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Research article

Lameness in broiler chickens in Kazakhstan: prevalence and key risk factors from commercial farms

Gulim K. Assetova[1], Assel B. Zhexenayeva[1], Aizhan Y. Akhmetzhanova[1]
Serik D. Tussupov[1], Yermekkazy Y. Bilyalov[1], Dilora T. Senkebayeva[2]
Akerke S. Temirova[1], Adlet K. Kamzanov[1], Bakytzhan T. Bolkenov[1]

[1]Shakarim University, Semey, Kazakhstan
[2]National Agrarian Scientific and Educational Center, Astana, Kazakhstan

Corresponding author: Bakytzhan T. Bolkenov: b.bolkenov@shakarim.kz
Co-authors: (1: GA) assetova_gulim@shakarim.kz , (2: AZh) a.zheksenaeva@shakarim.kz
(3: AA) a.akhmetzhanova@shakarim.kz, (4: ST) s.tussupov@shakarim.kz
(5: YB) er_men67@mail.ru, (6: DS) d.senkebayeva@nasec.kz, (7:AT) uas_91@mail.ru
(8: AK) kamzanov02@gmail.com
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Abstract

Background and Aim. Lameness in broiler chickens is a major welfare and economic concern affecting productivity and farm profitability worldwide. However, information regarding the prevalence and associated risk factors of broiler lameness in Kazakhstan remains limited. This study aimed to evaluate the prevalence of lameness in commercial broiler farms and identify the main contributing factors under local production conditions.

Materials and Methods. A cross-sectional survey was conducted from July to October 2025 on 10 commercial poultry farms located in different regions of Kazakhstan. Data were collected using a structured questionnaire covering housing conditions, litter management, stocking density, feeding practices, environmental control, health management, and the occurrence of lameness. Descriptive statistical analysis was performed to evaluate the collected data.

Results. Lameness was reported on mostfarms, although prevalence varied substantially among production systems. The proportion of lame birds at slaughter ranged from 0 to over 10%, with an average prevalence of 2.1 ± 3.2%. Severe lameness cases (Score ≥ 3) averaged 4.7 ± 6.9%. Poor litter quality, high stocking density, inadequate temperature and humidity control, and differences in feeding strategies were identified as major risk factors. Among infectious agents, *Staphylococcus* spp. was the most frequently reported pathogen. Although preventive measures were implemented on most farms, their implementationwas often inconsistent.

Conclusion. The findings demonstrate that broiler lameness in Kazakhstan is a multifactorial problem influenced by management, environmental, and infectious factors. This study provides one of the first comprehensive assessments of lameness in commercial broiler production in Kazakhstan and highlights the need for improved management practices, standardized monitoring systems, and more effective prevention strategies.

Keywords: broiler chickens; Kazakhstan; lameness; prevalence; poultry farms; risk factors.

Introduction

Poultry farming plays a key role in ensuring food security, economic development, and social stability both in Kazakhstan and worldwide. In Kazakhstan, the industry is characterized by dynamic growth, the adoption of innovative technologies, and government support, helping toreduce dependence on imports and create new jobs [1, 2]. These trends reflect the government's strategic focus on developing the agro-industrial complex. Globally, poultry farming provides an affordable source of protein; its products (meat and eggs) constitute an important component of the human diet, and increased domestic production reduces dependence on imports [2, 3].

Poultry meat production in Kazakhstan has shown steady growth over the past decade. According to data from the National Statistics Bureau of the Republic of Kazakhstan, production increased from approximately 220–230 thousand tons in 2020 to approximately 360 thousand tons in 2024, indicating a significant increase in domestic production. This trend reflects improved industry efficiency and expanded production capacity. This growth trend continued in 2025, increasing by approximately 2.6–2.7%, and data from early 2026 indicate that the industry continues to expand. The poultry population also grew, reaching 45.7 mln birds in 2025. These trends underscore the growing importance of broiler production in ensuring Kazakhstan's food security and economic stability [4].

