup>

The experts' scores for the management of the transition period (i.e.,  $\pm 3$  weeks of calving), as a preventive factor, ranging from 1 to 5, reveal varying opinions about its importance in lameness. Further investigation is necessary to fully understand its impact. During the transition period, dairy cows are more at risk of infectious and metabolic diseases, and these diseases are the cause of lameness in dairy cows. Notably clinical lameness tends to be more prevalent in high-production herds compared to low-production herds.<sup>50</sup>

Infectious hoof lesions and systemic infections are among the factors identified in this study as being factors associated with lameness (median: 4, range: 2-5; median: 2, range: 1-4). More than 90% of hoof lesions lead to lameness. Lesions can be infectious or non-infectious.<sup>51</sup> On the other hand, there are foot lesions that are equally associated with poor locomotion. For instance, Flower and Weary (2006) found that cows with sole hemorrhage did not exhibit significantly different locomotion compared to sound cows. This suggests that some foot lesions may not directly impact locomotion. Berry (2006) reported that only certain stages of digital dermatitis cause pain. Therefore, it's possible that only severe cases of specific foot lesions affect locomotion.<sup>52</sup> There is an association between Johne's disease (JD), Foot and Mouth Disease, and lameness; JD cows were found to be 2.7 times more likely to be lame (OR = 2.7, 95% CI:1.2-6.0).<sup>50,53</sup>

In conclusion, the results of this study provided insight into potential environmental and managerial risk factors related to lameness in Iranian dairy herds based on expert opinions. Identifying these risk factors helps prioritize cost-effective lameness prevention. Notably, maintaining the daily time budget of lactating dairy cows emerges as a crucial factor for preventing lameness, emphasizing the need for herd management practices that support this.

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## Conflict of Interest

The authors declare that there is no conflict of interest.

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