Lameness in broiler chickens is one of the key challenges in modern poultry farming. It is directly linked to pain, deterioration in the birds' condition, and significant economic losses in industrial production. The importance of addressing this problem is increasing as production expands. The problem is exacerbated by the extremely rapid growth of modern broilers and intensive rearing technologies. Gait abnormalities are recognized as one of the most sensitive indicators of reduced bird welfare, as they limit mobility, consequently, access to feed and water, and are accompanied by pain. Lameness is often associated with metatarsal dermatitis and hock burns, reflecting poor litter quality and housing conditions [5, 6].

Lameness in poultry farming leads to significant economic losses due to reduced meat quality and increased costs for treatment and preventive measures [7]. In addition, lameness negatively affects both the welfare of the birds and their productivity. Collectively, these effects reduce production efficiency and increase production costs. For the industry, these consequences translate into substantial economic losses associated with mortality, culling, and reduced production performance.

The multifactorial nature of lameness in broiler chickens poses a serious problem both from an animal welfare perspective (pain, restricted movement) and from an economic standpoint (mortality, culling, reduced weight gain). Lameness, typically, does not have a single cause but is caused by a combination of factors. Growth, nutrition, infection, and management factors all play a role simultaneously. Bacterial chondronecrosis with osteomyelitis (BCO) is considered the leading cause of lameness: bacteria (primarily *Staphylococcus* spp.) colonize microcracks in bone tissue after penetrating from the gut or respiratory tract. Viral, bacterial, and mycotoxicosis-related diseases, as well as staphylococci, cause arthritis, osteomyelitis, deformities, and paralysis of the limbs [5, 8, 9]. Bone development is closely linked to the availability of IP6 (phytate), calcium, and phosphorus; mineral nutrition deficiencies impair bone quality. Deficiencies and imbalances in Ca, P, and vitamin D3, as well as other nutritional disorders, impair bone mineralization and increase the risk of lameness. Feed contaminated with mycotoxins (deoxynivalenol, fumonisin, aflatoxins) markedly increases the incidence of lameness and bone damage, and disrupts phosphorus metabolism and mineralization [10–12]. Lameness in broilers has a distinctly multifactorial nature: rapid growth, mineral imbalances and mycotoxins, mechanical stress, bacterial infection (BCO), and housing conditions act in concert. Therefore, the development of lameness in broilers is due to the combined effects of metabolic, infectious, and technological factors.

Surveys of farmers and experts complement the clinical assessment of lameness and provide data on the scale of the problem, risk factors, management characteristics, and economic aspects at the farm and industry levels. In poultry farming, this approach is used less frequently than direct clinical examinations, but where it is applied, it is evident that the farmers' attitudes and management practices often determine the severity of the problem and the success of prevention. Structured questionnaires are particularly valuable, as they allow the quantitative assessment of the influence of environmental and management factors. Questionnaire sections completed by farmers (feed type, duration of the dark period, stocking

density, slaughter age, mortality rate) enable statistical associations between lameness and management- and resource-related factors to be identified. In multifactorial studies of broilers, questionnaire data on housing conditions and management (lighting, litter quality, age) are combined with assessments of lameness, dermatitis, and fear, allowing for the identification of key risk factors (dark period duration, age, litter) and demonstrating that modifying just a few parameters can simultaneously improve several welfare indicators [13].

Despite the existence of numerous studies on lameness in broilers that detail the causes, prevalence, and preventive measures, most of them were conducted abroad (Europe, Australia, China, the USA, Pakistan, etc.). This limits the ability to generalize the results to conditions in Kazakhstan. Currently, no published scientific data reflecting the situation in Kazakhstan are available. Thus, the problem of lameness in broiler chickens in the context of domestic poultry farming remains insufficiently studied. The aim of this study was to assess the prevalence of lameness in broiler chickens and to identify key risk factors at the level of poultry farms in Kazakhstan using a structured questionnaire.

Materials and Methods

A cross-sectional study was conducted from September to November 2025. The questionnaire was developed using web-based software (Google Forms) and distributed to key stakeholders in Kazakhstan's broiler industry working in vertically integrated broiler production companies. Respondents included managers and executives of broiler farms, veterinary specialists at poultry farms, as well as executives of processing plants and employees of food quality control and safety departments.

The questionnaire was developed by the authors of this study. A preliminary version was tested by a group of researchers to assess the clarity and comprehensibility of the questions. In addition, the questionnaire was reviewed and approved by a research group in this field. Based on the comments and recommendations received, the questionnaire was revised and adjusted before being used in the main study. Participating farms were selected using purposive sampling to ensure representation of commercial broiler production systems from different regions of Kazakhstan. Farms were identified through professional industry networks, poultry production companies, and veterinary contacts. Invitations to participate were sent by email to managers, veterinarians, and technical specialists working in broiler production. Participation was voluntary, and only farms that completed the questionnaire were included in the final analysis. The surveyed farms represented both vertically integrated and independent broiler production systems.

A link to the online survey was distributed via email. Participation in the study was voluntary, and participants received no compensation for completing the questionnaire. The full version of the questionnaire in print format is available in the "Additional Materials" section.

All surveys were conducted anonymously, and no personal or corporate information was collected or processed. The questionnaire was structured and included six thematic sections. The first section collected basic descriptive data on poultry farms, including geographic location, type of production system (integrated or contract-based), farm capacity, number of production cycles per year, and annual production volume. Additional information included the presence of veterinary supervision on the farm, farm management experience, broiler breed/cross, and slaughter age. This section was used to characterize the epidemiological situation on the farms.

The second section assessed housing systems and microclimatic conditions affecting broiler welfare. Variables included temperature, humidity, ammonia ($NH_{3)}$ and carbon dioxide (CO_2) levels, ventilation type, lighting schedule, and stocking density. Particular attention was givento the type of litter, its quality, replacement frequency, and moisture content, as these factors are directly linked to foot health issues. General hygiene procedures and disinfection protocols between production cycles were also evaluated.

The third section focused on feed sources, feeding systems, and nutrient quality control. Information was collected on feed type (pelleted, mash, or mixed), feed origin (commercial or self-produced), and quality control methods (protein, energy, and mineral content, as well as mycotoxin testing). The use of feed additives intended to improveskeletal health was also recorded, including calcium, phosphorus, vitamin D_3, trace minerals, probiotics, enzymes, and toxin binders. Water sources, water treatment methods, and drinking system hygiene were included as additional indicators of proper nutrition.

The fourth section assessed the epidemiology and clinical manifestations of lameness in broiler chickens. Data were collected on the age at onset, severity, and frequency of lameness cases, as well as the proportion of affected birds at slaughter. Lameness severity was assessed using the Bristol Gait Scoring System, a widely accepted method for evaluating walking ability in broiler chickens. The system uses a 0–5 scale, where score 0 represents normal locomotion and score 5 indicates severe locomotor impairment with an inability to walk normally. Higher scores reflect increasing degrees of gait abnormality and reduced welfare. Where available, farms reported lameness prevalence using this scoring system. General clinical signs, such as gait abnormalities, joint swelling, pododermatitis, deformities, and reduced mobility, were also documented.

The fifth section assessed the involvement of infectious agents associated with lameness. Participants provided information on bacterial, viral, mycoplasmal, and fungal pathogens commonlydetected in their flocks, including *Staphylococcus* spp., Escherichia coli, reoviruses, infectious bursal disease virus, Mycoplasma synoviae, and Aspergillus spp. The frequency of laboratory diagnostics and the use of surveillance programs on breeding farms and in broiler flocks were also recorded.

The final section assessed disease prevention strategies and control measures implemented on farms. Data were collected on vaccination programs, the use of antibiotics (prophylactic and therapeutic), and alternative control measures, such as probiotics, organic acids, and herbal supplements. Management practices related to stocking density regulation, biosecurity measures, and welfare monitoring systems were also included. In addition, participants identified the main suspected causes of lamen ess and reported on economic losses and production problems associated with its occurrence.

Statistical Analysis

The data were analyzed using descriptive and non-parametric statistical methods. Continuous variables are presented as mean ± standard deviation (SD), along with median and range where appropriate, while categorical variables are summarized as frequencies and percentages.

Because the sample size was relatively small (n = 10 farms) and several variables were ordinal, non-parametric approaches were used throughout the analysis. Associations between lameness prevalence and selected management, environmental, and diagnostic factors were evaluated using Spearman's rank correlation.

To further explore differences between farms, they were grouped according to lameness levels, and comparisons between groups were performed using the Mann–Whitney U test where appropriate. Associations between categorical variables were assessed using Fisher's exact test.

Statistical significance was defined as $p < 0.05$. Given the exploratory nature of the study, the results were interpreted with appropriate caution.

Results

The study involved 10 commercial poultry farms from various regions of the Republic of Kazakhstan (Abai, Akmola, and Almaty regions, among others). Respondents included farm managers, veterinary specialists, and production staff representing both vertically integrated and independent broiler production systems.

Most farms operated under intensive production conditions. Most farms completed 6–7 production cycles per year. The majority of enterprises were characterized by large production capacities, with annual production volumes ranging from 1 to over 10 mln birds. 90% of the farms had a full-time veterinarian on staff, and all respondents had more than 5 years of experience in poultry farming.

The summarized production characteristics of the surveyed farms are presented in Table1.

Table 1. Production characteristics of poultry farms (n = 10)

Parameter	Value
Presence of a veterinarian (yes/no)	9 / 1
Type of production (% vertically integrated)	40%
Ross 308 strain (% of farms)	80%
Average slaughter age (days)	41.2 ± 4.1
Production cycles per year (predominant)	6–7

Most farms used enclosed poultry houses with controlled housing conditions and mechanical ventilation (including tunnel and cross-ventilation). However, variability in the effectiveness of microclimate control was noted, particularly regarding the maintenance of optimal humidity and air quality. This fact indicates differences in the level of technological implementation even in the presence of similar infrastructure.

Bedding management practices also varied significantly. Wood shavings and straw were the most commonly used materials. A number of respondents pointed to problems with high bedding moisture and condensation, which is considered a risk factor for the development of musculoskeletal disorders. Cleaning and disinfection of the premises were carried out between production cycles, but their frequency and effectiveness varied. This may contribute to the accumulation of pathogenic microflora and a deterioration in the sanitary condition of the poultry houses.

All farms used compound feed (either produced on-site or purchased). Regular feed quality control was carried out at 90% of the facilities. Analysis of feed additive useshowed that the most common were sources of calcium and phosphorus, mycotoxin adsorbents, and trace elements. The frequency of use of various types of additives is presented in Table 2. At the same time, inconsistencies were identified in approaches to the use of modern feeding strategies.

Table 2. Frequency of use of feed additives (n = 10)

Type of feed additive	Number of farms	% Of total
Bioavailable sources of Ca and P (dicalcium phosphate, etc.)	9	90%
Trace elements (Zn, Mn, Cu, Se) in organic form	4	40%
Mycotoxin binders	7	70%
Vitamin D3 (high doses)	1	10%
Enzymes (phytase, xylanase)	4	40%
Probiotics / prebiotics	3	30%

Most farms used nipple drinkers, with water supplied by centralized systems or wells. Bacteriological testing of water was conducted on 70% of farms, while pH and hardness testing was performed on 60%.

Regular gait assessment of broilers was performed on 70% of farms, while 30% did not conduct such assessments. Visual inspection of birds was performed on all farms; however, standardized scales (e.g., the Bristol Gait Score) were used in only 37.5% of cases. The frequency of monitoring varied: weekly – 50%, before slaughter – 25%, twice per cycle – 25%.

The average percentage of birds with marked lameness (Score ≥ 3) was 4.7 ± 6.9%, whereas the subjective assessment of lameness levels at the time of slaughter ranged from 0 to over 10% (average 2.1 ± 3.2%). Lameness most commonly developed between 29 and 42 days of rearing. In 20% of farms, no cases of lameness were recorded. Such variability in indicators may reflect differences in housing conditions and diagnostic approaches.

The impact of lameness on production performancewas assessed on a 4-point scale. The most pronounced impact was observed on a decrease in carcass quality and live weight gain. Detailed indicators are presented in Table 3.

Table 3. Indicators associated with lameness (n = 10)

Parameter	M ± SD	Median	Range	n
% Of birds with Score ≥ 3 (Bristol)	4.7 ± 6.9	3,5%	0–20%	8
% Of lameness at slaughter (assessment)	2.1 ± 3.2	1,0%	0–>10%	9
Reduction in body weight gain (score)	2.4 ± 1,3	2,0	1–4	10
Increase in feed conversion ratio (score)	2.1 ± 1,1	2,0	1–3	9
Increase in culling (score)	1.8 ± 1,1	1,0	1–4	10
Increase in mortality (score)	1.6 ± 1.0	1,0	1–3	10
Reduction in carcass quality (score)	2.5 ± 1,2	2,0	1–4	10

Laboratory testing for lameness was conducted on 60% of farms. Staphylococcus spp. was the most commonly identified pathogen, followed by Escherichia coli and adenoviruses. Pathogen

Laboratory investigations oflameness was conducted on 60% of farms. Staphylococcus spp. was the most commonly identified pathogen, followed by Escherichia coli and adenoviruses. Pathogen monitoring was carried out in 80% of farms for the parent flock and in 40% of farms for broilers.

Chicks were vaccinated primarily at an early age (1–10 days), and the vaccination schedule was followed in 90% of farms. Vaccines against infectious bronchitis and infectious bursal disease were the most widely used.

Antibiotic prophylaxis was used on 80% of farms, with half of the operations using antibiotics specifically to control lameness. However, 70% of farms used alternative agents, including organic acids and probiotics.

Poultry welfare monitoring programs were in place at 80% of farms (formal – 40%, informal – 40%), while 20% lacked such programs.

The respondents' perceptions of the main causes of lameness and the perceived effectiveness of control measures are presentedin Table 4.

Table 4. Perceived causes of lameness and effectiveness of measures (n = 10)

Parameter	Category	n	%
Main causes of lameness (multiple responses)	Multifactorial	6	60%
	Feeding	5	50%
	Housing conditions	5	50%
	Infection	4	40%
	Genetics	3	30%
Effectiveness of control measures (5-point scale)	5 (very effective)	4	40%
	4	1	10%
	3	1	10%
	2	2	20%
	1 (ineffective)	1	10%
	Not assessed	1	10%
Economic losses due to lameness	Yes	6	60%
	No	3	30%
	Not sure	1	10%
Willingness to participate in future studies	Need more information	7	70%
	No	1	10%
	No response	2	20%

The analysis identified the most important factors asthe quality of feed ingredients, staff qualifications, climatic conditions, and stocking density. Economic losses due to lameness were reported in 60% of farms and included reduced live weight, increased culling, and higher mortality rates.

To better understand the factors associated with lameness, a Spearman correlation analysis was conducted (Table 5). A significant positive relationship was found between lameness at slaughter and reported feed quality problems ($r = 0.737$, $p = 0.015$), suggesting that farms experiencing issues with feed quality tend to report higher levels of lameness. In contrast, severe lameness (Score ≥ 3) was strongly negatively associated with the perceived effectiveness of preventive measures ($r = -0.877$, $p = 0.004$). This indicates that farms implementing more effective prevention strategies generally have substantially lower levels of severe lameness.

Diagnostic limitations also appeared to be important. A moderate positive association was observed between diagnostic difficulty and both overall lameness prevalence ($r = 0.701$, $p < 0.05$) and severe lameness ($r = 0.722$, $p < 0.05$), implying that farms facing greater challenges in diagnosis tend to report higher levels of lameness.

Conversely, the use of laboratory diagnostics was negatively associated with lameness (r = -0.641 to -0.662, $p < 0.05$), suggesting that farms with more developed diagnostic capacity may be better equipped to manage and control lameness.

Table 5. Spearman correlation between lameness indicators and selected factors

Variable	Lameness at slaughter (r)	Score ≥ 3 (r)	p-value	Interpretation
Feed quality problems	0.737	-	0.015	Significant positive
Prevention effectiveness	-	-0.877	0.004	Strong negative
Diagnostic difficulty	0.701	0.722	<0.05	Moderate positive
Laboratory diagnostics	-0.641	-0.662	<0.05	Moderate negative

"–" indicates that the correlation coefficient was not calculated for the respective variable

Among preventive measures, respondents most frequently cited improving housing conditions, optimizing feeding, and adhering to production protocols. Thus, priority is given to management and technological solutions aimed at reducing the cumulative impact of risk factors.

Discussion

The results of this study confirm the multifactorial nature of lameness in broilers and demonstrate that, in commercial poultry farming, this problem is primarily influenced by management, technological, and economic factors, rather than by infectious causes alone. Thus, lameness in broilers should be viewed as a comprehensive indicator of overall production system performance.

The findings indicate that housing conditions, primarily stocking density, microclimate, and litter quality, play a key role in the development of lameness. Despite the widespread use of closed poultry houses with controlled environmental parameters, significant variability was observedin the management of humidity and air quality, indicating a gap between the availability of technological solutions and their actual implementation. This gap can significantly reduce the effectivenessof even modern production systems. International studies also confirm a strong link between lameness and wet or poor litter, high growth rates, short dark periods, and environmental stress (related to temperature and stocking density). The higher the average gait score, the greater the culling of carcasses at slaughter and the poorer the overall herd welfare index [5, 6, 14].

Most farms operate under an intensive production regime (6–7 cycles per year), which may limit opportunities for thorough disinfection of facilities and stabilization of the microclimate. Under these conditions, the technological burdenon production systems increases, raising the likelihood of poultry welfare issues. In this context, lameness serves not only as a veterinary problem but also as an indicator of overloading of the production system. An additional risk factor is injury occurring during the transport and handling of poultry, the frequency of which depends on the condition of the broilers prior to loading (their health and physical condition), as well as on external conditions—temperature and humidity. Adverse transport conditions can cause hyperthermia or hypothermia, which increases the risk of injury and mortality. Consequently, ensuring proper transport conditions is a key element of prevention. Reducing these risks requires improving transport conditions (temperature and humidity control) and optimizing handling procedures [14, 15].

The importance of feeding-related factors (feed quality, use of additives) is consistent with the fact that mineral metabolism disorders and deficiencies in bioavailable trace elements directly affect bone formation and the stability of the musculoskeletal system. Although most farms conduct feed quality control, the composition of the additives used indicates a lack of uniformity in approaches. This suggests a lack of standardized feed management practices at the farm level. In particular, the relatively limited use of organic trace elements and probioticsmay indicate limited adoption of modern nutritional strategies. Deficiencies or excesses of vitamin D, calcium, phosphorus, and trace elements (Zn, Mn, Cu, etc.) exacerbate the development of rickets, bone deformities, and limb pathologies in broilers. Organic trace elements, mycotoxin control, moderate restriction of early growth, and the use of whole grains or combined diets can significantly improve the condition of the musculoskeletal system.

However, the isolated application of these measures is insufficient without a comprehensive approach. A sustained reduction in lameness rates requires a combination of balanced nutrition with optimal housing conditions and consideration of the birds' genetic characteristics [8 ,11, 12].

Lameness in broilers is widespread and significantly compromises bird welfare, but its assessment and monitoring remain methodologically challenging. Although visual assessment of lameness is conducted on all farms, the use of standardized scales remains limited. This limitsthe comparability of data across farms and hinders an objective assessment of trends. Additionally, laboratory diagnostics are performed in only 60% of farms, and pathogen monitoring in broilers in 40%. This indicates insufficient integration of epizootiological surveillanceinto the flock health management system. Current diagnostic reviews recommend combining laboratory methods, visual examinations, radiography, thermography, and new automated tools to improve the accuracy and early detection of lameness [16].

The multifactorial nature of lameness observed in this study is summarized in Figure 1, which illustrates the interaction between nutritional, environmental, infectious, and management-related factors contributing to the development of musculoskeletal disorders in broiler chickens.

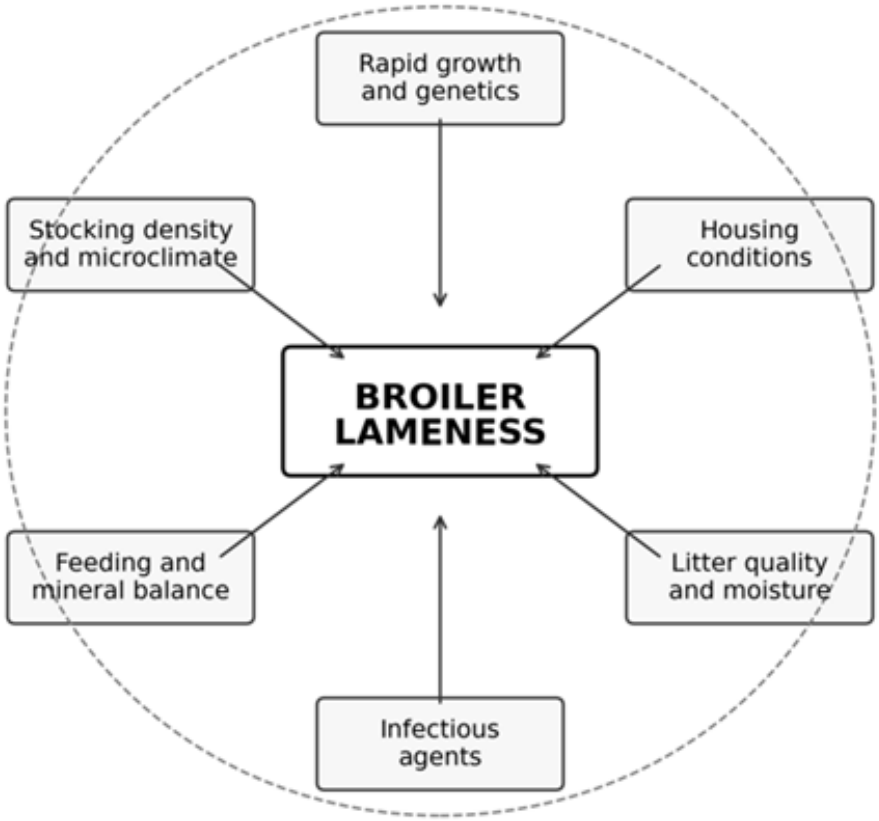

Figure 1. Conceptual model illustrates the multifactorial nature of lameness in broiler chickens

Lameness in broilers is a complex systemic problem resulting from the interaction of genetic factors, growth rate, infections, mycotoxins, feeding, housing conditions, litter quality, and management decisions. In other words, it is the result of the combined effects of many interrelated factors. Analysis of respondents' answers shows that in most cases, lameness is viewed as the result of a combination of factors (60%) rather than the consequence of a single cause. This aligns with the current understanding of the complex nature of this pathology. Furthermore, the proposed preventive measures (improving housing conditions, optimizing feeding, adhering to production protocols) indicate that industry participants themselves associate solving the problem primarily with the management of production processes. Consequently, effective prevention of lameness requires a systematic approach that includes optimizing breeding programs, rational feeding, microclimate control, and improving broiler production technologies.

Conclusions

This study demonstrated that lameness is a widespread and multifactorial problem in the commercial broiler industryin Kazakhstan. The results indicate that the development of lameness is associated not only with infectious agents but also with a combination of management, technological, dietary, and environmental factors. The main causes contributing to musculoskeletal disorders in broilers were identified as poor-quality litter, high stocking density, inadequate microclimate control, and differences in feeding practices.

The results also showed that preventive and diagnostic measures on poultry farms are not always implementedconsistently and systematically. Limited use of standardized lameness assessment scales and insufficient use of laboratory diagnostics can reduce the effectiveness of monitoring and early detection of the problem. This underscores the need to implement more standardized approaches to management and to improve veterinary control systems in the poultry industry.

Overall, lameness should be considered an important indicator of poultry welfare and the efficiency of the production system. Effective prevention requires a comprehensive approach, including optimization of housing conditions, balanced feeding, control of litter quality and microclimate, enhanced biosecurity measures, and continuous monitoring of the birds' condition. The present study is one of the first comprehensive assessments.

Authors 'Contributions

GA: conducted a comprehensive literature search, analyzed the gathered data, and drafted the manuscript. AZh, AA, DS: contributed to data interpretation, manuscript editing, and methodological support. ST, YB, AT, AK: assisted in data collection and preliminary analysis. BB: Conducted the final revision and proofreading of the manuscript. All authors have read, reviewed, and approved the final manuscript.

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Statement on Competing Interests

The authors declare that they have no competing interests.

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